

LONG-RANGE PROJECTIONS OF THE WORLD POPULATION BY REGIONS, 1975-2150

Alice Hecht
Population Division
United Nations

*The views and opinions expressed in this paper are those of the authors and do not necessarily reflect those of the United Nations.

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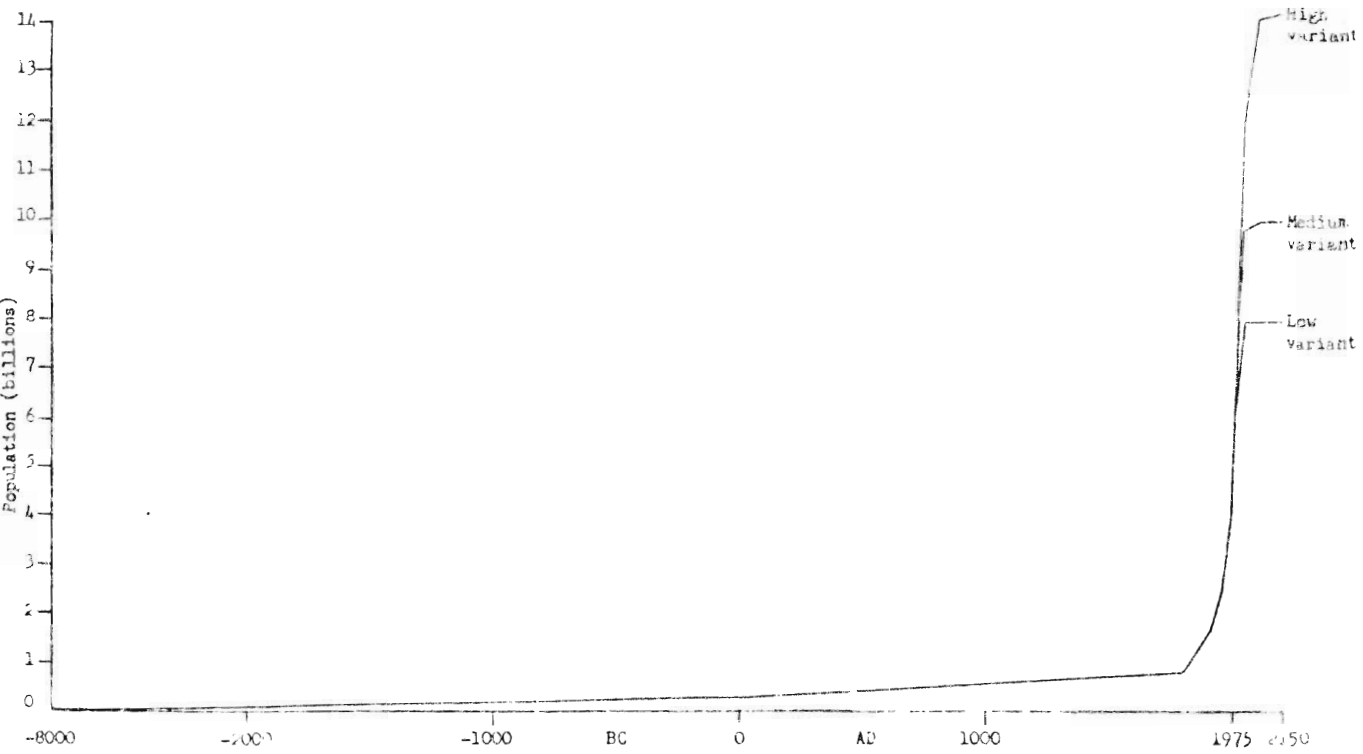
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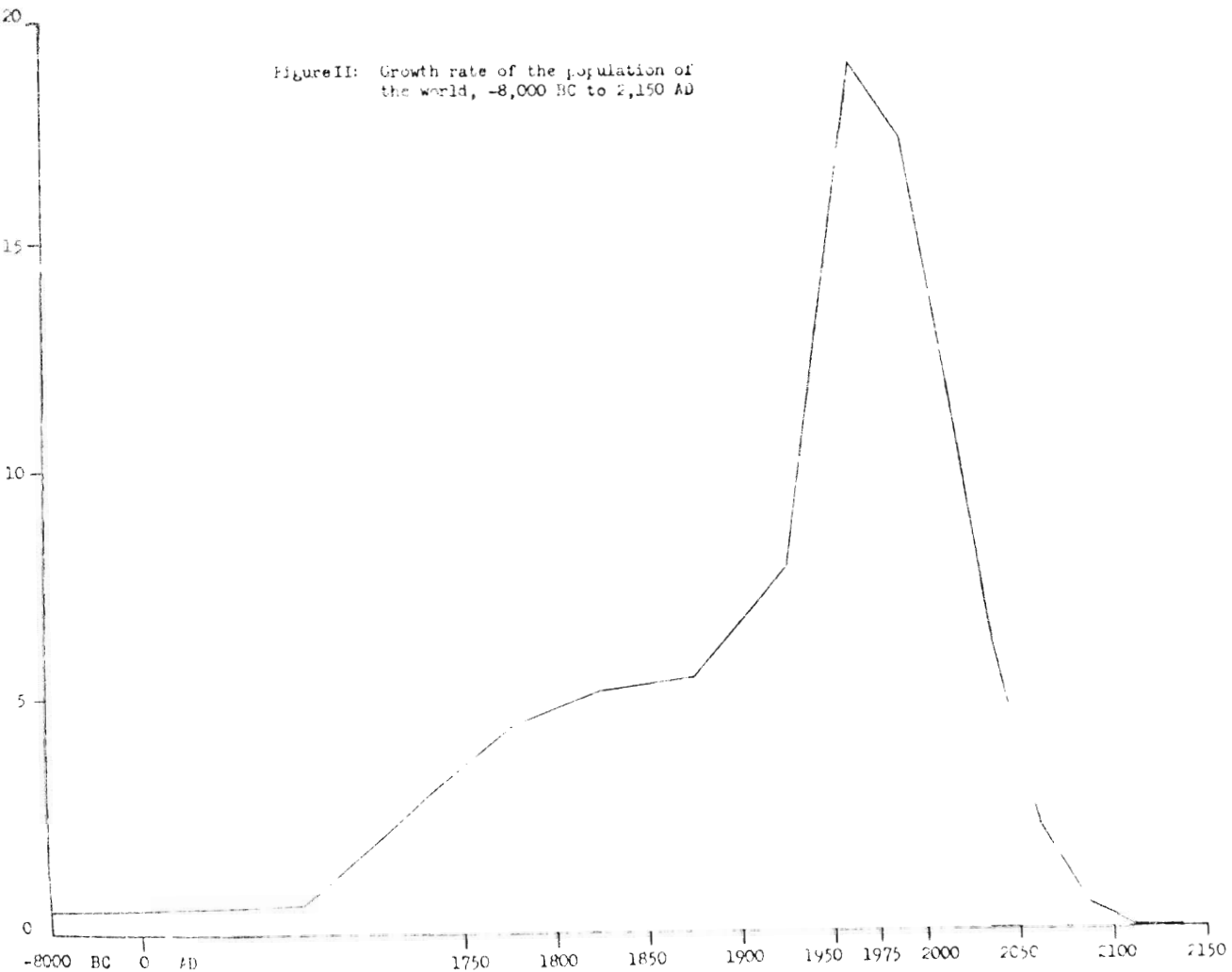
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Figure 1: Population of the world, -8,000 BC to 2,150 AD



Sources: Durand, John D., "Historical estimates of world population: An evaluation", *Population and Development Review*, 3(3), September 1977, pp.253-296; Coale, Ansley, "The history of the human population", *Scientific American*, 231(3), September 1974, pp.41-51; Long-Range Projections of World Population by regions, 1950-2150, table 1A.

