

The world population over the next three centuries: explosion, implosion or equilibrium?

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The United Nations has just published projections of the world population until 2300. The population is expected to increase for fifty years then stabilize... or explode or implode, depending on whether fertility remains durably above or below replacement level. But how much value should we place on projections so far into the future? François Héran explains that this exercise in demography-fiction is useful if it teaches us how to avoid the disaster scenarios of population explosion or implosion.

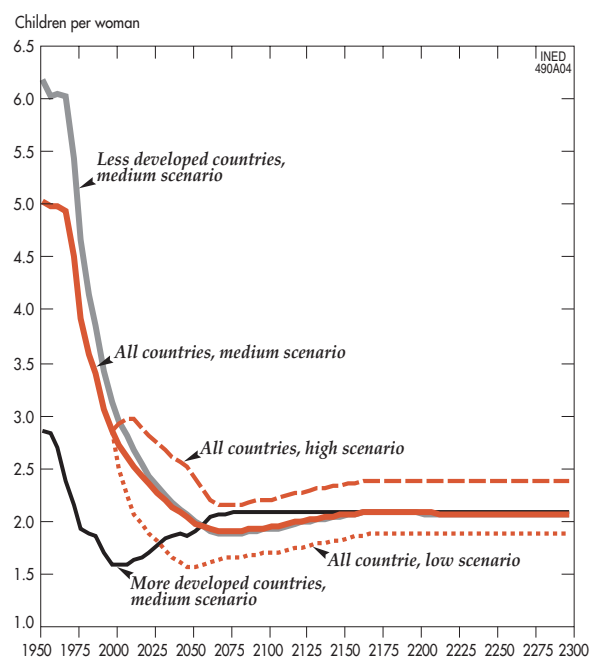
The United Nations Population Division has just published the final version of a bold exercise in population projection: several scenarios of the future of every country in the world to 2300 [1]. According to the study, the world population will continue to grow rapidly until 2075, reaching a historic high of 9.2 billion, compared with 6.4 billion now, and then gradually stabilize at around 9 billion. But this is only the central scenario, based on the assumption that the fertility rate will eventually settle at the replacement level, i.e. 2.1 children per woman. The United Nations demographers also show that by adding or subtracting a few decimal points to this rate (plus or minus 0.5 children per woman on average until 2050, then 0.25 thereafter), the world population would rise to 36.4 billion or fall to 2.3 billion in three centuries' time.

Given this extraordinarily broad range, it is easy to be sceptical about the value of the exercise. Researchers who prefer probabilistic projections, i.e. with clearly defined confidence intervals, are unimpressed [2, 3]. Finding out that there is a 95% chance of the world population being somewhere between 2 billion and 36 billion in 2300 does not tell us much. But, anticipating that criticism, the UN's demographers assert that the projections are not intended to be forecasts of the future, but extrapolations of current trends with a target. They

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liken thinking in 2004 about the world population in 2300 to a basketball coach predicting the outcome of a

Figure 1 - Total world fertility since 1950 and UN projections to 2300



Source: UN, Population Division, World Population to 2300, [1].

game after only a few minutes' play. The prediction may well be unreliable, but it can give enough of an idea for the coach to ask for time-out to define a new strategy. Similarly, the UN hopes that a careful examination of extreme population variations over the long term will encourage societies to react if necessary.

◆ Below replacement for a century

The UN's previous long-range projections were based on a horizon of 50 or 150 years [4, 5]. Why extend the horizon to 2300? The aim is mainly educational: it's a way of projecting future trends on a bigger screen. In fact, trends emerge clearly at the end of the 21st century and the real novelty lies elsewhere: for the first time, the UN admits that fertility could remain below the rate of 2.1 children per woman for a long time before returning to equilibrium (Figure 1). In other words, it acknowledges the "second demographic transition", i.e. the shift to a demographic pattern where delayed marriage and childbearing are driving fertility below replacement level, even as mortality continues to fall. Supported by a longitudinal analysis, Tomas Frejka and Jean-Paul Sardon have shown recently that this trend, which began in central and southern Europe several decades ago, is strong and difficult to reverse, even if France continues to remain an exception [6].

