

POPULATION, PROJECTIONS, AND POLICY: A CAUTIONARY PERSPECTIVE

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ABSTRACT

Population projections depend on censuses, vital statistics, and sample surveys, all of which have deficiencies that are most marked in developing countries. Long-range projections by international agencies have recently undergone major revisions, and forecasts of the United States (U.S.) population have changed drastically over the past four years. The United Nations (UN) typically prepares high, medium, and low projections. Even the high projection contains optimistic assumptions about fertility decline, while assumptions of constant or increasing fertility receive no serious attention. This paper suggests that high and constant fertility projections should receive more attention from policymakers. They should treat medium estimates as targets achievable only through considerable programmatic effort. At the same time, they should plan economic and environmental efforts to deal with the population sizes implied by the high projections [note 1].

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INTRODUCTION

"Population projection is not a bloodless technical task, but a publicly-charged craft of great interest to policymakers and the public (Ahlburg and Vaupel 1990: 649)."

Policies, by definition, deal with the future. The number of people strongly affects demand for food, shelter, health, and infrastructure. Therefore, in creating and monitoring social, economic, and environmental policies, no data set is more crucial than population projections. Indeed, population enters as either numerator or denominator in many of the most frequently-used measures assessing both current and future needs. Persons per hectare of arable land, population per physician, or student/teacher ratios are examples of population data in the numerator. But consumption or gross national product per capita depend upon demographic denominators. In Erlich's popular formula for assessing future environmental impact, $I = PAT$ (Environmental Impact equals the product of Population size, per capita Affluence and Technology), population projections are critical for both the P and the A. Besides global and national projections, there has been increasing use of Geographic Information Systems in local and regional planning. This has heightened the demand for population projections of sub-national areas.

While professional demographers are acutely aware of the limitations of population projections, others tend to accept them uncritically. In part, this comes from the prestige of the two major international organizations that publish them--the UN and the World Bank. But it also stems from ignorance about how these agencies collect and interpret population data. Because of the crucial policy potential of population projections, we need to look closely at their assumptions, procedures, and shortcomings. We begin with a brief appraisal of the basic data at the core of the projections.

POPULATION DATA

Censuses, Vital Statistics, and Surveys: the Raw Material of Projections

Projections usually depend on three sources of data: censuses (usually each decade), vital statistics (continuous records of births, deaths, and migration), and special surveys.

National Censuses

The quality and quantity of developing-country census data have improved greatly since the 1950s, mostly because of the availability of technical and financial assistance from international agencies. These groups view data collection as an important first step toward national population planning.

Between 1965 and 1988, the U.S. Agency for International Development (USAID) expended \$105 million on data collection. Its rationale was clear: "A central assumption of early policy assistance was that if reliable and up-to-date information was made available to policymakers, they would be stimulated to

develop national policies" (Maguire 1990: 44).

At the UN, the improvement of demographic data "has been one of that organization's unqualified successes." The relevance of such data for population policies has long been recognized. "At a time when it was not yet permissible for international agencies to promote population control, taking censuses was an outlet for the urge to do something about the population problem" (Keyfitz 1987: 239). A milestone occurred with the Chinese census of 1980, counting one-fifth of the world's population apparently with a high degree of accuracy (Coale 1984). During the decade of the 1980s, 191 countries carried out a national census, covering 95% of the world's population.

Vital Statistics

However, as many as 20 countries did not conduct a census during the 1980s, and nearly all the others will not do so again for 10 years. Since planners usually deal with the short and medium range, 1-10 years, they need additional data sources. For trends between censuses, and to analyze population change into its components of fertility, mortality, and migration, they rely on vital statistics. This information comes from the registration of births, deaths, and residential moves and is often missing or incorrect. As Farooq and Pernia (1988: 14) put it, "It can hardly be repeated too often that non-availability of accurate demographic indicators in statistically less-advanced countries remains one of the most important constraints on sound development planning."