Figure II: Growth rate of the population of the world, -8,000 BC to 2,150 AD



INTRODUCTION

The Rationale for Long-Term Projections

The long term projections presented in this report are the attempt by the United Nations Secretariat to prepare population projections for the next one hundred and fifty years for 24 regions^{1/} as well as aggregations into eight major areas, the less developed and more developed regions and the world.^{2/}

The purpose of such an exercise is often debated. Opponents will rightly argue that even short term projections limited to a five year period often fail to meet reality because of inaccurate estimates of benchmark population, data and our poor knowledge of the dynamics underlying fertility and mortality behaviour. In this context, long term projections carried out over fifty, one hundred, or more years belong to the realm of science fiction as they illustrate the long term effects of relationships seemingly valid in the present population but which might not be tenable in the distant future.

^{1/} For convenience in presenting global demographic trends, the Population Division of the Department of International Economic and Social Affairs of the United Nations Secretariat has been using the three levels of country classification mentioned in the text, of which the last two are essentially geographical groupings. The bisection of the 24 regions into the "less developed" and the "more developed" regions has also been made on the basis of demographic and other social and economic indicators. The less developed regions include all regions of Africa, Asia (excluding "Japan"), Latin America and Oceania (excluding "Australia and New Zealand"). The more developed regions include all regions of Europe, the Union of Soviet Socialist Republics, Northern America and the regions just cited as being outside the less developed category. In Latin America, "Temperate South America", which was formerly included among the more developed regions, is currently included among the less developed regions.

^{2/} In 1974, the United Nations prepared long term projections until 2075; see Concise Report of the World Population Situation in 1970-1975 and its Long-range Implications (United Nations publication, Sales No. E.74.XIII.4), pp. 37-70. In 1979, a new series of speculative world population projections were presented until 2125 in "Development of the Methodology used in the United Nations Global Projections" in Prospects of Population: Methodology and Assumptions (ST/ESA/SER.A/67), pp. 35-41.

However, one has to consider that the demographic profile of the world in the next century is being outlined in our present as most of the children born in the last decade are expected to live far beyond the year 2000. Already apparent fertility trends will determine much of the upper section of the age distribution of the world population in the beginning of the next century. Long term projections are needed because changes in a demographic variable will often bear effects on a population with a very long time lag.

But undoubtedly, behind the demand for long term projections lies the need to give a tentative answer to a long sought-question brought about by the acceleration of population growth since the Second World War. When will the population of the world stabilize and what will be its level at that time? Seen in a long term perspective, the actual growth of the human population represents a transitional stage in human history and is the culmination of a process which began a million years ago when the human species emerged on the face of the earth. Historical demographers estimate that at the dawn of the Agriculture Age, some 12,000-10,000 years ago, the population of the world was about 8 million which became about 300 million by A.D.1, growing by 0.05 per cent per year. In the next 1750 years growth was about 0.06 per cent per year and the population increased to about 800 million.^{3'}

^{3'} Durand, John D., "Historical Estimates of World Population: An Evaluation", Population and Development Review, 3(3):253-296, September 1977.

Coale, Ansley, "The History of Human Population", Scientific American, 231(3):41-51, September 1974.

Since the Industrial Revolution, the rate of population growth began to accelerate more rapidly. With the exception of a few setbacks such as widespread epidemic and two world wars, the growth rate steadily increased from 0.5 per cent in 1750 to around 2 per cent in 1975 which accounts for the extraordinary worldwide expansion from 800 to 4,000 million population (see figures 1 and 2).

In the long run, there is no doubt that the very low growth rate which has characterized humanity for 99 per cent of its history will have to be restored. Governments throughout the world have made a cause of containing population growth and bringing it in equilibrium with the country's technical achievements and the available natural resources. A fall in fertility large enough to offset a decline in mortality is expected to set this process in motion.

The short term projections of the United Nations Secretariat illustrate the theory of limited population growth by providing different scenarios of fertility decline large enough to offset expected mortality fall.^{4/} But the time limit set for these projections, the year 2000, does not permit these assumptions to be carried to their terminal point in the areas where high fertility and mortality levels presently prevail. Long term projections have been carried out until hypothetical minima gross reproduction

^{4/} Inoue, Shunichi and Yu, Y.C., "United Nations New Population Projections and Analysis of ex post facto Errors", paper presented at the 1979 Annual Meeting of the Population Association of America, April 1979, Philadelphia.

rates and maxima life expectancies at birth . spread throughout the world and the effect of population structure on its growth is nil.

The benchmark data of the long term projections are the total population by sex and age in the year 2000, the gross reproduction rate and the life expectancy at birth by sex in 1995-2000 for each of the 24 regions as presented in the short-term projections for the medium, high and low variants.^{5/} A valid basis for long term assumptions on the size of international migrations is lacking. Therefore, they have been omitted from the long-term projections. The method of projection used here is the cohort component method.^{6/} The Population Division of the United Nations Secretariat developed generalized models of fertility and mortality for the purpose of these long-term projections. The reader will find that sometimes the assumptions underlying these models conflict with the assumptions used in the "short-term" projections. This is because the line of thinking and the analysis which prevails at a country level may shift to different ideas once a whole region, which encompasses countries with different levels of development, is taken as a unit of projection.

^{5/} The reader will find the benchmark data used for these projections in Selected World Demographic Indicators by Countries, 1950-2000 (forthcoming); World Population and its Age-Sex Composition by Country, 1950-2000 (ESA/P/WP.65), January 1980.

^{6/} Manual III: Methods for Population Projections by Sex and Age (United Nations Publication, Sales No. 56.XIII.3).

