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IIASA Working Paper

WP-95-057

June 1995

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ABSTRACT

This paper focuses on the approach to population projections that has been labeled scenario analysis. It looks at the original meaning of "scenario" and then discusses its appropriate usage in population projections with respect to several criteria, especially that of consistency of assumptions.

Next, the paper describes the practical considerations and actual experiences in an IIASA effort to define alternative scenarios for 12 world regions to the year 2030 through discussions of a group of experts. Because of differential expertise and an uneasiness of experts to numerically define alternative scenarios, an interactive group process was chosen rather than a larger Delphi. On practical and theoretical grounds it became apparent that individual responsibility and judgement of the authors cannot be replaced by an anonymous "objective" entity making the assumptions.

Finally, the paper discusses what kind of alternative variants (or scenarios) the users can handle and do expect. It is exemplified through the specific question whether the UN should change its current practice of making population projections. Pro and contra arguments are listed concerning the proposal to include alternative mortality assumptions into the three main variants that are widely publicized.

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SCENARIO ANALYSIS IN POPULATION PROJECTION

Wolfgang Lutz

1. Introduction

As the pace of developments in our modern world increases, appropriate planning for the future becomes an ever more important element of success at all levels ranging from government policies to corporate strategies and private life-time planning. Changes in population size, structure and distribution generally are not the most important elements of planning, but they do make a difference for many issues. Furthermore, population patterns tend to change more slowly than other relevant factors (such as economic ones) and therefore can provide an element of stability in planning. Hence, there is a clear demand for some kind of population projections on global, national and even subnational levels. The users of such projections range from government agencies concerned with planning in education, social security and labor force, to members of the non-demographic, scientific community who need population figures as input to their own models (e.g. of energy demand) and private corporations concerned with future markets and labor supply.

For demographers, forecasting is one of their oldest activities, but yet--as Keyfitz (1994) recently stated--"it has never been fully integrated with the main body of demographic theory and data. The fact that the public regards it as our most important task, finds no reflection in our research agenda" (p. xii). A broad and comprehensive discussion about fundamental issues involved in population projections is clearly necessary and should include the users of population projections. Particular emphasis needs to be given to the questions of the output parameters desired, of the time horizon demanded, and of the way in which the users expect to see the issue of uncertainty treated. Whether they want to be presented with just one most likely prediction, or a full probability distribution of alternative futures, or anything in between these two extremes, is an important question which is rarely addressed explicitly. Usually, the people who produce the projections define the task themselves. This broad discussion will be attempted elsewhere[1] and will not be the focus of this paper, which will look explicitly at the issue of "scenarios" in population projection. Not to forget about the user's perspective, however, is a thought that will follow us throughout this paper.

Since by all that we know it is clear that a primary concern for all kinds of users is information about the most likely course of future population trends, possibly together with certain alternatives, in this paper we will only discuss point estimates of future trends rather than full probability distributions. In Section 2 we will discuss the usage of the notion of "scenarios" and its specific meaning in the context of population projections, followed in Section 3 by some practical experiences in defining alternative assumptions based on expert opinions. In Section 4, finally, we will discuss what are the priorities from a user's perspective, especially with respect to the question of how much emphasis should be given to alternative mortality trends as compared to fertility and even migration.

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[1] An international meeting on the broad issue of basic approaches to international population projections is planned to be held at IIASA in January 1996 as a component of IIASA's new International Population Projection Workshop (IPPW). This meeting will also include various groups of users.

Only in recent years the notion of scenarios has been introduced into the population projections terminology. EUROSTAT, IIASA, the Council of Europe and some statistical agencies and authors (e.g. Ahlberg and Vaupel 1990) now choose to call the alternative calculations "scenarios." It is not always clear whether those authors and institutions that now prefer to use the word "scenario" instead of "variant" also consider this a change in the basic approach to population projection, or whether it merely reflects a change in terminology without a change in the meaning.

Although the word "scenario" was occasionally used in the context of population at an earlier point in time, a library search among the English-language literature for titles of independent publications that include the word "scenario" and deal with population projections lists as the first title an IIASA study of the late 1980s. It is indicative of the process of spreading the usage of this notion that this particular title ("Population Futures for Europe: An Analysis of Alternative Scenarios," by Wolf et al., 1988), including the word "scenario," had not been chosen by the demographers, but had been assigned to IIASA's Population Program by the organizers of an IIASA meeting on the impact of new technologies on the European environment. By that time the word "scenario" had obviously become a standard notion in the analysis of environmental change, and more generally in systems analysis.