Unfortunately, those regions most in need of strong population policies and programs are those most deficient in vital statistics. For example, about two-thirds of the world's population has had adequate data on mortality since 1985 (Bureau of the Census 1991). In 71 developing countries, coverage of births and deaths is "unknown" to the UN. In another 42, the coverage is less than 90% (UN 1988: 11). According to Sadik (1991: 44), eight of every 10 African and Asian countries, and more than one-half of the South American countries have unsatisfactory (less than 90%) coverage of births. Baum and Moriyama (1990: 4-5) argue that the situation is not improving:

"In earlier times, registration of vital events and the vital statistics that are compiled from these registration records were an important concern of internationally-minded statisticians. Nowadays, it is not very often that one sees mention of these subjects in the programs of inter-national and regional statistical conferences, or in the table of contents of statistical journals....The temporary measures to utilize sample surveys and indirect estimation techniques to provide vital statistics are still with us and still provide us with inadequate and untimely statistics on births and deaths...the decades come and go with little observable progress towards a permanent solution."

Sample Surveys

Surveys provide a partial solution to the deficiency in census or vital statistics. However, although they are often quick and economical, they are usually one time only. Moreover, surveys in developing countries are not immune from problems of reliability and validity, despite their use of better trained interviewers than in censuses. The experience of the World Fertility Survey shows the formidable challenge of obtaining reliable data on such basic matters as number of births per woman. The group invested heavily in technical and financial means to get accurate fertility information from sample surveys in 38 developing countries. However, researchers judged that they had "reasonably reliable" data from only 27 countries.

Among those producing inadequate data were such large nations as Bangladesh, Indonesia, and Pakistan. Moreover, "It was in the very countries where the greatest attention and concern have been directed that the World Fertility Survey, carefully designed to take account of past survey experience, failed to provide reliable estimates of fertility levels and trends." Deficiencies do not occur at random, and, unfortunately, tend to underestimate the problem of excess fertility. "There is the strong suggestion of a deficit of children aged 1 and 2 for many countries, leading to the possibility that for a number of countries recent birth rate estimates may still be too low" (UN 1987b: 38-39).

Another problem is that each survey focuses on one substantive area, making it impossible to investigate important cross-disciplinary relationships. Thus, fertility surveys rarely contain questions about agriculture or migration while agricultural surveys contain little on migration or fertility (Bilsborrow and Geores 1990: 124). A promising exception to some of these limitations are the Demographic and Health Surveys sponsored by USAID. These surveys combine detailed fertility questions with important maternal and child health items. Moreover, researchers have administered the surveys two or three times in several countries, facilitating the identification of trends.

Nevertheless, there is much room for improvement in basic data collection, and developing countries are aware of it. Most of them assign a high priority to data collection and believe it is well suited to international aid. A 1988 UN inquiry asked nations to rate "the priority the government assigns to current and future international technical cooperation" for eight areas. The ratings were "none," "low," "medium," or "high." Of 49 responding African and Latin American developing countries, 34 rated data collection as high. Only 29 rated family planning programs this highly (Baldwin 1991). Despite this emphasis, international aid for data improvement has been declining compared to more action-oriented population programs. While USAID continues to support data improvement for policy goals, costs for data collection declined from 44% of the budget in 1965 to 33% in 1984-88. The agency's "priorities for the future" have moved from "assisting third world Governments in formulating national policies to helping them supplement them" (Maguire 1990: 51). As a proportion of all international population assistance, basic data collection declined from a high of 7.5% in 1981 to 3.3% by 1985 (Rao 1990: 165).

To summarize, the quality of the data base at the heart of demographic analyses is only fair in many countries and is decidedly poor in others. It is on this somewhat shaky base that researchers construct population projections, the most important single set of demographic analyses.

POPULATION PROJECTIONS

The Short Life Expectancy of Population Projections

The first fact that should instill a degree of doubt about projections is the frequency with which they require revision. The UN revises its shorter-range projections (up to year 2025) every two years, and the World Bank does so at least as often [note 2]. As new data or new analytic techniques become available, groups make changes, and they often are not trivial. In 1982, the UN made long-range projections of a world population of 10.2 billion by 2100 but, in 1992, raised this figure by one billion. In 1982, the organization projected the populations of Asia would stabilize at 5.05 billion and Africa at 2.59 billion. But in 1992, despite the many promising family planning programs, the group increased the projections to 6.16 and 3.15 billion (UN 1992: 32).

