International Institute for
Applied Systems Analysis
Schlossplatz 1
A-2361 Laxenburg, Austria

Tel: +43 2236 807 342
Fax: +43 2236 71313
E-mail: publications@iiasa.ac.at
Web: www.iiasa.ac.at

Interim Report **IR-11-002**

The Uncertain Timing of Reaching 7 Billion and Peak Population

Sergei Scherbov (sergei.scherbov@oeaw.ac.at)
Wolfgang Lutz (lutz@iiasa.ac.at)
Warren C. Sanderson (wsanderson@notes.cc.sunysb.edu)

Approved by

Detlof von Winterfeldt (detlof@iiasa.ac.at)
Director

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Contents

Abstract

This paper addresses the uncertainties in global population forecasts of the timing of reaching certain important milestones such as a total population of 7 billion or peak population. This is studied in the context of probabilistic world population forecasts.

About the Authors

Sergei Scherbov is Director of Demographic Analysis at the Wittgenstein Centre for Demography and Global Human Capital (a collaboration between IIASA, the Austrian Academy of Sciences and the Vienna University of Economics and Business); Senior Research Scholar at IIASA's World Population Program; and Research Group Leader at the Vienna Institute of Demography of the Austrian Academy of Sciences.

Wolfgang Lutz is the Founding Director of the Wittgenstein Centre for Demography and Global Human Capital; Leader of the World Population Program at IIASA; Director of the Vienna Institute of Demography of the Austrian Academy of Sciences; and full Professor of Applied Statistics (part time) at the Vienna University of Economics and Business. He is also Professorial Research Fellow at the Oxford Martin School (University of Oxford).

Warren C. Sanderson is Professor of Economics and Professor of History at Stony Brook University in New York. He is also an Associate Research Scholar at IIASA's World Population Program.

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Sergei Scherbov, Wolfgang Lutz, and Warren C. Sanderson

The timing of demographic milestones is uncertain, not only when they refer to the distant future, but also when they are near to hand. Population forecasts must reflect this uncertainty, which is partly due to incomplete information about current conditions and partly to assumptions about the future. Probabilistic forecasts are an appropriate tool to incorporate these uncertainties. They are richer than conventional probability-free projections or scenarios since they provide quantitative uncertainty distributions for important demographic variables.

Probabilistic demographic forecasts have recently become more widely used not only by research centers but also by statistical offices. But until now most probabilistic forecasts were concerned with the uncertainty distributions of demographic variables at a specific point in time. There is, however, another interesting way of using probabilistic forecasts for estimating the distribution of possible dates when particular well-defined demographic milestones are likely to happen.

Two important global demographic milestones have recently received public attention: the date at which the world's population would reach 7 billion and the date at which the world's population would peak. In particular, the statement that the world population would reach 7 billion over the course of 2011 has received extensive mass media coverage all around the globe. In this interim report, we will focus on the uncertainties associated with the timing of these two events. But the general approach is applicable to the timing of any milestone in a probabilistic context.

When Will the World's Population Reach 7 Billion?

Using recent world probabilistic forecasts (Lutz et al. 2008), we can estimate the distribution of the dates at which the world's population reaches 7 billion. This is shown in Figure 1.

The distribution is highly skewed with a mode in July 2012, a median in January 2013, and a mean in April 2013. There is a 60 percent chance that the world's population would reach 7 billion between February 2012 and July 2014. According to the United Nations, the "Day of 7 Billion" should be celebrated on August 26, 2011 (United Nations Department of Economic and Social Affairs 2010). As indicated in Figure 1, the chance that this milestone occurs later than that date is over 90 percent. According to the U.S. Census Bureau (2011) that day should be celebrated in the middle of 2012, which is exactly the mode of the distribution in Figure 1.