But what exactly does "scenario" mean in the context of population projections? In the following section we will try to elaborate a bit on this question in order to avoid confusion in the rest of the paper and elsewhere.

2. Definition and Common Usage of "Scenario"

The word "scenario" clearly originates from the world of theater. The *Oxford English Dictionary* (in its 1970 edition) defines "scenario" as "A sketch or outline of the plot of a play, giving particulars of the scenes, situations, etc." In the 1982 supplement to the *Oxford Dictionary*, additional usages are listed: First, a cinematographic analogy to the usage in theater is given, followed by a much more general meaning: "A sketch, outline, or description of an imagined situation or sequence of events." But in a short note the editor mentions that the over-use of this word in various loose senses has attracted frequent hostile comment.

Historically the first use of the word "scenario" outside the realm of theater and movies was by Herman Kahn in his 1962 book, *Thinking About the Unthinkable,* in which he painted the picture of the consequences of a hypothetical nuclear war, most notably the possibility of a nuclear winter. He used the notion of a scenario in the sense of an unlikely but possible and consistent set of events, such as that of an accidental nuclear war. On page 143 Kahn states as part of a chapter entitled "Some strange aids to thought": "A scenario results from an attempt to describe...some hypothetical sequence of events...".

Gradually, the word "scenario" spread into common usage especially in the context of computer models for the future. In 1971 the *Observer* (June 1, p. 27) wrote: "Several of the computer 'scenarios' include a catastrophic and sudden collapse of population" (I/3). In 1976 the *Scientific American* (October, p. 79a), in an article by Strong and Klebesadel, comments: "Many of the models we have mentioned here are better characterized by the term scenario... There is so little detailed information that the proposals should not be dignified by the term model. Nevertheless a good scenario can sometimes lead to a good model" (A/2).

This last quote indicates that in the natural sciences the notion "scenario" has developed its own meaning by characterizing something more vaguely-defined than a quantitative model and often expressed in narrative form. In this sense the 1987 *Systems and Control Encyclopedia* states: "A scenario is a narrative account of possible states of affairs, typically as these evolve over time. Scenario contents are typically based on expert knowledge... Many scenarios are written in relation to the exploration of the future... Narrative scenario descriptions are particularly useful in situations where the future is highly uncertain" (pp. 4152-4153). By putting emphasis on the narrative and non-quantitative nature of scenarios, this is clearly a different use of the notion from the social and political sciences, where scenarios tend to be associated with quantitative computer models of the future.

What is the appropriate usage of the term "scenario" in the context of population projections? Should it reflect the natural or the social science meaning? In the usage of the term in demography, so far it has clearly been with respect to alternative quantitative assumptions on future fertility, mortality, and migration levels (Ahlberg and Vaupel 1990; Lutz 1991, 1994; EUROSTAT 1991; Cliquet 1993). But there seem to be different views as to whether scenarios should describe a specific situation (or futuristic vision) at some point in the future--see the definition in Öberg and Springfeldt (1991) which seems to reflect the usage in population geography and policy planning--or whether it should define the path between now and a specific point in the future (which is necessary for any quantitative projection). The above definition of the *Oxford English Dictionary* seems to give both views a legitimate place in referring to "an imagined situation *or* sequence of events."

Another common feature of most writings in the field of population is that scenarios are considered as something that clearly needs to be possible but not necessarily likely. To distinguish scenarios from variants of population projection, Lutz et al. (1993) made an attempt to define scenarios by four criteria: (1) more emphasis is put on the if-then nature of the calculation as opposed to a likely prediction; (2) a scenario approach is expected to make all assumptions very explicit; (3) all three components of change should be addressed separately; and (4) the scenario approach typically looks at a somewhat larger number of scenarios (i.e. more than two or three).

In IIASA's new world population scenarios (Lutz 1994), the two chapters that give "The IIASA World Population Scenarios to 2030" (Chapter 15) and "Special World Population Scenarios to 2100" (Chapter 16) both adhere to the above given criteria, but still have a somewhat different underlying philosophy. In Chapter 15, the scenario assumptions are independently defined for all three components with alternative projections based on systematic combination (permutation) of these assumptions. The three components are treated as being independent. For the long-term scenarios given in Chapter 16, alternative assumptions are seen as referring to alternative future developments of the underlying socio-economic macro-system (rapid versus slow demographic transition). Hence, fertility and mortality are no longer seen as independent, and consistency of assumptions becomes an additional criterion. While the first approach (systematic combinations) is clearly legitimate and very useful, especially in the context of sensitivity analysis (see Stoto 1988), the second probably comes closer to the original meaning of "scenario" in the sense of an imagined sequence of events that form a consistent "scene." In the first view, scenarios are an intermediate step towards a probabilistic modeling of future population; under the second view, scenarios serve the more exploratory and educational purpose of thinking alternative futures. Both purposes are important; but authors should make clear what they have in mind when they use the word "scenario."