The UN's 1982 projections underestimated 1990 world population by nearly one percent (0.9%) according to its most recent estimates (UN 1993). The picture is less impressive for regions and countries. Thus, the projection for Asia made in 1982 fell 2% short (61 million people) of the 1990 population as estimated 10 years later. Latin America's population was over-projected by 2.6%, and Central America's by 5.8%. At the country level, even estimates of 1990 population made only two years apart (1990 and 1992) show considerable variation. Of projections for 149 countries made in 1990, three-quarters were revised in 1992, half up and half down (UN 1993: 95-103).

Unexpected increases in life expectancy in developing countries explains most of the upward revision. Although forecasting mortality is easier than projecting fertility, it relies on at least two assumptions that could be troublesome. First, in making alternative projections such as high, medium, and low, the UN uses only medium mortality rates. Thus, the projected range of the population estimates is more conservative than it would be if using high and low mortality estimates.

Second, "It is common practice to assume that orderly progress will be made and that, during the projection period, catastrophes such as war, famines or new epidemics will not occur" (UN 1993: 84). This assumption seems increasingly questionable in a significant number of developing countries. As an initial corrective to this course, in its 1993 projections, the UN introduced separate models considering the possible impact of the AIDS epidemic in several African countries. In Uganda, for

example, the UN projects an additional 1.8 million deaths between 1980 and 2005. Assuming AIDS, it projects a population size of 26.7 million for 2005. Without AIDS, it projects population at 29.2 million (UN 1993: 67).

But as difficult as it is to project mortality trends, it is even more difficult to project migration and fertility. Both require "assumptions as to the frequency and magnitude of essentially unpredictable events, as well as affirmations of faith concerning the nature of the political, social, and economic life of the future" (UN 1973: 562). Figure 1 dramatically illustrates the sensitivity of national population projections to unexpected changes in birth, death, or migration rates. This chart compares several recent U.S. Census Bureau projections of the U.S. population. The current (1993) "middle estimate" for the U.S. population in 2050 is 92 million higher than one made only four years before. Further, the 1989 projections predicted that population size would level off by 2030, but the 1992 and 1993 trends imply indefinitely continuing growth [note 3]. If we see such drastic shifts in levels and rates in a country with the world's top census technicians using the highest quality data collection and analytic procedures, what can we expect of the projections for developing countries?

The Myth of the "Most Likely" Variant

According to Irene Taueber, "The inability of demographers to predict future changes accurately or perhaps the inherent unpredictability of such changes has led most of the makers of projections to prepare several alternative series" (cited in Brass 1970). Since a shotgun may be the best weapon for a moving target, the UN has traditionally prepared three projections: low, medium, and high.

Unfortunately, both scholarly and public sources give an inordinate amount of attention to the medium forecast. Most publications do not bother to cite the high and low projections, and even official presentations may encourage the reader to disregard them. Thus, the UN publication THE STATE OF WORLD POPULATION 1992 accompanies a graph with the statement: "The medium variant is considered the most likely" [note 4] (UN 1993: 84).

The World Bank has traditionally published only one projection, which has been very similar to the UN's medium estimate [note 5].

This gave the Bank's projections an unwarranted appearance of certainty. However, the zealous reader might discover buried in technical footnotes disclaimers such as "the assumed year of reaching replacement level fertility is speculative and should not be regarded as a prediction" (World Bank 1993: 318).

In 1992, the UN improved its chances of hitting the target by increasing the number of its long range (1950-2150) projections to six. In addition to high and low, it added medium-low, medium-high, constant fertility, and instant replacement

fertility [note 6]. In its most recent series, the UN (1993) has reverted to high, medium, and low variants but has retained the constant fertility projection. It gives projections for 211 countries for each five years until 2025.

These are short-run projections, and in the short run the difference between high and low estimates is trivial. In the 1992 projections, for example, the difference between highest and lowest of the five world forecasts for the year 2000 is only 327,000 people. But the difference between high and low projections for the middle of the next century is nearly 5 billion. And by 2150 the difference is about 24 billion people (4.2 versus 28 billion). Seemingly trivial differences in fertility have huge implications in the long run. The medium-low and medium-high projections differ by only 10% in the final assumed level of fertility (1.96 versus 2.17 births per woman). But, by year 2150, world population would total 5.6 billion using the medium-low assumption and 21 billion using the medium-high (figure 2).

