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After the Demographic Explosion

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Demographic forecasting is not an exact science. UN projections, which suggest that the world population may rise to 11.2 billion in 2100, could be overestimates. Indeed, fertility could fall more rapidly and life expectancy may rise less than expected. The Sahel is set to experience the most spectacular demographic explosion, but this will not necessarily lead to massive migration to Europe.

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On January 11, 1960 the hard-hitting cover of *Time Magazine* carried the banner "That population explosion." The center of the cover image was filled with sad women in traditional costumes, holding naked or swaddled children. To one side, two young Western women – one brunette, the other blonde – smile happily, and the latter has two young children and a full shopping cart. The allegory could not be clearer: what was then called the Third World was collapsing under the number of children, which contributed to the misery of its population and also presented a danger for sensible people who were happy with few children, like the two Western women pushed to the edges.

At the time, the situation was indeed alarming. The global population – which had reached 2.5 billion ten years previously – had just reached 3 billion. Even more worryingly, the growth rate was increasing. In 1955, it was 1.75 percent per year. Five years later, it was in excess of 1.9 percent. It had doubled in 36 years. In 1968, Paul Ehrlich's best seller, *The Population Bomb*, described the dire consequences of this rampant population growth. But the growth rate continued to accelerate. In 1970, it reached 2.1 percent (a doubling time of 33 years) and the global population increased to

3.7 billion. Two years later, the famous Club of Rome report[1] appeared and the oil crisis burst onto the scene. But peak population growth had already been passed.

Since then, the growth rate has slowly declined and is now at 1.1 percent per year. Global population growth has started to slow down. In 2018, the number of humans on the planet rose to 7.6 billion. If growth since 1970 had continued at a rate of 2.1 percent per year, the global population would now stand at 10 billion. The current state of play is therefore not entirely discouraging. True, 3.9 billion humans have been added since 1970, but 2.4 billion have been "avoided."

The future global population

A special department of the United Nations, the Population Division, regularly produces projections of the global population. These are not, strictly speaking, forecasts, but they are generally taken as such, as no alternative exists. These projections are, moreover, adopted by all major international organizations including the World Bank, the International Monetary Fund (IMF), and the World Health Organization (WHO).

To carry out its work, the Population Division collaborates with each country, each of which sends in its national population projections. In France, for example, this is done by the Institut national de la statistique et des études économiques (INSEE, The French National Institute of Statistics and Economic Studies). The Population Division harmonizes the data – discussing modifications to the underlying assumptions with each country –, then combines the results to give a projection for the global population. The "cohort component" method that is used consists of predicting changes in fertility and mortality by age in each country separately (and also migration, but of course these changes have no effect on the global population). The projections are then calculated for each year in turn. For each year, the headcount for people of one age is transferred to the next age up. The number of deaths at this age that have taken place during the year is removed, and the net migration figure at this age is added. The first age group is made up of the year's births, minus infant mortalities. These births are calculated by combining the number of births for each maternal age group – the births at any given age being the number of women of this age multiplied by the fertility rate at this age.

1. This 1972 report, entitled *The Limits to Growth*, predicted that the earth would be unable to support economic and population growth beyond the year 2100 if they were to continue at the rates of the time. See: <www.clubofrome.org>.

I am highlighting the method used in order to show that it is based on weak assumptions. While it is true that everyone ages by a year each year, it is somewhat presumptuous to predict the number of deaths at a given age in a given country in 2050 or 2080. It is the same for forecasts of fertility, changes in which have for more than 100 years mostly been unforeseen (for example, the baby boom).

Due to these uncertainties about fertility and mortality, the Population Division produces several variants: a "high," "medium," and "low" projection. The latest medium-variant projection gives a figure of 9.7 billion people in 2050. The high variant gives 10.8 billion, and the low variant 8.75 billion. In the medium-variant projection, the growth rate will still be 0.5 percent, or a doubling of the global population in 140 years. Assuming this stabilizes by around 2100 (an assumption used by the United Nations), the global population will rise to 11.2 billion people.

However, there is a simple and empirical alternative to this projection. Instead of making detailed predictions about fertility and mortality by age in each country, you could realistically simply follow the changes in the growth rate of the global population and extend it. This leads to a growth rate of zero between 2060 and 2075, much earlier than in the United Nations' projections.

Between 1970 and 1980, the growth rate decreased rapidly then stabilized before dropping very rapidly between 1987 and 2000. It then dropped less quickly before continuing a rapid decrease in the last few years. If we extrapolate from 1960, a rate of zero will be reached in 2075 (extrapolation using linear regression). If we extrapolate from 1980, the zero rate will be reached in 2060. If the average drop seen between 1960 and 2015 continues, the rate will be zero in 2065. However, a zero rate indicates that growth will cease or that the global population will start to shrink. Given these uncertainties about the date when growth will stop, we must look at recent changes in fertility and mortality, which are the parameters used by the United Nations.

A global drop in fertility

Population change depends on two opposing forces: fertility, which boosts growth, and mortality, which restricts it. These two forces have changed considerably over the last half-century. Fertility – which rose in 1960 to a global average of 5 children per woman – had dropped to 3 by 1990 and now stands at 2.45. The decrease has been very rapid in most large countries. In 1950, Brazil, China, India, and South Africa – four of the five

BRICS countries – had a fertility rate of between 5.9 and 6.1 children per woman. By 2017, Brazil had dropped to 1.7, China to 1.65, India to 2.3, and South Africa to 2.4.