In the current thinking of the author on this issue, the consistency criterium is essential. Scenarios must make sense, and it is therefore not legitimate to combine assumptions that

contradict each other into one scenario. This would clearly not produce a "possible sequence of events" or a "scene." On the other hand, scenarios may and should describe unlikely sequences of events which, in the case of population projections, does not only include unlikely levels of fertility, mortality and migration, but also unlikely combinations of the three components. For this reason, the consistency criterium only excludes strict inconsistencies but not unlikely combinations.

For practical choices of what assumptions to combine in a scenario, the visions of alternative megatrends (i.e. socio-economic trends that impact on fertility, mortality and migration) in the future of both the users and the producers of the projections should provide guidance. This is more important for long-term projections than in the shorter run where the three components may be rather independent. For developing countries, there could be a vision of "rapid modernization" (implying rapid educational improvements for women combined with rapid mortality and fertility declines) as opposed to "slow modernization." For the United Nations system, the Cairo Programme of Action provided the important vision of mutually reinforcing improvements in health services, female empowerment, and access to quality family planning. Hence, for the UN population projections, the presentation of a scenario combining lower fertility with lower mortality would make more sense in the context of the Cairo vision than its current practice (as will be discussed in Section 4 below). In this context, it needs to be questioned whether the two "scenarios" (they are actually called scenarios) presented by EUROSTAT (combining high fertility with low mortality in one scenario, and low fertility with high mortality in another one, and not giving the user any most likely case) are really a wise choice.

3. Practical Experiences in Translating Expert Knowledge into Global Population Scenarios

The following describes a case study of one attempt at defining a set of global population scenarios by a group of experts. The goal of the exercise was to produce a new set of alternative population projections that avoid some of the shortcomings of the United Nations and World Bank projections. The two most significant things to be done differently were (a) to give much more room to substantive elaborations behind the specific assumptions chosen (and 80% of the resulting book (Lutz 1994) was devoted to this), and (b) to give more attention to possible alternative trends in mortality and migration as opposed to the traditional focus on fertility. As mentioned above, the book gives two quite different sets of projections to 2030 and to 2100. The following notes will only refer to the first set of projections, because the invited experts refused to consider assumptions beyond the year 2030. Consequently, the assumptions of the long-term projections were entirely defined by the group of authors of the projections (Lutz et al. 1994).

In general, there seem to be three strategies for specifying all the necessary assumptions on alternative future fertility, mortality, and migration levels: (1) Specify some time series models for past trends that, when continued into the future under different assumptions, would provide the necessary parameter values; (2) select our own assumptions based on our informed judgement after reading all the commissioned background papers and other relevant literature; and (3) define the assumptions in a Delphi-like effort in a workshop of experts.

Possibility (1) seemed to be too mechanistic, leaving out some of the important expert knowledge (such as information on reproductive preferences or advances in medicine) that is not reflected in past time series data. Possibility (2) had been practiced in IIASA's 1991 book on Europe and North America (Lutz 1991) and was clearly a fallback strategy in case of no better choice.

Possibility (3) was the most challenging to us and seemed to be most appropriate in synthesizing the expertise of a group of specialists. Consequently, a group of 12 experts and authors of background papers was convened at IIASA for three days in December 1992.

The typical approach for collecting the views of a number of experts about future trends is the so-called Delphi technique. The most common form of the Delphi is the paper-and-pencil version, which is also referred to as a "Delphi Exercise" (see Linstone and Turoff 1975). In this situation, a small monitor team designs a questionnaire which is sent to a larger respondent group. After the questionnaire is returned, the monitor team summarizes the results. Sometimes the respondent group is given an opportunity to reevaluate its original answers, based upon examination of the group response. This typical Delphi approach does not provide for any further interaction or discussion among the group participants. Because of this we did not choose a typical Delphi for the following three reasons:

(1) Differential expertise: We needed many specific assumptions, such as fertility and mortality levels in specific world regions. But only very few experts exist who could reasonably evaluate the specific component at the given level of aggregation (i.e. transcending the national level and yet have specific knowledge about the individual 12 world regions chosen). How should the answers of different people be weighted with respect to their degree of expertise on the issue?