Perhaps because these figures are so daunting, analysts give us the impression they have at least covered the maximum range and that even the high estimate is improbable. However, an analysis by Keyfitz (1981) of past errors in projections concludes there is one chance in three that world population will be under five or over 21 billion by 2150. Theoretically, exceeding the upper limit would not be difficult. Even the high estimate assumes that world fertility will decline from its current 3.3 children per woman to 2.5. In the high estimate, the Total Fertility Rate of Africa south of the Sahara, now at 6.4 births per woman, would decline to 3 by 2025 and to 2.5 by the middle of the next century. (The low estimate assumes African fertility will stabilize at 1.7 by 2040.)

But the "unthinkable" could occur and current world fertility rates could stay constant. This would result in an estimate of 21 billion people by the middle of the next century and 109 billion by its end. The UN discounts this possibility by saying that the constant fertility projection "incorporate(s) unrealistic assumptions of future fertility change." It also says, "If 28 billion persons exceed the earth's carrying capacity, an ultimate family size of 2.5 children is contrary to reason or would need to be combined with higher mortality than assumed here" (UN 1992: 7, 34). Most recently, UN demographers have judged that their three main variants "provide reasonable and plausible future trends in fertility." But they virtually dismiss the constant fertility projection as a purely technical exercise. "The constant-variant projection is prepared for analytical purposes" (UN 1993: 84).

Perhaps even more controversial than assumed declines in fertility is the assumption that once reached, fertility will remain at replacement levels. Thus the Bank sets specific dates for each country--not whether, but when [note 7]. It assumes China will reach replacement fertility by 1995, Brazil by 2000, Bangladesh by 2015, Pakistan by 2030, and the tardiest African nations (Malawi and Niger) by 2055 (World Bank 1993: 290-91). One critic of the stabilization assumption maintains mildly that "the logic ...is hardly compelling" (Demeny 1984: 120). Another holds that its "only real justification...is that it is

statistically convenient" (Haub 1992: 6); and still another maintains that the chosen dates "stem more from hope than evidence" (Brass 1970: 148).

How are these dates determined? The UN (1988: 21) explains that:

"The assumed date for a country to reach the replacement level is estimated by taking into account the population policies and programmes, adult literacy rates, school enrollment ratios, and gross national product per capita and gross domestic product per capita of the country. Historical, cultural and political factors and current levels of fertility and infant mortality were taken into consideration as well. No mathematical equation, however, was set up for determining the date to reach the replacement level from current values of those indicators...partly because some important factors such as population policy were qualitative indicators difficult to quantify, and partly because many developing countries lacked reliable recent data on some quantitative socioeconomic indicators.

The Inevitable Decline to Replacement

Obviously projection involves a high degree of subjectivity. This raises a question. How reasonable is it to set "medium" (and therefore the "most likely" estimate) as the projection that assumes fertility will stabilize at replacement level in the next century? Demographic theory does suggest that as countries modernize, fertility and mortality will decline to low levels. But it does not tell us when this will happen. Although an impressive number of developing countries have had large fertility declines, many others have shown no sign of decline. Data from the UN's WORLD POPULATION PROSPECTS, 1990, shows there are 31 countries where fertility rates have been constant for the 30 years between 1960 and 1990. These countries, many in Africa, will be 14% of developing-country population in 1995. The World Bank and the UN medium projections assume replacement fertility for all of them by the middle of the next century. This implies a decline in total fertility of three or four children per woman over the next 30 years. But these nations had essentially no reduction in the previous 30 years.

Although there have been promising trends in contraceptive use in recent years, much of that progress has been in urban areas. Among 29 developing countries that participated in the World Fertility Survey, the median total fertility rate in the major city was 3.9, compared with 6.2 in rural areas (calculated from data in Alam and Casterline 1984: 16). Fifteen to 20% more married women were practicing contraception in large cities than in rural areas. Both declines in fertility and increases in age at marriage have been greater in urban than in rural areas (UN 1987a: 187).

However, data from more recent surveys show a mixed picture. Let us compare the urban and rural total fertility rates in 18 Demographic and Health Surveys administered between 1988-89 with national surveys taken earlier in the decade. Urban total fertility rates declined more than rural in seven countries, less

than rural in five, and about the same amount in six. Direct comparison of surveys conducted by different agencies at different times is, of course, subject to considerable error. (Computed from data presented in country reports of the Demographic and Health Surveys).