PART ONE. ASSUMPTIONS

I. Fertility assumptions (figure III)

The short-term projections suppose that by 1985, fertility will have started an irreversible downward trend in all presently classified high fertility populations but that by the year 2000 the gross reproduction rate will remain in most of these regions well above replacement levels with the highest level projected in Western Africa, 2.85. The Gross Reproduction Rate in the year 2000 in all low fertility regions, as well as China and Temperate South America, is expected to oscillate around replacement level. This is a result of the assumed gradual return to replacement levels in the countries of Northern America, Japan, Northern and Western Europe where gross reproduction rate between 0.7 and 0.9 have been recorded in 1975-1980. The long-term projections expand these trends and postulate that fertility rates will converge at net replacement levels in all world populations in the next century. This idealized scheme of the demographic future of the world is most reasonable within the limits of our knowledge of fertility behaviour. Using it as a conceptual framework, one has to resolve the difficult problem of deciding for the high fertility regions, when will replacement levels be reached and what is the most appropriate pattern of decline. Models were formulated bearing the following considerations:

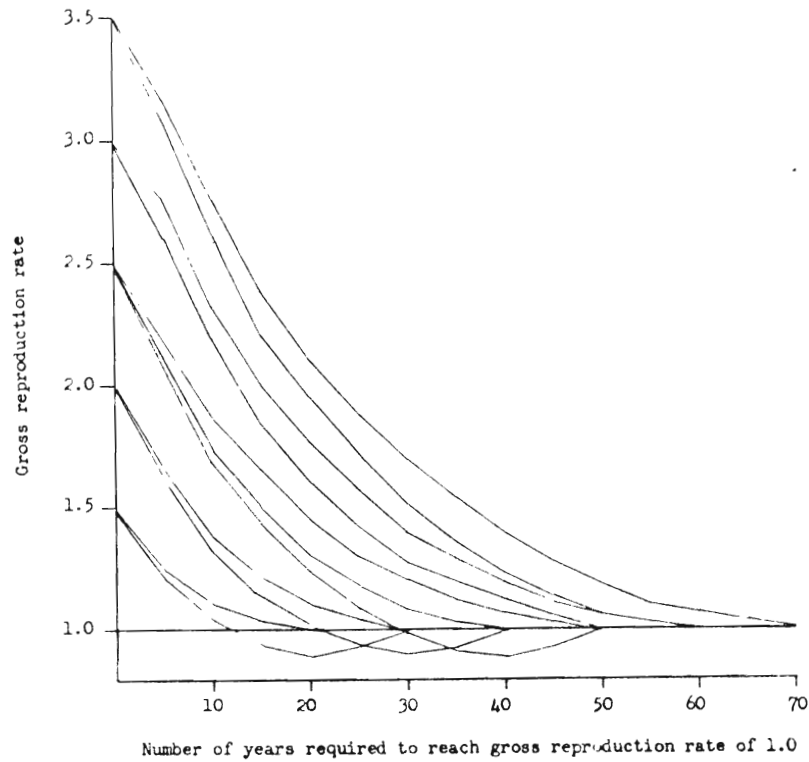
- By the year 2000, the momentum of fertility decline will be strong.

It will slow down as gross reproduction rate reaches replacement level.

- The number of years expected for a region to reach replacement level would depend on its actual level of economic development on the existing or anticipated family planning policy of the Government, and the cultural and social values inherent to the society. Consequently, regions with very

Figure III :

Working model of fertility decline 2000-2070:
Initial gross reproduction rate of 3.5, 3.0, 2.5,
2.0 and 1.5



different values of gross reproduction rate in the year 2000 can reach replacement levels in the same time span while regions with the same initial fertility level can take different lengths of time to attain replacement levels.

To illustrate different but plausible consequences of various population growth that would all ultimately lead to non-growing populations, three variants of fertility, namely medium, high, and low were prepared. (figure 3)

Medium variant:

The number of years necessary to reach replacement level for each region varies between 20, 30, 40, 50 years after the year 2000.

High variant:

It will take 20 years more under the high variant for each region to reach replacement level than under the medium variant.

Low variant:

The low variant takes into consideration the possibility for a population to cross the border of replacement level and encounter for a limited time period gross reproduction rates smaller than 1, the lowest level being 0.9 which should be reached in the period when fertility stabilizes at replacement level in the medium variant. A rise of fertility would then occur and bring fertility back to 2 children per woman in a ten-year period. The difference between the medium and high variant is solely in the time span assumed in each region to attain replacement level while the medium and low variants differ in the minimum fertility chosen. The latter takes into account historical experience of today's low fertility countries. It assumes that the forces which brought fertility to below replacement either the expansion of contraception techniques, availability of legal abortions, or changes in the status of women can be correlated to socio-economic development will eventually spread to all geographic regions and that for a limited period of time fertility will remain under replacement level. The high and medium variants envisage a decline in fertility to a level where the replacement of generations will continuously be assured.

Assumptions for the more developed regions and China follow a small range of possible trends. The medium variant of the short term projection set fertility at replacement level in most of these regions in the year 2000 so that the medium variant of the long term projections can merely expect the number of children born per woman to fluctuate around 2. The gross reproduction rate in the USSR, equal to 1.1 in 1995-2000 in the short term projection will be equal to 1 in 2010-2015. The high variant assumes for the more developed regions and China a gradual decline to replacement level by 2020-2025 while the low variant expects the gross reproduction rate to remain smaller than 1 between 1975 and 2015.

The percentage distribution of age specific fertility rates used in each region is derived from standard regional models^{8/} or from the unweighted average rates of the countries in the region in the year 2000. The patterns have been kept constant throughout the projection. This might be seen as a shortcoming of the results as fertility patterns are bound to change in the future and the effects on the population growth can be significant. Keeping the overall decline in fertility constant, a shift in the mean age of child-bearing can accelerate or decelerate the population growth.^{2/} However, 24 units of projection are being considered here, and for practical purpose, the assumption of linear decline in the age specific fertility rates was believed to be most reasonable.

^{8/} World Population Prospects as Assessed in 1974, pp. 7-10 (United Nations Publication, Sales No. E.76. XIII.4)

^{2/} Frejka, Tomas, The Future of Population Growth, Alternative Paths to Equilibrium, a Population Council Book, New York, John Wiley and Sons, 1973, pp.148-154

II. Mortality assumptions

By the year 2000, the life expectancy at birth is expected to be above 60 years in all regions of the world except in Eastern, Middle and Western Africa where it is assumed to be around 55 years for both sexes. The model of mortality decline of the short-term projections has been used for the purpose of the long-term projections. The United Nations working model for mortality improvements presents annual gains in mortality with a maximum of e_0 equal to 73.5 years for the males and 80 years for the females.^{10/}

Several considerations led to keep these limits in the long term projections. The small increments in life expectancy at birth assumed in the model are such that maxima would be reached in all population only in 2110. Further increases in duration of life expectancy at birth would affect little the stable population growth.^{11/} The age specific survival ratios needed for the projections are derived from the model life tables. The model life table used in the short-term projection for a region was used in the long term projection.

The assumptions on life expectancy at birth are summarized per decade in table 6A.

^{10/} Inoue, Shunichi and Yu, Y.C., op. cit., p. 29.

^{11/} Coale, Ansley, "Increases in Expectation of Life and Population Growth" International Population Conference, Vienna 1959 (Vienna, I.U.S.S.P. 1959), pp. 36-41.

Keyfitz, Nathan, "Changes of Birth and Death Rates and their Demographic Effects", Rapid Population Growth, Consequences and Policy Implications, Vol. II, The John Hopkins Press, Baltimore, 1971. pp. 639-680.