(2) There is a real possibility that most experts are biased in the same direction. A good cautionary example is given by the ongoing survey of projections on the likely future price of oil by the International Energy Workshop (see Manne and Schrattenholzer 1995). Figure 1 shows the projections as assessed by a large group of the world's leading energy experts and relates it to the actual oil price at the time of the assessment. It is stunning to see how the average assessment of this expert group always extrapolates the most recent trend. Only in the years immediately following the rapid decline in oil prices, conventional thinking about increasing prices seems to have been stronger than the influence of the decline, which obviously was considered a short-term perturbation of the long-term trend. More than ten years after the decline, however, the view that oil prices tend to be stable at a low level seems to dominate the picture. It is remarkable that the average assessment of this significant group of experts declined by a factor of more than four within only one decade. Unfortunately, we have no information about the ex ante uncertainty attached to these estimates, because the International Energy Workshop only asked about one most likely value.

There are many less extreme examples for changing assumptions in the field of population projections, especially concerning fertility assumptions before and after the baby boom. But also in the fields of mortality, the UN assumptions about the maximum life expectancy considered (see Bucht 1994)--which result from extensive interagency consultations--needed to be increased by ten years of life expectancy within only 15 years (1973 to 1988) because observed life expectancies in the most advanced countries were likely to surpass the assumed absolute limits.

This evidence of past misjudgments on one most likely trend by whole groups of experts seems to suggest that experts should also be asked about the range of uncertainty they perceive in addition to the most likely value. It can be assumed that the expert views on future oil prices would not have given such a bad picture of reality if experts had been asked to also give their high and low extremes. At least one could think that the extremes would have reacted more quickly than the most likely price to the observed decline. This example strongly supported our view that it was very important to ask not only for the most likely path, but also for less likely and more extreme ones. This, however, leads us to the third reason not to have a larger scale Delphi study in written form.