It also affects other continents, as Adolphe Landry anticipated in *The Demographic Revolution* (1). Half of the world's population now lives in countries where fertility is below 2.1 children per woman [8]. The UN expects this "second transition" to spread to the rest of the world, lasting from 1975 to 2060 in the "more developed" countries and from 2050 to 2150 in the "less developed" countries (2). At the same time, lifespans will increase so that in three centuries' time, female life expectancy could exceed 100 years in the more developed countries and 96 in other countries, with men only two or three years behind.

How much value should we place on these projections? For the first few decades, their predictive power is real, because the near future remains largely conditioned by the inertia in the age structure. It is quite another matter for the next few centuries: the aim of the projections is no longer to describe the course of events, but to show the potential of current trends. The problem is that this aim is coupled with another objective, which makes the enterprise a hybrid one. The UN demographers' central scenario has population curves moving towards the target of a return to demographic equilibrium. After a century in the "second demographic transition", the world population would return to the equilibrium postulated in the "first transition", with an invariant age structure and total population. The UN's projections are thus targeted.

Their destination, with respect to the fertility rate and the replacement level, is not the result of a calculation; it is a target set in advance, whose predictive value over the long term is zero by construction. Much of the pathway is also predetermined. What the calculation produces are the consequences in terms of total population and age structure, and the results generated by the different scenarios, depending on whether they maintain, increase or decrease the fertility rate.

◆ If fertility remains constant, the population explodes or implodes

Let us first consider the simplest scenario, which consists in maintaining current fertility levels for the next three centuries (3). This scenario of "constant fertility" produces extreme results, because the slightest initial deviation from replacement level (2.1 children per woman) increases exponentially (Figures 2 and 3). Under this scenario, in 2300 Africa would have a population of 115,000 billion people (that's one hundred and fifteen thousand billion!) and would be home to 86% of the world population, compared with 13% today, while Europe and North America would be close to extinction, with 90 million inhabitants instead of 730 million, i.e. a near-zero fraction of the world population. In demography as in other fields, cumulative growth soon leads to explosion if it is positive, and to implosion if it is negative. There is no need to wait until 2300 for this to happen: the population curves shoot up or drop sharply in the first century. The present is simply an ephemeral juncture of contrasting paces of growth in different regions. As soon as we make the data permanent, reality turns into unreality.

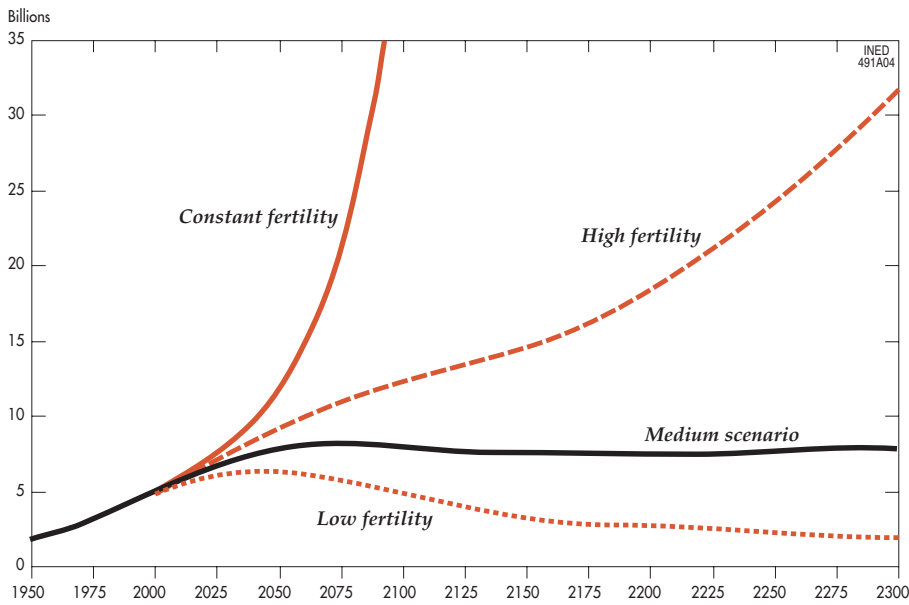
France offers a striking illustration of this. According to the UN's calculations, on the basis of an initial fertility rate of approximately 1.9 children per woman in metropolitan France and 2.2 in the French overseas dependencies (but as high as 3.8 in French Guiana), maintaining fertility rates constant over three centuries would eventually reverse the numerical ratio of the two populations: in 2300 metropolitan France would have only 21 million people, compared with... 234 million in the overseas dependencies! Similarly absurd results would be obtained by a projection for metropolitan France that maintains the respective fertility rates of native French people and immigrants from Africa constant over the long term.