PART II. RESULTS

I. Overview of the future of the world population (tables 1, 1A, 2A, 3A and figure IV)

The world population estimated to be in the vicinity of 8 million in 8000 B.C. and which grew to 4 billion in 1975 is projected to increase by another 6 billion and exceed 10 billion before it reaches a new stationary size at the end of the 21st century (medium variant). The range of the companion variants calculated under the low and high variants is 8 and 14 billion. Between now and the time humanity halts its growth, the population of the world will thus at least double and at the most quadruple, if the future trends fall somewhere between the conditions set by the high and low variants (table 1).

The assessment implies that the world population will soar during the next two centuries even though the pace of the increase will rapidly fall. The rate of population growth reached its peak in 1960-1965 at 2 per cent per annum^{12/}. The medium variant assumes that it will decline to 1.4 per cent in the first decade of the next century, fall under 1 per cent by 2030 and flatten down at 0.5 per cent by 2050. These rates imply a decline in the annual average increments of population in absolute numbers from about 90 million between 1975 and 2000 to 70 million in the following 50 years. After 2050, the world population would increase by a mere 15 million annually until 2100 when the gains would be minimal.

The high limit projection depicted by the high variant suggests that the growth rate which peaked in 1960-1965 and declined slightly in 1970-1975, from 1.95 per cent to 1.85 per cent per annum, will reach a second peak in 1980-1990

^{12/} World Population Trends and Prospects by Country, 1950-2000: Summary Report of the 1978 Assessment, table 1B, (United Nations Publication, ST/ESA/SER/R/33).

Table 1. Total Population of the world and its regions, 1975 and 2140, percentage increase from 1975 to 2140 according to low, medium and high variants, and percentage difference in total population in 2140 between low and high variants.

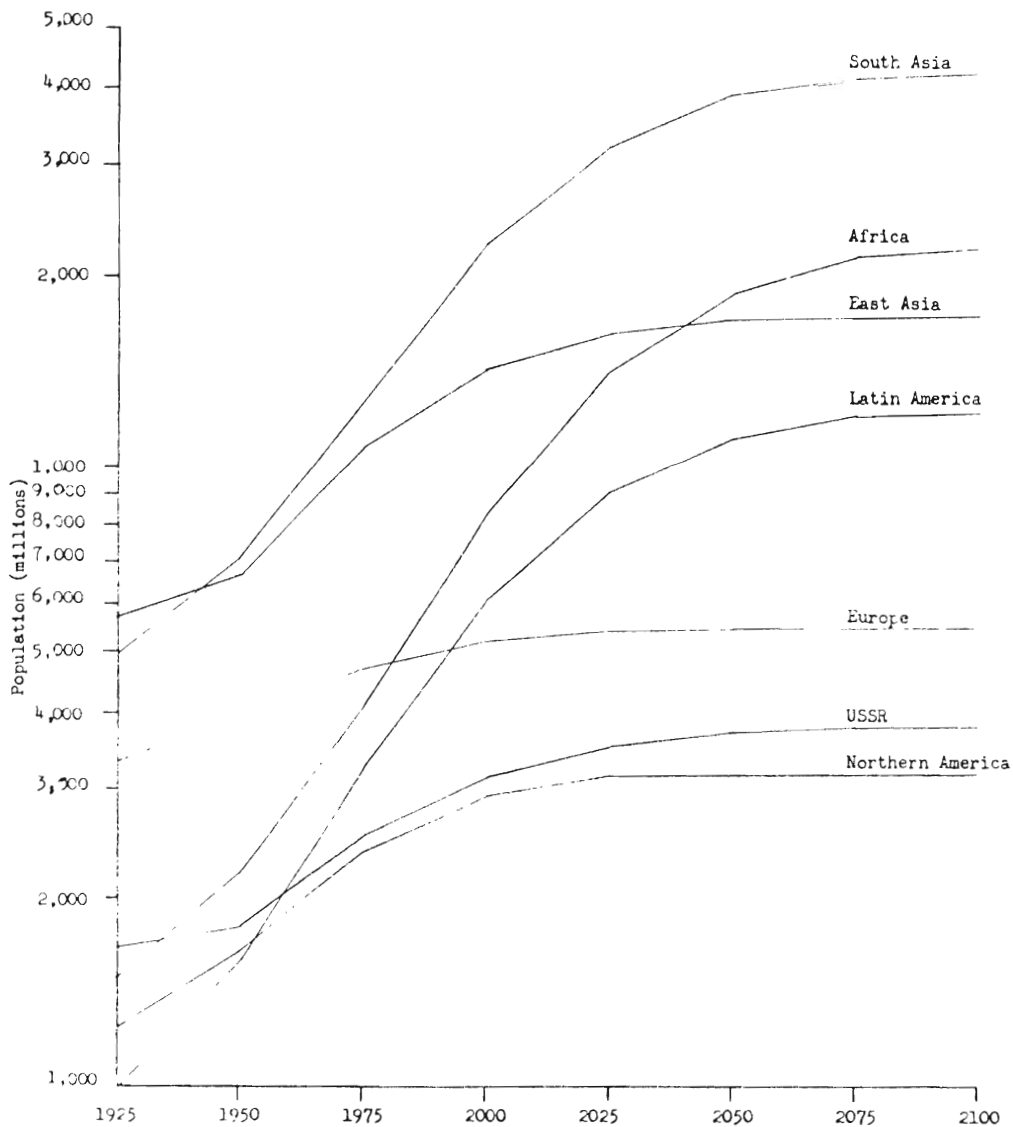
Regions	Population 1975			Population 2140			Percentage Increase 1975-2140			Percentage difference in 2140 between high and low variants
	Low	Medium	High	Low	Medium	High	Low	Medium	High	
World	4,033	8,023	14,200	99	161	252	77			
More developed regions	1,093	1,218	1,601	11	27	46	31			
Less developed regions	2,940	6,805	12,599	131	211	328	85			
Africa	406	1,399	3,359	244	440	727	140			
Eastern Africa	115	421	1,092	266	510	850	159			
Middle Africa	47	123	316	161	325	572	157			
Northern Africa	94	300	568	219	321	504	89			
Southern Africa	29	85	172	193	317	493	102			
Western Africa	121	470	1,211	288	540	900	158			
Latin America	323	888	1,684	175	267	421	90			
Caribbean	28	54	86	93	143	207	59			
Middle America	79	295	544	273	386	589	84			
Temperate South America	38	56	76	47	76	100	36			
Tropical South America	177	483	978	173	277	452	102			
Northern America	236	263	418	11	35	77	59			
East Asia	1,063	1,493	1,877	40	62	76	26			
China	895	1,275	1,586	42	64	77	24			
Japan	112	115	140	3	14	25	22			
Other East Asia	57	103	151	81	121	165	47			
South Asia	1,255	3,128	5,794	149	230	362	85			
Eastern South Asia	325	760	1,307	133	202	302	72			
Middle South Asia	845	2,106	4,005	149	234	374	90			
Western South Asia	85	262	482	208	307	467	84			
Europe	474	482	597	2	14	26	24			
Eastern Europe	106	123	149	16	26	41	21			
Northern Europe	82	72	95	-12	5	16	32			
Southern Europe	134	154	185	15	25	38	20			
Western Europe	152	134	169	-12	1	11	26			
Oceania	21	33	53	57	95	152	61			
Australia-New Zealand	17	21	28	24	47	65	33			
Melanesia	3	9	19	200	333	533	111			
Micronesia-Polynesia	1	3	5	200	300	400	67			
USSR	254	337	418	33	49	65	24			

and increase to the value of 1.97 per cent. A gradual decline in the growth rate could then be expected but it would remain well above 1 per cent a year until 2030-2040 and fall below 0.5 per cent as late as 2070. Under these conditions, the average annual increments in the world population would rise from 100 million in 1975-2000 to 110 million in the following 50 years. A sharp dip in the annual increase of population would then occur and the world population would augment by 40 million a year between 2050 and 2100 when the world population would stabilize around 14 billion.