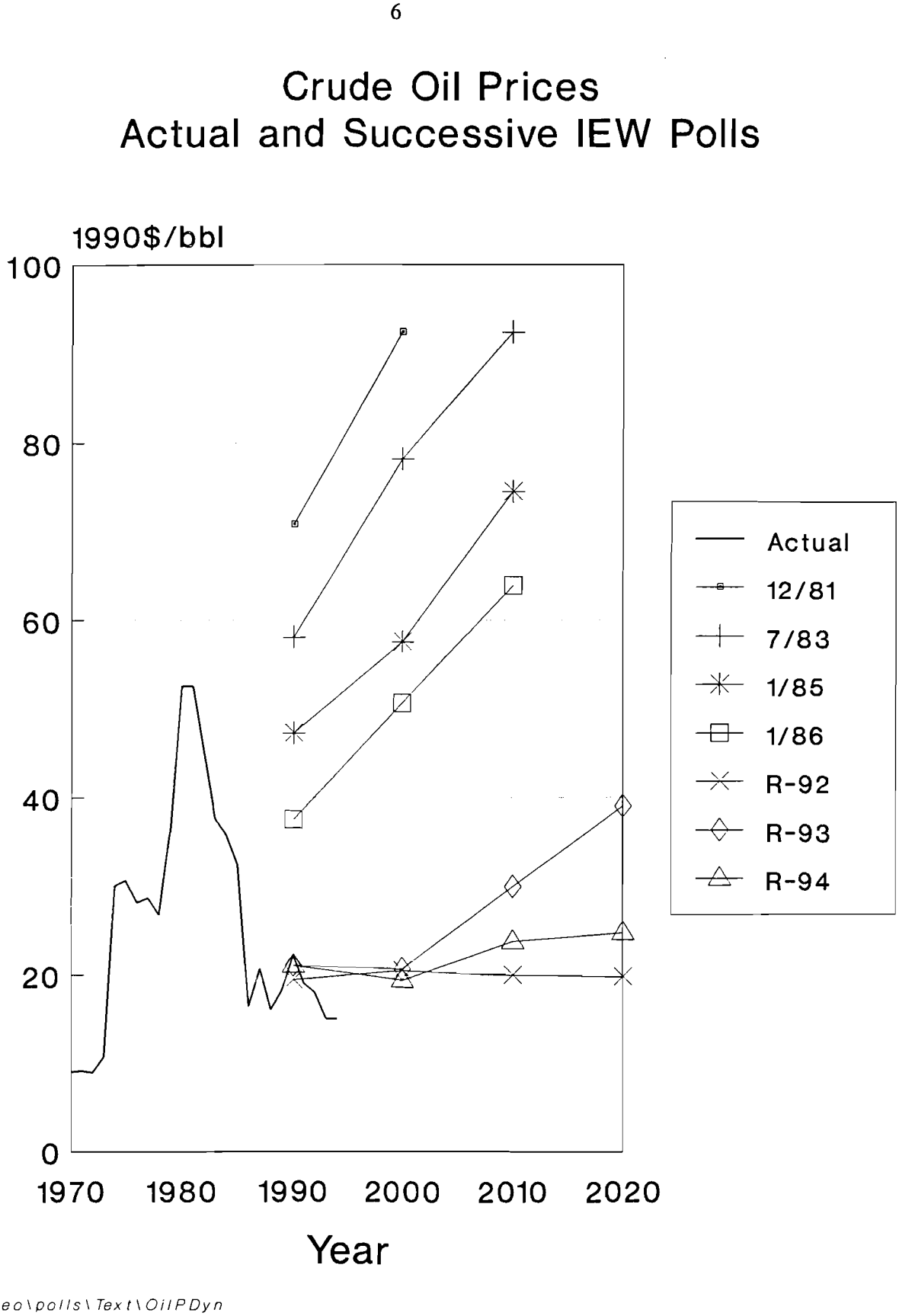

Figure 1. Oil price projections produced by the International Energy Workshop. Source: Manne and Schrattenholzer 1995, p. A-2.

(3) To most population experts, the thought of having to specify alternative scenario assumptions is still very unusual, if not uncomfortable. Only a very small fraction of international experts in population analysis has in the past been involved in defining assumptions for projections. Many colleagues, when asked informally on a trial basis, have refused to come up with any specific numeric value. And many of those who are willing to come up with some kind of a guess about the future tend to think in terms of one most likely future path. The concept of alternative low and high values for each of the three components (roughly covering 80% of all possible cases) in addition to a most likely value still needs more introduction and explanation than can be given in a short cover letter. Although this is a mostly psychological factor, it is very relevant for the success of any Delphi. Stoto (1988), commenting on the same phenomenon, points out that we are asking experts for accuracy in communication (what is meant e.g. by "somewhat lower") and not in estimation. In a sample of students, Behn and Vaupel (1982), for instance, found that the phrase "It is probable that..." was given numerical interpretation ranging from 20% to 98%. Hence, we should ask the experts simply to spell out more clearly what is on their minds.

For the above-given reasons, a workshop of experts with the possibility of interaction was thought to be the most appropriate setting for a group effort to define the scenarios. Although there would be only one expert with specific knowledge, e.g. on African mortality conditions, other experts in the group could challenge his views and ask for further clarification. The expectation was that through the process of discussion, the subjective views of the expert would become modified and corrected in an inter-subjective manner that would make it a consensus view (at least about alternative possibilities).

During the first two days of the workshop, a most interesting and stimulating substantive discussion on trends in fertility, mortality, and migration identified a large array of relevant factors impacting on future trends. But on the third day, when it was hoped that the individual experts would come up with specific numbers for high, central, and low values for TFR, life expectancy, and net migration in 2030 in 12 world regions--with the range between the high and the low values covering roughly 80%-90% of all cases--the group thought that filling out individual forms with blank matrices was not a good idea. Instead, it was felt that a group discussion of the values was a more fruitful strategy, because it could combine individual special expertise with the considerations of others.

In order to reduce the number of necessary choices on parameter values, a number of structural simplifications was introduced:

(1) Changes over time will only be assumed for the total level (e.g. the TFR), while the shape of the age pattern is assumed to remain unchanged. In mortality, one would pick the life expectancy and then use extended model life tables.

(2) In general, a linear trend between the starting year (1990) and the value chosen for 2030 was assumed. For fertility, the TFR for 2030 was fixed and the intermediate values derived by linear interpolation. For mortality, a constant number of years in life expectancy improvement over a decade was to be chosen, and for migration, the assumed total of net migration would be reached within ten years and kept constant thereafter.

(3) The underlying probability distribution was assumed to be symmetrical, i.e. if only two of the high, central, and low values were chosen freely, the third was already determined. Although this is a rather strong assumption, it turned out to be a significant help in reducing the number of difficult choices to be made.