(1) In this essay published in 1934, Landry considered that if the "vast human masses" of Asia applied birth control, it would upset their demographic equilibrium and eventually take fertility below replacement level [7].

(2) This is the UN's terminology. It goes without saying that many of the countries in the second category would join the first before the end of the projection period.

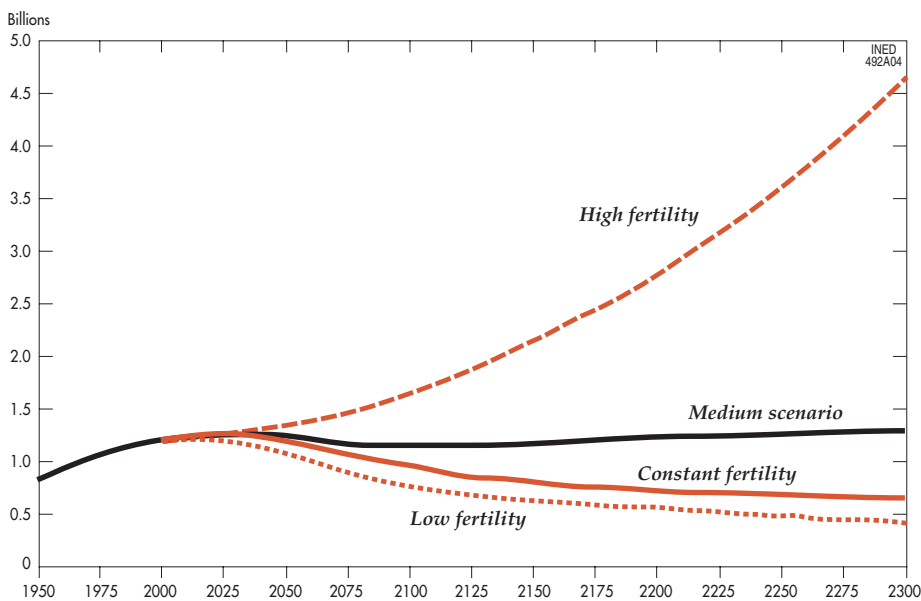
(3) Scenario published in the draft version of March 2004, but not included in the final version of October 2004.

Figure 2 - Population of "less developed" countries. Scenarios, 2000-2300



Source: UN, Population Division, World Population to 2300, [1].

Figure 3 - Population of "more developed" countries. Scenarios, 2000-2300



Source: UN, Population Division, World Population to 2300, [1].

of metropolitan France would swell to 248 million in 2300, which would give a population density of 450 per sq.km., higher than that of the Netherlands now. As for the scenario of low fertility, if the birth rate stagnated at around 1.35 children for almost a century, the population would shrink by around two-thirds. But would France simply sit back and watch this happen without reacting? Fifteen years ago, Jean Bourgeois-Pichat constructed a disaster scenario that went even further, based on the fertility rate in the Federal Republic of Germany (1.2 at the time). If that rate became permanent, Europe would become extinct by around 2250 and the entire human race by around 2400... [9].