The first stages of family planning tend to select those already highly motivated. It is more difficult to make later inroads in the rural populations and among the urban non-users of contraceptives. This depends upon the willingness of governments to invest in family planning infrastructure and outreach programs in less accessible areas. "However, the social and economic conditions inherent to under-development have frequently meant slow progress in extending family planning services, or for that matter, other sorts of social services, beyond the major cities" (UN 1984: 84).

Even increases in fertility are not implausible. These occurred initially in many countries before fertility decline. Healthier and longer reproductive lives of women, and declines in breast feeding are the reasons. Many developing countries expect these conditions. Demographers from the industrialized nations also ruefully recall that the theory of demographic transition did not expect the post-war baby booms in the United States and several European countries. However, projections can accommodate both booms and busts in birth rates. For example, in a model by Ahlburg and Vaupel, the U.S. total fertility rate can range from 1.8 to 3.2 births in bust/boom cycles. This scenario is at least as realistic as constant or declining fertility. When we add assumptions of one to two million immigrants per year and an annual decline of 2% in mortality to the high projection, the result is a U.S. population of 553 million for 2050, 31 million more than the Census Bureau's highest current variant. Ahlburg and Vaupel's model projects 811 million by 2080.

Lest we think this is wildly improbable, the authors point out that "...the average growth rate that produces it runs at only 1.3% per year...the same as the average annual growth rate that has prevailed in the U.S. over the last century and not too much above the 1% average annual growth rate of the last decade" (Ahlburg and Vaupel 1990: 645). Despite these reasonable procedures, none of the UN's seven projections in 1992 or four variants in 1993 includes an assumption of increasing fertility.

At the very least, the situation does not appear as promising as that suggested by the medium projections. Declines in world population growth rates, in fact, stagnated in the 1980s. This occurred because of 1) stalls in the fertility declines of China and India [note 8]; 2) the virtual cessation of new fertility declines since the 1970s, especially among African and South Asian nations; and 3) a change in age structure that has favored high birth rates (Horiuchi 1992). While there is room for optimism concerning the weakening impact of the last factor, there is little ground for assuming major changes in the first two.

Although the UN's 1992 medium projection for world population in year 2100 contains a billion more people than its 1982 projection, it still seems vastly optimistic. It assumes (as does the World Bank's projection) that Chinese fertility will

drop well below replacement early in the century. It also assumes that African and Latin American fertility will drop to the replacement level by the middle of the next century.

The rationale for translating such optimistic assumptions into a "medium" projection is not clear. In sum, it is difficult to disagree with a recent appraisal by the former chief of the UN Population Division. "There are indications that the UN high-variant projections are more plausible than the medium-variant projections for the poorer countries of the Third World..." (Tabah 1992: 41). Demographers do not limit this argument to developing countries. Concerning the Census Bureau's 1989 projections for the U.S., Ahlburg and Vaupel reasoned that "their high projection might be treated as a reasonable middle forecast" (1990: 645).

POLICY IMPLICATIONS

These observations have several implications for policymakers who use population projections, for demographers who make the projections, and for the institutions that support demographic research and its dissemination. These groups should be aware of the frequent weakness of the data bases for projections. The weaknesses vary with the country, and the more developed nations are not immune. (For example, undetermined illegal migration and frequent fertility swings make U.S. projections a hazardous exercise.) There are significant numbers of unregistered births and deaths in many developing countries, making projections especially difficult. In some countries, the optimistic assumptions about mortality (no catastrophes, famines, or AIDS) will be problems. But even more serious are the usually optimistic fertility assumptions. These depend on rapid and substantial decline, even in countries that show no signs of such decline. Policymakers need to be alert to the chance that fertility may stagnate at high levels or may even increase. The latter can occur as a result of such varied circumstances as higher rates of marriage, declines in sexually transmitted diseases, or reduced breast feeding practices.

Perhaps the most difficult task for policymakers will be to take seriously a variety of projections, rather than one labeled as "medium" or "most likely." A social and economic planner understandably prefers a single projection. But alternate plans should be ready, in the (not infrequent) case that projections other than medium become reality. Indeed, it might be prudent for many policymakers to regard the medium estimate as a target to achieve by specified family planning and development programs.