Due to these simplifications the quantitative values to be chosen boiled down to 24 numbers for fertility and mortality. Because of the assumption of symmetry, any two of the three values (high, central, low) determined the third for each of the 12 world regions. Table 1 presents the final choices made for fertility, and Table 2 those for mortality. For migration, assumptions were somewhat more complex, because a full matrix of interregional migration had to be assumed. But only one such matrix had to be chosen, because the additional simplifying assumption was made that in the low case, every region has zero net migration.

Table 1. Fertility assumptions. Source: Lutz et al. 1994, p. 393.

		2030		
	1990	Low	Central	High
North Africa	4.7	2.0	3.00	4.0
Sub-Saharan Africa	6.4	2.5	3.75	5.0
Central America & Caribbean	3.3	1.7	2.35	3.0
South America	2.9	1.7	2.35	3.0
West & Central Asia	4.2	1.7	2.35	3.0
South Asia	4.2	1.7	2.35	3.0
China/Hong Kong/Taiwan	2.2	1.5	2.25	3.0
Southeast Asia	3.2	1.7	2.35	3.0
North America	2.0	1.4	1.85	2.3
Japan/Australia	1.7	1.3	1.70	2.1
Eastern Europe	2.0	1.3	1.80	2.3
Western Europe	1.6	1.3	1.70	2.1

Table 2. Mortality assumptions. Source: Lutz et al. 1994, p. 397.

	Life expectancy 1990		Assumed change in years of life expectancy per decade		
Region	Male	Female	Low	Central	High
Developing regions					
North Africa	58.6	61.1	0.50	2.25	4.00
Sub-Saharan Africa	49.0	52.4	-3.00	0.00	3.00
Central America & Caribbean	65.7	71.3	1.00	2.00	3.00
South America	64.0	69.6	1.00	2.00	3.00
Western & Central Asia	64.4	69.3	0.50	2.25	4.00
South Asia	58.1	58.4	0.00	2.00	4.00
China	68.6	71.8	1.00	2.00	3.00
Southeast Asia	61.2	65.3	0.00	2.00	4.00
Industrialized regions					
North America	72.2	79.0	1.00	2.00	3.00
Japan/Australia/New Zealand	75.3	81.1	1.00	2.00	3.00
Eastern Europe	65.9	74.7	0.50	2.25	4.00
Western Europe	73.0	79.4	1.00	2.00	3.00

As to the process of choosing these values, the group discussion resulted in important information, but was not conclusive. It either took the form of an auction of fertility levels ("I give a TFR in Southern Asia of 3.0, does anybody bid higher?") with a certain degree of randomness and inconsistency of logic across regions, or led to very inspiring, yet non-numerical, discussions about underlying forces. When it became clear that this "anti-authoritarian" discussion process did not generate the necessary matrix of parameters, it was finally decided to retreat to a less ambitious and more pragmatic solution: Following the meeting, the group of IIASA authors would fill in the matrix based on their best knowledge and informed by the discussion at the meeting, send it out to all participants, and ask for suggestions to improve it. This was how it finally happened. For the three IIASA scientists involved, it was easier to play the "auction game" internally and produce the matrix. Only minor modifications were made later on, based on comments by the workshop participants and other experts with whom the set of assumptions were discussed.

By this more pragmatic strategy, which originally was not considered to be the most desirable under objectivity criteria, a full set of assumptions could be defined that has a consistent logic and still reflects the broad knowledge base of a group of experts. It also has been challenged in critical discussions, and adjustments have been made based on convincing arguments. This broad scientific discussion process made the authors confident that the alternative scenarios defined adequately reflect the present state of knowledge about the future, including its degree of uncertainty. For this reason, "What can we assume today?" also became the subtitle of the book.

One important lesson learned from this exercise of trying to define the assumption for projections by an expert group was that ultimately the responsibility for the full set of assumptions needs to rest with the authors of the projection. It can be shared to some degree with a broader group of experts, but a fully collective responsibility is impractical, if not impossible.

4. What Do the Users Expect in Terms of Information That Goes Beyond One Most Likely Variant (or Scenario)?

In the publication of IIASA's world population scenarios, it was chosen to present nine alternative scenarios for each of the 12 regions until 2030: the Central scenario, combining the central assumptions of fertility, mortality and migration, plus the eight possible combinations of high and low values of the three components. On a global level, migration becomes irrelevant, and four combinations of fertility and mortality are presented in addition to the Central scenario. For the long range (up to 2100), five main scenarios and an odd number of special scenarios are presented. This fairly large number of alternative scenarios is appropriate for a scientific audience that can follow the underlying reasoning and appreciates the consideration of uncertainty, but it may be too much for non-scientific users. The problem with this question is that nobody ever systematically studied what the non-scientific users of projections expect to see in terms of uncertainty variants, and with what complexity they can deal.