Provided that the assumptions outlined by the low variant should materialize, the annual growth of the world would fall to 1 per cent by 2010 and under 0.5 per cent by 2030. The average annual increments of population would exceed 70 million until the turn of the century. It would decline to an average of 40 million per year between 2000 and 2050. The projection implies that the population would reach its maximum in 2070 at 8 billion and would start a slow and gradual declining trend. The world population would have a net loss of about 90 million persons in the next 70 years.

A decline of the world crude birth rate from its present level of 30 thousand below the level of 20 is unlikely in this century. The low variant which illustrates the sharpest fertility decline of all three projections, indicates a fall below 20 per thousand in the first decade of the 21st century. The minimum crude birth rate set by the hypotheses underlying the different projections is about 13 per thousand which would be reached sometimes in the latter part of the next century. Following the assumed improvements in life expectancy at birth and the impact of the presently young age structure of the world, the crude death rate of the world population is expected to decline from its present value of 12 per thousand to about 8 per thousand in

Figure IV: Population in major world areas, 1925-2100, according to "medium" variant of long-term projections (charted on a logarithmic scale)



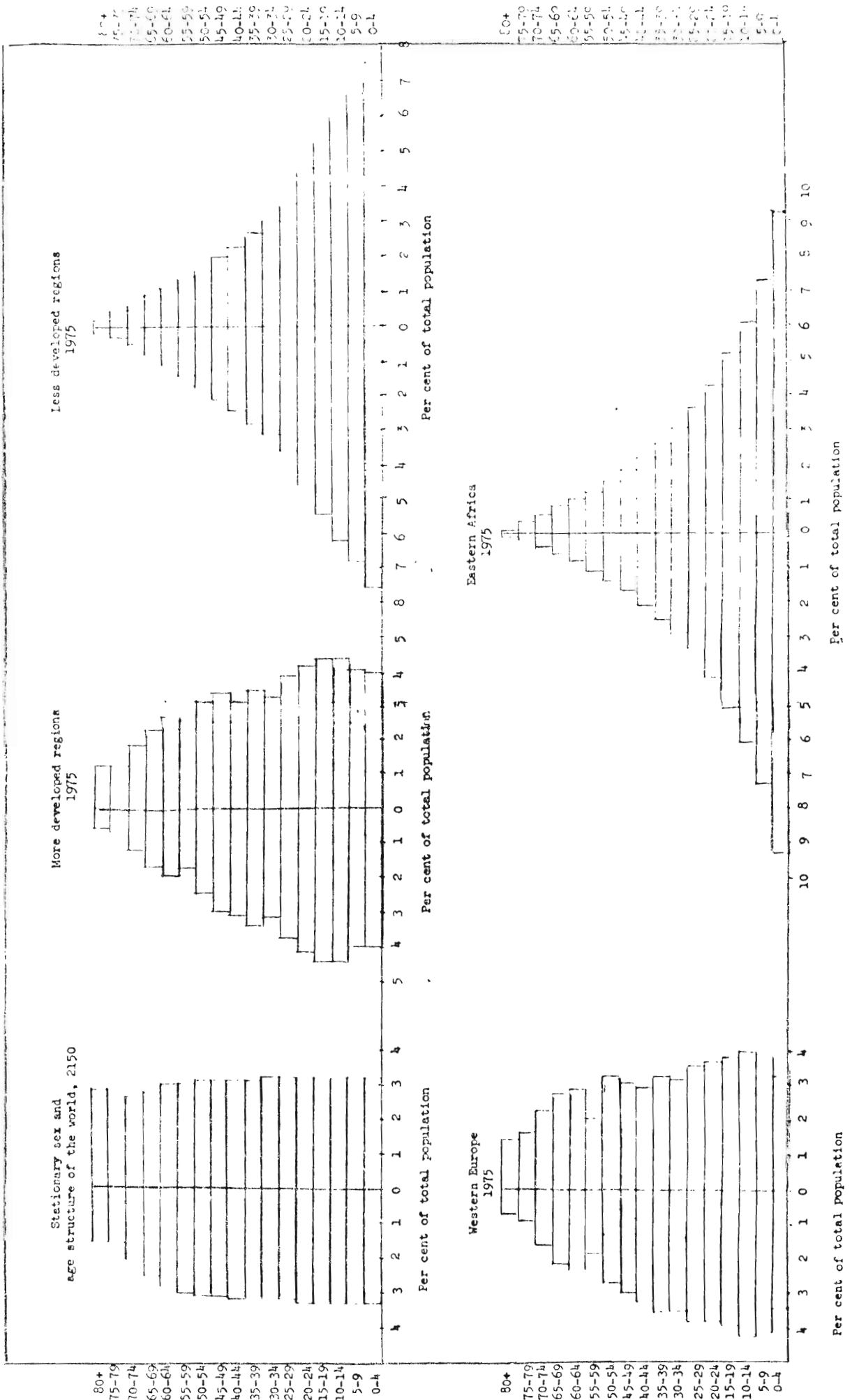
in the next 20-30 years. In the long run, as of 2020, the crude death rate will rise in spite of further increments expected in life expectancy at birth as the gradual aging of the population will foster increase in crude death rate. The maximum value, 13 per thousand would be reached around 2100.

II. Age composition (figure V)

The 1975 world population portrays a young age structure; 45 per cent is estimated to be less than 20 years and 9 per cent over 60 years. However, marked differences may be noted between the profile of the more and less developed regions. In 1975, the population aged under 20 years of age was estimated to be 34 per cent in the more developed regions and 51 per cent in the less developed regions while the population over 60 years of age was respectively 15 and 6 per cent. The proportion in the middle age group, 20-60 years, was estimated to be 51 per cent in the former and 43 per cent in the latter. The contrast in the age profile is well illustrated by a comparison of the age structure of Eastern Africa, a typical "young" population and Western Europe, the epitomy of an "old" population (figure V).

By the time the population of the world becomes stationary, dramatic changes will have occurred. The age profile of the population of each region will move towards roughly equal numbers in every age cohort up to age 60 and the striking contrast found in the age structure of the more and less developed regions will gradually disappear and eventually blend into a common rectangular shape already foreshadowed in many countries of Northern and Western Europe. The two extreme age groups, less than 20 years of age and over 60 years of age, will include 26 and 24 per cent respectively of the world population. The middle age group, 20 to 60 years, would remain fairly stable; 45 per cent in 1975 and 50 per cent in 2000. This is a salient feature of these projections; they show that, in spite of shifts in the age distribution between the present and the time the world population approaches a stationary level, the proportion of the population expected to be most economically productive will remain fairly stable.