In such long-range projections, shooting arrows that are too heavy or too light will send them way off course. The assumption of "moderate" population growth – which may seem reasonable in the short term – is untenable in the long term, because of exponential increase. The unreality of the alternative scenarios justifies the scenario of a return to equilibrium. Equilibrium is thus validated by a process of elimination, because it is

◆ The only way out is equilibrium

Let us take a look at the UN's alternative scenarios, which at first glance seem more reasonable, based on assumptions of high and low fertility. Surprisingly, they are scarcely more realistic than constant fertility. How would a scenario of fertility that remained above replacement level, at between 2.15 to 2.35 children per woman, affect France? Half a child more than the current 1.8 or 1.9 is comparable to the fertility of the baby boom (when it rose from 2.1 to 2.6 children per woman). The result of a permanent baby boom would be unmanageable. Under this scenario, the population

the only viable long-term target. It is neither a dogma nor a premise. And certainly not some kind of homeostatic mechanism in our biology. It is a constructed equilibrium, which implies that societies can measure the long-term consequences of aggregated individual behaviours and react accordingly.

◆ How soon will the South catch up with the North?

It is worth thinking about that reaction time. Why does the purgatory of the "second demographic transition" last for a century in all regions in the UN exercise?

Could we not predict the South catching up with the North faster than this, given that imported models have already enabled developing countries to adopt, in the space of a few decades, fertility and health-related behaviour that developed countries took centuries to establish?

There are serious limitations to this logic. The pace of diffusion of innovations in the countries of the South is still uneven and contradictory. In sub-Saharan Africa, Internet cafés can be found five kilometres from villages with no electricity. The same disparity is observed in social behaviour: modern urban lifestyles coexist with polygamy, excision, under-education of girls, and lack of access to contraception, which are all more persistent than expected. We are still a long way from circular migratory flows that would benefit the countries of both arrival and departure. Much remains to be done to improve development assistance and make trade fairer. Against this backdrop, convergence with the North will be neither automatic nor linear. For the changes taking place on the shores of the Mediterranean to spread to Africa and Asia, obstacles of every kind – political, economic and cultural – must be removed. These uncertainties justify the UN demographers' decision to not project poor countries catching up with rich ones fast, but to assume the same pace of change, for want of a better alternative. While a return to demographic equilibrium should remain within our sights, in North and South, it cannot be achieved without the intense mobilization of governments, international organizations and NGOs.

◆ From demography-fiction to demography-action

There is also the objection that the demographic trend over the next few centuries will take a more tortuous path than the smooth curves of the UN projections. That is inevitable. But the aim is not to predict the actual course of events. A combination of scenarios or different scenarios in different regions, with various assumptions of international migration, are likely. It is also conceivable that conflicts or epidemiological, climatic, nuclear, nanotechnological or other disasters might take their toll on highly populated countries. Major discoveries may one day remove natural barriers (by delaying menopause, preventing sterility, blocking ageing), while social and legislative changes could lift prohibitions (e.g. on reproductive cloning, prenatal sex selection). On this principle, Jacques Vallin and Graziella Caselli have constructed a series of highly instructive crisis scenarios [10], which can be simulated on the interactive CD-ROM developed by Gilles Pison [11]. However, the entire projection is based on a disruptive

factor that is neither certain nor datable, which does not get us very far.

As stimulating as they may be, these exercises in demography-fiction offer more a reflection of fears or hopes than any real influence over the future. It is probably wiser to leave fiction aside and take action. Instead of handing the keys of the future to some not necessarily desirable technico-scientific innovation, we might like to think that the evolution of fertility and health-related behaviour depends first and foremost on our own actions. Societies must be better informed about the demographic situation of the world, be more organized and more proactive, show a concern to improve the welfare of women and children, and work towards equitable relations between the generations and between the nations – with ever more unity of action on a global level. In the end, it is our capacity to correct the deviation from equilibrium over the long term that the UN scenarios encourage us to develop.

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