The following discussion of how many and what kind of uncertainty variants (or alternative scenarios) should be present to the users will mostly make reference to the United Nations Population Projections, which are the most prominent international projections. They are mostly intended for non-scientific use, but are also most frequently used by scientists. More specifically, the following considerations are based on discussions among demographer colleagues and government representatives at the recent (February/March 1995) meeting of the UN

Commission on Population and Development (CPD) in New York, which defines the activities of the UN Population Division, including its population projections.

A first step in approaching the question of what the users expect was a small informal survey among delegates in New York (scientists as well as diplomats). One common opinion became apparent right at the beginning: There was no interest in fully probabilistic population projections. Quite aside from methodological uncertainties on how to go about and the question of how to disseminate it, there was the strong feeling that almost nobody would know how to use them. Even for the few people who could see some positive aspects, it was unclear in what way government planning could benefit in practical terms from a fully probabilistic projection.

The second question was about the usefulness of a larger number of alternative scenarios. Here the response was more positive, but only in terms of a useful academic exercise for a smaller group of interested people. There was a near consensus that the officially-published and widely-circulated UN projections for all countries in the world should mainly focus on one main variant with a maximum of two additional variants shown.

Accepting, for the time given, this view of a maximum of three alternative paths, the question still arises how these two additional projections should look. There is little doubt that one main projection, which is considered most likely, is being demanded by the users and serves a very useful purpose. So far, the additionally published "high" and "low" variants of the UN population projections have been defined in terms of higher and lower fertility rates resulting in higher and lower total population sizes. For mortality, all three variants assume an identical path, and international migration is assumed to be virtually non-existent. It is not clear for what these additional two variants stand. They are not meant to represent confidence intervals, although a large number of non-demographic users do interpret them in this way. They also do not directly relate to any alternative policies that would result in the high or low paths given, nor do they want to indicate the maximum or minimum growth possible.

The high and low variants of the UN projections are now defined to simply demonstrate the consequences of two alternative paths of future fertility trends without attaching any probability to them. The design of the alternative projections, which only varies fertility assumptions and uses identical mortality and migration assumptions, reflects a situation where the primary concern is with the impact of alternative fertility trends, while future mortality and migration are considered less problematic and of minor importance. In a way they are educational model calculations demonstrating what happens to population dynamics under two examples of higher and lower than medium fertility.

Has the demographic situation--or our perception of it--changed sufficiently in recent years to suggest a change in this established UN projection practice? The only reasonable alternative within the constraint of only two additional projections would be to combine a low fertility with a low mortality assumption on the one hand, and a high fertility with a high mortality assumption on the other. And these variants would further gain validity if even a very rough probability range would be attached to the assumptions. If, for instance, the range between the high and low fertility assumptions would be taken to cover anything between 60% and 90%, then they would represent more than just more or less arbitrary sample paths.

On the question of whether to continue with the current practice of variants in the UN projections, or to give alternatives for both fertility and mortality, there are political and scientific arguments. Below is a list of reasons supporting such a change in practice, followed by some arguments in favor of continuity.

(1) The most important political reason for a change would be consistency with the Cairo Programme of Action. A major achievement of the Cairo document was that the issues of family planning and fertility--the almost exclusive focus of earlier conferences such as 1974 in Bucharest--were embedded in the broader issues of reproductive health and female status. The Cairo Programme of Action contains at least as many health-relevant components as fertility-relevant components. And all UNFPA documents tend to mention health in the first instance, followed by female empowerment and family planning at the end. And if this is not merely lipservice, a successful implementation of the Programme of Action would not only result in lower fertility, but also in lower mortality. For this reason, a reference to the low variant of the UN projections (which assumes the same mortality as the medium and high variants) contained in a draft version of the preamble had to be removed (see discussion in Lutz 1995). Hence it would only be logical to come up with a low fertility/low mortality variant in the UN projection that adequately reflects the vision of Cairo and its Programme of Action.

Figure 2, which gives the global level results of IIASA's world population scenarios, indicates that alternative mortality assumptions do make a big difference. Low fertility combined with low mortality brings the total population size in 2050 more than half way towards the central scenario as compared to low fertility combined with high mortality. Low mortality results in a higher total population size than high mortality simply because more people will stay alive. This may present an ethical dilemma to population control advocates, but it is a simple fact of population dynamics that should not be hidden by not presenting such calculations.