At the same time, we need to make plans to meet the demands for employment, services, infrastructure, and environmental quality resulting from increased population sizes.

Demographers can help by better packaging of their projections. It would be better to avoid designating any of the projections as "most likely." Instead, they should use some more neutral

labeling (such as Projection A, B, C , and D), avoiding a "middle" and compelling the reader to look more closely at the various assumptions. Alternative labels might vary according to assumptions about family planning prevalence or advances in women's educational levels. Such projections might involve more complex models than are currently in use, incorporating more socio-economic and environmental data (and their linkages) from each country.

We can make several recommendations regarding organizations that support and disseminate population projections. First, they should continue at the present rate or increase investment to improve basic data. They should institutionalize surveys such as the Demographic and Health Surveys and put them on a regular basis for key countries. Although fertility should remain central to such studies, successive surveys should substitute topics other than health. Other topics that could profitably link with fertility data at the household level include environment, employment, women's status, and agriculture. We need to encourage more complex models incorporating these and other data.

Agencies such as the UN and the World Bank play critical roles in the dissemination of projections and need to exercise particular care in packaging. The Bank's movement away from publishing only a single variant is a step in the right direction. Such agencies should also consider designating constant fertility as "high" and the present high or medium-high variants as "medium." Finally, all international agency personnel who deal with developing countries and who lack demographic expertise could profit from training sessions dealing with the assumptions and implications of population projections. These are basic to the social and economic goals of modernization and sustainability.

*The seven projection estimates based on different assumptions about future trends in world fertility.

- 1) Instant replacement assumes that fertility levels reach replacement by 1995 and remain at that level through 2150.
- 2) The low variant assumes that population growth of each major world region will "eventually" stabilize at 1.7 children per woman. ("Eventually" varies for each region. In Africa, for example, the low variant assumes stabilization of fertility by 2040, at a level of 1.7 children per woman. The high variant assumes fertility stabilization at 2.5 children per woman by the year 2050).
- 3) The medium/low variant assumes that fertility will stabilize at 1.96 children per woman (or 5% below the replacement level).
- 4) The medium variant assumes that population will eventually stabilize at the replacement level, about 2.05.
- 5) The medium/high variant assumes stabilization at 2.17 children (5% above replacement level).
- 6) The high fertility variant assumes that fertility will eventually stabilize at 2.5.

7) The constant fertility variant assumes that 1990-1995 fertility levels will remain unchanged through the year 2150.

ENDNOTES

1. The research assistance of Joseph W. Brown is gratefully acknowledged.
2. Since the World Bank derives its data from the UN, as well as from the same national statistical offices as the UN, we discuss UN procedures at greater length. The Center for International Research of the Bureau of the Census makes independent projections. These are not reviewed in this paper, other than those dealing with the U.S. population (Figure 1).
3. The "highest" projection was increased much less than the "middle" series, by only 17 million (3%), as compared with 92 million (31%).
4. The UN has recently argued that since its medium projection "has well-described future world population growth, at least for 20 to 25 year horizons...In that sense, the medium variant projections can be thought of as 'most likely'" (UN 1993: 84).
5. This was true as late as its 1993 WORLD DEVELOPMENT REPORT, but future projections are expected to include high, medium and low variants.
6. While more rather than fewer variants are desirable, in practice this could exacerbate the tendency to ignore the extremes. A good example is a paper by El Badry (1992) in which the new UN medium, medium-high, and medium-low variants are used throughout, with no mention of high, low, or constant variants.
7. The Bank uses the date at which the Net Reproduction Rate (the mean number of surviving girl children per woman) is expected to equal one. The UN recently changed its procedures, and, in the 1992 projections, assumes stabilization at replacement levels only for its medium estimate. In the other extensions, fertility stabilizes at levels higher or lower than replacement.
8. The UN Population Division recognizes that both its 1973 and 1982 forecasts underprojected the population of Asia. At that time it was expected that the unprecedented declines in fertility that took place in China and India in the late 1960s would continue at the same pace into the 1990s. However, the late 1980s saw a slowing down in the rate of fertility decline in these two large countries (UN Population Division 1992: 5).

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