Figure V : Sex and age structure of the stationary population of the world, 2150; the more and less developed regions, Western Europe and Eastern Africa, 1975



III. Growth by geographical areas (figure IV)

The distribution of the population of the world by region and area will present a dramatically different picture than the present one. Our actual bisection of the world into more and less developed regions will certainly have a different meaning by the time zero population growth is achieved. But taking this classification as a standard for comparison purposes, it appears that the principal impetus to future population growth will come from the less developed regions whose populations will triple while the population of the more developed regions would augment by one third.^{13/} The percentage of the world population living in the less developed regions so defined in 1978, would see their share increase from 73 per cent to about 85-90 per cent while the population of today's more developed regions would decline from 27 per cent to about 11-15 per cent (table 1). Supposing an upward trend in fertility in the more developed regions which would restore replacement levels of gross reproduction rate by the year 2000, the population of these areas would stabilize about 60 years later after adding another 110 million to their population. Fertility is projected to reach replacement level in all less developed regions around 2050. Population would become stationary around 2100 and augment in that time span by 750 millions.

^{13/} Space considerations make it necessary to limit the discussion to the results of the medium variant unless specified otherwise. However, the arbitrary nature of the assumptions makes it necessary for the reader to consider all three variants as plausible course of events.

Table 2. Percentage distribution of the population of the world by regions and areas, 1975 and 2140, medium, high and low variants.

Regions	1975	2140		
		Medium Variant	High variant	Low variant
World	100.0	100.0	100.0	100.0
More developed regions	27.1	13.2	11.3	15.2
Less developed regions	72.9	86.8	88.7	84.8
Africa	10.0	20.8	23.6	17.4
Eastern Africa	2.8	6.7	7.7	5.2
Middle Africa	1.2	1.9	2.2	1.5
Northern Africa	2.3	3.8	4.0	3.7
Southern Africa	0.7	1.1	1.2	1.0
Western Africa	3.0	7.4	8.5	5.8
Latin America	8.0	11.3	11.9	11.1
Caribbean	0.7	0.6	0.6	0.7
Middle America	2.0	3.6	3.8	3.7
Temperate South America	0.9	0.6	0.5	0.6
Tropical South America	4.4	6.3	6.9	6.0
Northern America	5.8	3.0	2.9	3.3
East Asia	26.4	16.4	13.2	18.6
China	22.2	14.0	11.2	15.9
Japan	2.8	1.2	1.0	1.4
Other East Asia	1.4	1.2	1.1	1.3
South Asia	31.1	39.4	40.8	39.0
Eastern South Asia	8.6	9.3	9.2	9.5
Middle South Asia	21.0	26.8	28.2	26.2
Western South Asia	2.1	3.3	3.4	3.3
Europe	11.8	5.1	4.2	6.0
Eastern Europe	2.6	1.3	1.0	1.5
Northern Europe	2.0	0.8	0.7	0.9
Southern Europe	3.3	1.6	1.3	1.9
Western Europe	3.8	1.5	1.2	1.7
Oceania	0.5	0.4	0.4	0.4
Australia-New Zealand	0.4	0.2	0.2	0.3
Melanesia	0.1	0.1	0.1	0.1
Micronesia-Polynesia	0.1	0.1	0.1	0.1
USSR	6.3	3.1	2.9	4.2

Table 3. Period when population growth is projected to oscillate around 0.005 per cent per annum, medium, high and low variants.

Regions	Medium variant	High variant	Low variant
Africa			
Eastern Africa	2120-2125	2135-2140	2120-2125
Middle Africa	2115-2120	2130-2135	2120-2125
Northern Africa	2090-2095	2110-2145	2135-2140
Southern Africa	2105-2110	2125-2130	2120-2125
Western Africa	2110-2115	2130-2135	2120-2125
Latin America			
Caribbean	2095-2100	2105-2110	2095-2100
Middle America	2105-2110	2105-2110	2095-2100
Temperate South America	2095-2100	2100-2105	2100-2105
Tropical South America	2105-2110	2105-2110	2100-2115
Northern America	2035-2040	2085-2090	2110-2115
East Asia			
China	2075-2080	2090-2095	2115-2120
Japan	2060-2065	2070-2075	2085-2090
Other East Asia	2085-2090	2090-2095	2090-2095
Western Asia			
Eastern South Asia	2110-2115	2110-2115	2095-2100
Middle South Asia	2100-2105	2115-2120	2110-2115
Western South Asia	2095-2100	2110-2115	2115-2120
Europe			
Eastern Europe	2060-2065	2080-2085	2070-2075
Northern Europe	2055-2060	2070-2075	2085-2090
Southern Europe	2040-2045	2080-2085	2080-2085
Western Europe	2055-2060	2080-2085	2080-2085
Oceania			
Australia-New Zealand	2055-2060	2080-2085	2075-2080
Melanesia	2100-2105	2120-2125	2110-2115
Micronesia-Polynesia	2095-2100	2115-2120	2110-2115
USSR	2100-2105	2110-2115	2090-2095

Source: Computer printouts of the Long Range Projections of the World Population by Regions, 1975-2150.

IV. Less developed regions

The divergence in the recent growth rates of population among the less developed regions will continue over the next century so that wide difference in the population increases are expected. On the high side, there are the five regions of Africa, Western South Asia and Melanesia with average annual rates above 2.0 per cent in 2000-2010; on the low side, there is China and Temperate South America where growth falls short of 1 per cent. Over the next two centuries these discrepancies in the population growth will lead to major changes in the population distribution among these regions.

Spectacular population increases are expected in Africa. From its actual estimated size of 406 million, the population of Africa will grow to 2,193 million or by 440 per cent (medium variant). Under the low and high variants, the population would increase to 1,399 million and 3,359 million respectively or by 244 and 727 per cent. The percentage of the world population living in this area would double, from 10 per cent in 1975 to around 20 per cent in 2140. It is also in Africa that the difference in total population in 2140 represented by the low and high variants are the most impressive, 110 per cent (table 1). Growth in Middle, Northern and Southern Africa will most likely be quite substantive. Confining our attention to the medium variant, it may be said that the population of each region will augment by about 320 per cent but it is in Eastern and Western Africa that considerable gains in population are expected. Under the high variant, the percentage of increase in Western Africa could be as high as 900 per cent. These soaring growth in population are the result

of the combined effect of slow fertility and sustained mortality decline. The long term projections suppose that fertility in these two regions and in Middle Africa will be last to drop down to net replacement level which would be reached under the medium variant around 2050.