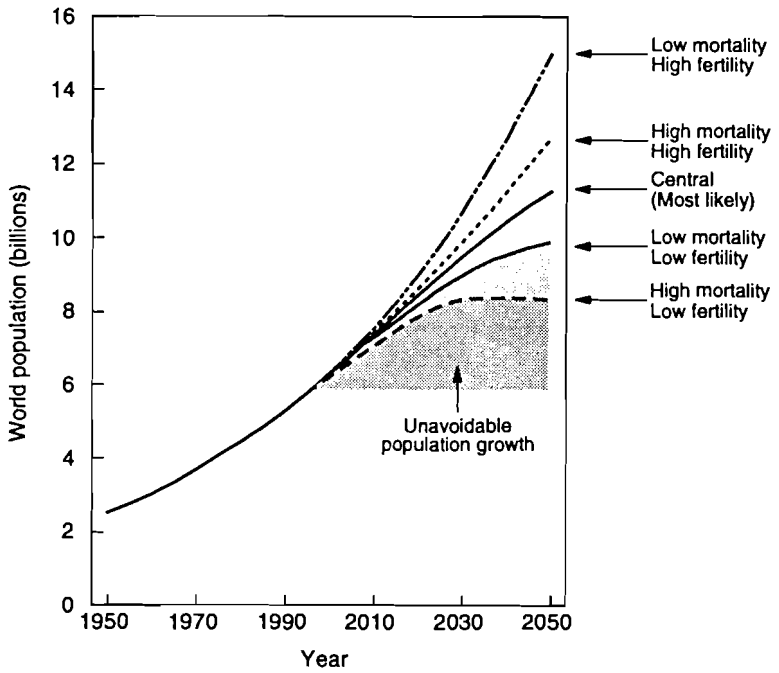

Figure 2. Alternative paths of global population growth. Source: Lutz 1994, p. 446.

(2) A substantive reason why alternative paths of future mortality should be considered in the published projections is that, indeed, the future course of mortality looks more uncertain today than it did 20 years ago. Different sources of uncertainty have arisen in different parts of the world. Mostly in Sub-Saharan Africa and Southern Asia HIV infections have added a dramatic amount of uncertainty because only insufficient information exists about the present HIV prevalence and much less about its future spread. In a large number of European and Central Asian countries in economic transition, recent mortality increases have added considerably to

the uncertainty about future trends. And even in the lowest mortality countries the feeling of uncertainty has increased, due to the erosion of the dogma of an asymptotic approach to a fixed maximum life span.

(3) In an increasing number of countries the concern is not merely with total population size but with the age structure and especially aging. This is not only an issue for the industrialized countries, but for all countries with recent fertility declines--most notably China--facing tremendous aging problems for which they are essentially unprepared. The extent and pace of aging will depend crucially on the future course of mortality, which is a strong argument not to disregard mortality uncertainty. In this context, the low/low projection would give the highest possible degree of aging, and high/high the lowest. The current three variants obscure this issue.

(4) Finally, a combination of high fertility/high mortality and low fertility/low mortality does not make the problematic assumption of independence of fertility and mortality. Even if the two components do not directly influence each other (e.g. through child replacement or fertility stress), there is a lot of evidence that in the longer run they are determined by joint forces, e.g. better education, health systems, and modernization in general.

But there are also some arguments against the departure from the current practice:

(1) Discontinuing a long tradition always causes confusion. The question is whether this confusion is harmful or healthy in terms of making people think more about the nature of population projections.

(2) In the long run, fertility is still the dominating determinant of population patterns. The new practice would not allow isolation of the effect of alternative fertility trends, all things being equal. This is primarily an educational concern rather than a planning concern.

(3) Finally, in very low fertility countries, constantly low or even further declining fertility is often not considered desirable. In those cases, the low fertility/low mortality projection would only be considered positive in one of its components. Furthermore, in periods of crisis such as presently in Eastern Europe, low fertility tends to be associated with high mortality. The question is whether this is only a temporary phenomenon, as has been argued in historical demography. In the long run "modernization" tends to move both in the same direction. But there clearly needs to be a lower limit to fertility.

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In the context of a methodological discussion, the above considerations were presented in order to demonstrate the concerns of the users and even of the institutions preparing the projections that may be quite different from the high-flying ideas of statisticians and technical demographers. There clearly is an unmet need--to use the most prominent Cairo buzz word--for a serious and open exchange of views between those who produce population projections and those who use them, and the international community of demographers and statisticians that hopefully will lead to population projections that are more satisfactory to all parties involved.

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