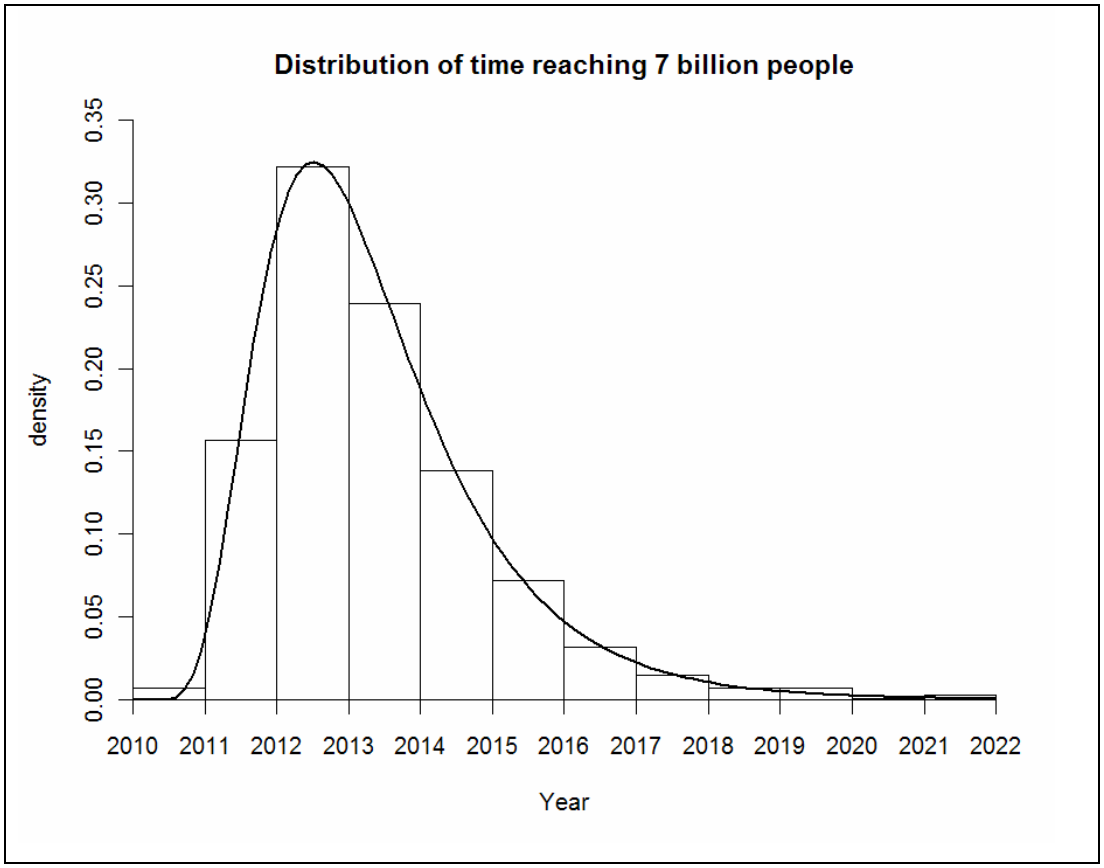

Figure 1. Uncertainty distribution of the time at which the world's population reaches 7 billion (year labels mark the beginning of the year). Source: Derived from Lutz et al. (2008).

Generally, all demographic projections suffer from two kinds of potential errors: errors resulting from incorrect or incomplete empirical information about recent population size, structure and current vital rates (baseline errors) and errors resulting from the uncertainty about future trajectories of fertility, mortality and migration. Typically, for statements about the near term future, the base line error tends to be more relevant whereas for the longer term the errors in vital rates carry more weight.

The sizes of many populations today are not known with high accuracy, including the population billionaires China (Ren et al. 2009) and India (Lutz and Scherbov 2004) and many countries particularly in Sub-Saharan Africa. Since the most recent census information tends to be a decade old (from the 2000/2001 round of censuses), the fertility assumptions used to project the populations from 2000 to 2011 play an important role, particularly when they are highly uncertain and concern countries with large populations.

When Will the World's Population Reach Its Peak?

According to the newest United Nations medium variant forecast (United Nations Economic and Social Council 2011), the world's population would peak in 2070. Figure

2 shows the distribution resulting from the probabilistic forecast referred to above. Here the picture is complicated by the fact that the demographic milestone studied is not just the reaching of one specific world population size, but the date at which world population size peaks, which can occur at different levels and different times for individual random trajectories.