Eastern, Middle and Western Africa stand out among the 16 less developed regions because of the marked gap in the total stationary population ultimately reached in 2140 under the high and low variants. In all three regions it is equal to 158-159 per cent (table 1). For example, in Eastern Africa, we note that the difference in total population between high and low variants in 2140 is 671 million (1,092 million minus 421 million) or 159 per cent. The high variant implies that the 1975 population estimated at 115 million would grow less than tenfold while under the low variant, growth would be less than four fold. This discrepancy is the result of the combined effect of different fertility trends and initial mortality levels. Distinct paces of fertility decline were assumed in the medium, high and low variants like in all other regions but given the inadequate statistical data on mortality, it was decided that these three regions required different estimates of life expectancy at birth in the initial period of the short term projections, 1975-1980. The gap in the year 2000 is equal to 3.5 years. The long term projections suppose that the difference diminishes regularly and disappears around 2050. The scope of uncertainty attached to the long term projections is well illustrated here as it shows how different but quite plausible momentum of fertility decline combined with a variety of realistic initial levels of mortality result in a wide scope of possible population trends.

In 1975, the population of Latin America was estimated at 323 million, about 8 per cent of the world population. It is projected to quadruple by 2100 with 1,187 million of the world population living on that continent. The boundaries set by high and low variant give possible stationary levels of 1684 and 888 million, a difference of about 100 per cent (table 2.).

The four different regions of Latin America are anticipated to follow very different paths on their way to stabilization. In the Caribbean and Temperate South America future population trends will rapidly approach **those** observed now in the more developed regions. Annual growth rates which have already fallen well below 2 per cent are expected to drop under 1 per cent by the turn of the century in Temperate South America and by 2020 in the Caribbean. Stationary population levels would be reached by 2095-2100 (table 3). The population in both regions would be equal to 67-78 million. The Caribbean would thus see its population double in the period while in Temperate South America, the increase would be around 75 per cent.

The speed of growth in Middle and Tropical South America will exceed 2 per cent per annum until about 2000 and will remain above 1 per cent until 2040 in the former and 2030 in the latter. Fertility will reach net replacement level in 2030. By then, the crude birth rate will equal 16-17 per thousand and the crude death rate 5-6 per thousand because of

the predominant young age structure. The population is projected to grow until 2105-2110 in Middle America and in Tropical South America (table 3). Stationary population would respectively be equal to 384 and 668 million or 5 and 4 times the actual population size. The difference in stationary population size implied by the high and low variants is rather striking for these two regions, as the high variant population is about twice the size of the low variant, 549 and 295 million in Middle America and 978 and 483 million in Tropical South America. (table 1). As mortality assumptions are the same for all variants, differences in population growth is strictly caused by different fertility trends for each specific variant which all originate from the same level of gross reproduction rate in 1975.

The population of China estimated at 895 million in 1975 is expected to be equal to 1,190 million in the year 2000 when fertility drops to replacement level. The relative increase of women in childbearing age, from 49 per cent to 56 per cent will foster high crude birth rate in the latter part of this century, around 16 per thousand in the year 2000. China will see its population increase slowly but steadily until it levels off at 1,471 million sometime around 2090, about one century after net replacement fertility has been attained. Thus, the population would augment by one quarter between the time each woman bears two children and the time population becomes stationary. Total population situated by the high and low variant are respectively 1,586 and 1,275 million. The share of China in the total world population estimated at 22 per cent in 1975 is anticipated to decline sharply and be ultimately 14 per cent under the medium variant, 11 per cent under the high variant and 16 per cent under the low variant (table 2). China's share of the total world population, like other low fertility regions, will be higher.

if the conditions of the low variant are realized. This is so because these conditions imply a steep and rapid fertility decline which has a greater effect on the relative position of the high fertility regions than on the low fertility regions.

Growth in Other East Asia will most probably be substantial. Between 1975 and 2085 population would double its size from 57 to 126 million. Population will thus grow for a few generations after fertility drops to net replacement level in 2020 because of the combined effect of a young age structure and further mortality decline.

31 per cent of the world population or 1,255 million were estimated to live in South Asia in 1975. Population growth will be above 2 per cent until the turn of the century when a sharp downward turn would occur so that forty years later around 2040 it would fall below 1 per cent and would be nil by the turn of the next century. By then, the population of South Asia will have soared to 4,145 million, almost four times its present size and would represent 40 per cent of the world population by the time stabilization is reached in all regions. The high and low variants suppose that the stationary sizes would eventually be 5,794 and 3,128 million. All three regions of South Asia, namely East, Middle and South Asia are expected to augment their population by very large amount but it is in Middle South Asia among all 24 world regions that the largest population increase is anticipated to occur. The population would rise from its present level of 845 million to 2,820 million in 2100, an absolute increase of 1,975 million. The analysis of the population trends in the region shows that in 2040 when fertility drops to replacement level, the population will be equal to 2,457 million. It will take another 60 years for the region to halt its

growth. In that time span, 400 million will be added to the population of 2040 so that by the time zero population growth is achieved in 2100, Middle South Asia will have a population of 2,820 million. The scope of the high and low variants give stationary population levels equal to 4 and 2.1 million.

The less developed regions of Oceania, namely Melanesia, Micronesia and Polynesia would grow respectively from 3 and 1 million in 1975 to 13 and 4 million in 2100 following the long term projections.

V. More developed regions

The population of the more developed regions is estimated at 1,093 million in 1975 and projected to increase to 1,389 million in 2080. The range of ultimate population size is fairly small as the high variant implies a population of 1,600 million and the low variant a population of 1,218 million, a difference of about 31 per cent.

In 1975, the population living in the eight more developed regions was about one third of the total world population. By the time the world population ceases to grow, this percentage will have fallen somewhere between 11 and 15 per cent (table 2). The momentum of population increase in all the more developed regions which appears to be around 0.7 per cent in 1975-1980 will, according to the projections, drop to 0.5 per cent by the turn of the century. If these low fertility rates registered in many developed countries continue for another two generations, the developed world will reach zero population growth around 2025-2050. This would be the culmination of a long historical process which started at the end of the 18th century in certain social strata of the population of Western Europe which slowly but surely extended to all the population of these eight regions as one after the other they started a long process of socio-economic development characterized by active industrialization. --

Future increments in total population are anticipated to vary widely in each region. In USSR, Eastern and Southern Europe, the percentage of population increase would be equal to 49, 26 and 25 per cent respectively as fertility is projected to remain above replacement level until the beginning of the next century (table 1).

In Northern America and Australia-New Zealand, population will grow by 35 and 47 per cent respectively even though the gross reproduction rate in each region is assumed to remain below replacement level until 1990 and 2000 respectively. This increase would result from the combined effect of a relatively young age structure and substantial projected migration. In spite of the projected low gross reproduction rate and the absence of positive migration movements, Japan is anticipated to increase its population by another 18 per cent between 1975 and 2010, from 112 to 132 million. However, in the next 40 years, the population of Japan would decline slightly from 132 million in 2010 to 128 million in 2050.

In Northern and Western Europe, the pervasiveness of downward fertility trends in all population strata has produced an age structure characterized by a high percentage of old people. Thus, low birth rates and high death rates combined with projected low fertility trends and declining migration movements result in the prospect of stagnating or declining populations. The medium variant supposes that the population will augment by 1-5 per cent while under the low variant, these two regions could lose 12 per cent of their population (table 1).