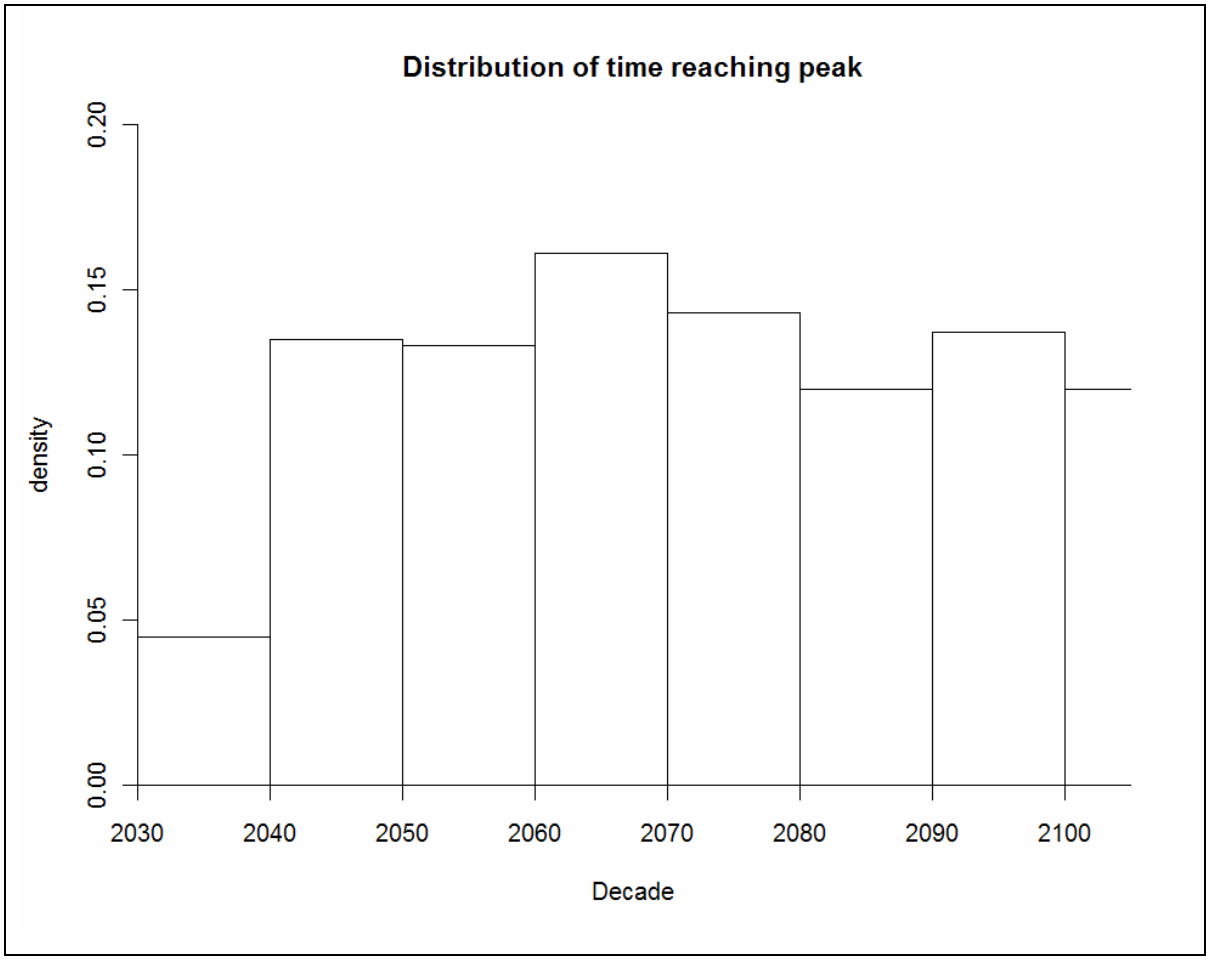

Figure 2. Uncertainty distribution of the time at which the world's population peaks. Source: Derived from Lutz et al. (2008).

Figure 2 shows the distribution over time when these maxima are reached. The probability of peaking turns out to be almost the same in every decade from 2040- 2050 through 2090-2100. The modal decade is 2060-2070, but the difference is small and certainly not enough to identify that decade as being especially likely to be the one in which the peak world population would occur. The probability that the global peak population would be in the decade 2060-2070 is only around 16 percent. The median year of the peak is 2072, but this provides little guidance because the central 60 percent of the distribution of the peaking dates is between 2052 and 2095. In other words, there is little uncertainty that world population will reach a peak and start to decline before

the end of the century (Lutz et al. 2008), but there is tremendous uncertainty about when during the second half of the century this peak population will actually happen.

We used a specific set of global probabilistic forecasts. There could be other global forecasts that take uncertainty into account, but whatever forecasts are used the same sorts of uncertainties in the dating of demographic milestones would result. This interim report has illustrated that we should try to convey to the users a sense of the uncertainty that is attached to demographic milestones, even if they lie in the near term future. This could help governments and the public to understand the importance of collecting and analyzing data that would contribute to reducing uncertainty.

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