VI. Alternative projections

Exploring the future permits one to suppose the most extraordinary scenarios for the development of humanity. Two extreme alternatives to the medium, high and low variants immediately come to mind. The first scheme investigates the implication of an instant adoption of a 2 child family size throughout the world; the second pays attention to the results of keeping constant the actual fertility trend of 4 children per family. Despite their lack of realism, it is instructive to compare the results of these two sets of projections with those obtained under the medium variant.

Table 4. Population of the world, 1975-2150 according to three projection variants (millions)

Year	medium variant	instant fertility reduction variant	constant fertility variant
1975	4,033	4,033	4,033
2000	6,199	5,380	6,719
2025	8,354	6,443	12,068
2050	9,775	6,919	22,387
2075	10,405	7,081	42,133
2100	10,525	7,155	79,534
2125	10,530	7,187	150,168
2150	10,528	7,190	283,444

Note: Base population is the estimated total world population in 1980.

The results are rather striking. If mortality diminishes as already assumed, but fertility remains unchanged, the total world population would reach 6,700 billion in 2000, thus only 500 million more than under the medium variant. It would exceed 12 billion in 2025, 22 billion in 2050, and 42 billion in 2075, and 80 billion in 2200. Even then it would continue to grow with breath-taking speed. Science-fiction may enable us to envisage some future planet, remote either in time or space, supporting 100 billion human beings in health, assuming that in the interim there have been carried into effect truly outstanding transformation in technology and social organization.

But it is equally certain that high fertility rates cannot be at once reduced to less than half their present levels. A projection has, in fact been calculated where mortality will decline as already assumed, but where fertility is suddenly cut down to net replacement level, beginning with the year 1980. In this projection, owing to the time needed for the adjustment of age structure, the world's population would still rise to 5.4 billion by the year 2000 and grow to 7.2 billion by 2120 when growth rate would become nihil. The impact of the age structure on population growth is well illustrated here as the projection indicates that 140 years will be needed for the population to stabilize even if fertility would suddenly fall to net reproduction level.

VII. Comparison with long range projections from other sources (table 5)

Among the plethora of ultimate population sizes possible, a few have been chosen for their comparability with the 1980 United Nations projections. All these projections illustrate different hypotheses of fertility decline and analyze the prospects for a stationary population. Let us quickly summarize the assumptions followed by each of them. The 1974 United Nations long-range projections used the 1970 population of the eight major areas as benchmark data and presented hypotheses for each. They assumed that gross reproduction rate will be equal to 1 in 2005 in Europe, 2010 in Northern America, 2015 in USSR, 2020 in East Asia and Oceania, 2035 in Latin America, 2060 in South Asia and 2070 in Africa. The high and low variants suppose that these levels will be reached respectively 10 years later or earlier. The 1974 projections also present instant fertility reduction and constant fertility projections.^{14/} Tomas Frejka's projections^{15/} illustrate a fall to net reproduction level as of 1970, the base year of the projection (Projection 1) or over a period of 10, 30, 50 and 70 years (table 5, Projections 2 through 5) respectively). The low and medium variants of Bogue and Tsui aggregate the results of country projections carried out at the country level.^{16/} The instant fertility projections (table 5, col. O, I and K) are informative because they illustrate the impact of a young age structure in conjunction with mortality improvements on future population growth. They all reveal the large amount of population increase to expect under such conditions. Otherwise, the unlikelihood of their events and the differences in the base population used makes the comparison meaningless.

^{14/} Concise Report on the World Population Situation in 1970-1975 and its Long-Range Implications, op. cit, pp. 47-69.

^{15/} Frejka, Tomas, "The Prospects for a Stationary World Population, Scientific American, 228(3):15-23, March 1973.

^{16/} Bogue, Donald J. and Tsui, Amy Ong, Zero Population Growth, unpublished paper, Table 7.

Table 5. Long term projections of the world population following different authors (billions)

Year	United Nations, 1978				United Nations, 1974				Tomas Frejka Projections					Bogue-Tsui			
	Low	Medium	High	Instant fertility reduction	Constant fertility	Low	Medium	High	Instant fertility reduction	Constant fertility	1	2	3	4	5	Low	Medium
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
2000	5.9	6.2	6.5	5.4	6.7		6.4			7.2	4.7	5.1	5.9	6.4	6.7		
2025	7.3	8.4	9.5	6.4	12.1		9.1			14	5.6						
2050	8.0	9.8	12.1	6.9	22.4		11.2			33	5.6	6.3	8.2	10.5	13.0	7.8	8.1
2075	8.1	10.4	13.6	7.1	42.1	9.5	12.2	15.8	5.6	80							
2100	8.0	10.5	14.1	7.2	79.5						5.7	6.4	8.4	11.2	15.1		

Sources:

Long-Range Projections of the World Population by Regions, 1950-2150, Table 1A and Table 4.

Concise Report on the World Population Situation in 1970-1975 and its Long-Range Implications, op. cit. pp. 65-67.

Frejka, Tomas, "The Prospects for a Stationary World Population", Scientific American, 228(3):15-23, March 1973.

Bogue, Donald J. and Tsui, Amy Ong, Zero World Population Growth, unpublished paper, Table 7.

The results of the constant fertility assumption simply show the cumulative effect of constant increments of growth (table 5, cols. E and J). Under such conditions, the population of the world would double every 25 years as of the year 2000. A comparison of the 1978 and 1974 United Nations medium, high and low projections indicates a smaller ultimate population in the former of about 11-15 per cent. This difference is due to the steeper fertility declines assumed in 1978. Tomas Frejka's projections 3, 4 and 5 fall short of the 1978 low, medium and high projections by a very small margin, about 5-7 per cent. Bogue and Tsui's medium projected figure is about equal to the United Nations 1978 "low" figure while their "low" variant population as well as Tomas Frejka's number 2 Projection do not fall in the range of the United Nations projected populations. Does the similarity of the United Nations 1978 projections and Frejka's projections 3, 4 and 5 give them any more reliability than the other sets? The answer is definitely no as the closeness of the figures results partly from the similar approach to the same problems but also, as it often happens in projections from, coincidences.

VIII. Conclusion

The overwhelming conclusion which can be drawn from this study is that, in the absence of major world disasters, zero population growth cannot be foreseen in the short future. Another indisputable conclusion which can be inferred from the various results of the projections is that in the short term the consequences of differences in fertility trends are small. Going back to table 5, the reader will see that the margins of the world population in the year 2000 delineated by the low and high variants are 5.9 and 6.5 billion. If the limits of the "instant fertility reduction" and the "constant fertility" projections are considered, the margins in the year 2000 extend to 5.4 and 6.7 billion. The long-term consequences of differences in forthcoming fertility trends are tremendous. In the next 100 years, the difference in the total world population implied by the low and high variants could be 6 billion. In this respect, we can hope that this study has served its purpose. Apart from giving plausible answers to these often asked questions, when will population stop growing and what will be its level then; it has also shown the importance of short term demographic developments on the long term future of the world population.