Overall, the fertility rate in Asia, the Middle East, and Japan is 2.15, which (taking mortality into account) is very slightly below the replacement rate necessary to maintain a constant population in the long term, without any subsequent increase in mortality in the under 50s. One might think that the drop in fertility in emerging countries is linked to their economic progress. After all, in 1974 at the World Population Conference in Bucharest, the Indian delegate declared that "development is the best contraceptive." But two other factors have played a major role in the reduction of fertility: secondary education for women, and relative improvements in women's autonomy – what the last World Population Conference (held in 1994 in Cairo) discreetly referred to as "maternal health." Thus Algeria has gone from 7.3 children per woman at the beginning of the 1950s to 2.4 today. And Iran went from 6.9 to 1.6 in just 20 years from 1985 to 2005, whereas France took two centuries to reach the same reduction.

Out of 201 countries (and a few territories like the French overseas collectivities or the Isle of Man), twenty-four have a fertility rate of less than 1.5 children per woman, seventy-one have between 1.5 and 2.1, thirty between 2.1 and 2.5, twenty-five between 2.5 and 3.5, and finally fifty countries still have a fertility rate greater than 3.5. Of them, forty-one are in Sub-Saharan Africa and five are small Pacific states. To give an indication of the decrease in fertility elsewhere, the country with the highest fertility rate in Latin America, the Caribbean, and Central America is French Guiana (3.6 children per woman), which is well ahead of the next two countries: Bolivia and Guatemala, which each have 2.9 children per woman. Although a good part of the over-fertility in French Guiana is due to an anomaly caused by women from neighboring Suriname (who travel from the other side of the river to give birth in Saint-Laurent-du-Maroni or the coastal towns), it nevertheless illustrates the extraordinary decrease in fertility in both South and North America. In North America, for example, Canada has gone from 3.7 children per woman in 1950 to 1.55 today.

Fifty countries still have a fertility rate greater than 3.5

It is therefore surprising that this drop in fertility rates is taking so long to have an effect on the global population. In principle, once the generation of mothers who were born during a period of high fertility has gone, the increase should become weak or non-existent. This is not

the case for two reasons. One is genuine (the drop in mortality, which will be examined in the next section) and the other is artificial – that is, it is due to the United Nations' assumptions about fertility. The United Nations wants to create a peaceful image of the world in 2100, because that is part of its mission. In its projections, the fertility of each country will converge in 2100 on values of between 1.7 and 2.35 children per woman, with three exceptions: Niger (2.5), for reasons we will look at shortly, Zambia (2.45), and Singapore (1.45), for mysterious reasons undoubtedly linked to negotiations between the United Nations and these two countries' statistical organizations about the assumptions behind their national projections.

This convergence only begs the question. There is no reason why some countries that still have high levels of fertility should not follow the same path as Iran well before 2100. The Population Division's desire for unity has another consequence that should be discussed. The very low fertility rate in some countries is expected to rise in the future. Thus, that of Portugal will rise from 1.25 to 1.75, as will that of Poland, or again that of South Korea (from 1.3 to 1.8). No explanation is given for this new baby boom, other than the assumption of convergence. Even France – which is expected to stabilize at 1.94 in 2100 – has already dropped below this bar and reached 1.87 two years ago. It is therefore reasonable to think that the United Nations has overestimated long-term population growth, and that the results obtained by directly projecting the trend toward a decrease in the global population growth rate are clearly more realistic, meaning that the end of global population growth is closer than the United Nations' figures suggest.

A decrease in mortality rates?

According to the theory of demographic transition, a country will go from a state of high fertility and mortality to one of low fertility and mortality. Mortality will decrease first, then fertility will follow a few decades later. During this time, the delay in the reduction of fertility rates will cause significant population growth, which will continue for a generation after the drop in fertility due to the large number of women of childbearing age. This is known as demographic inertia. In reality, in most countries of the world that had high mortality and fertility rates, both have dropped almost simultaneously. The extent of the decrease in the mortality rate is in line with life expectancy at birth. In 1950, the worldwide life expectancy for men was 45.5 years, and for women it was 48.5 years. By 2015, these figures had risen to 68.5 and 73 years, respectively.

This increase was also seen in emerging economies (from 44 years to 75 years in China, 36.5 years to 67.5 years in India, and from 51 years to 75 years in Brazil) and in the poorest countries of Sub-Saharan Africa (taken together, from 36 years to 58 years). Some countries did even better. For example, Iran went from 40 years to 75 (an increase in life expectancy of 35 years) and South Korea improved by 32 years. Others were left behind: particularly Russia, where life expectancy for men was 54 years in 1950 and is now just 64.5, or even the United States which has gone from 66 years to 76.5 over the same period.

We often neglect the fact that a decrease in mortality feeds population growth as people remain part of the population for longer. This contribution to population growth has not been calculated at a global level, but we can work it out for France. To do this, we simply need to determine what the French population would have been if mortality had stayed at, for example, the level it was in 1950. Due to migration, the calculation is a bit more complicated than if there had been no net migration, but it is still possible.[2] So, on January 1, 2016 the population of France reached 66.7 million. If there had been no drop in mortality rates since 1950, the figure would have been just 53.6 million. That gives 13.1 million extra people who can be attributed to the decrease in mortality. Since the population was 41 million in 1950, half of the increase since this date can be credited to the drop in mortality rates. The remaining 50 percent is divided between the gains due to the baby boom and particularly due to immigration.

A drop in the mortality rate drives population increase

It would not be realistic to make the same calculation for countries that had high fertility and mortality rates in 1950, because decreases in both these factors were linked. If mortality rates had remained high, fertility could not have fallen much, because if it had, the population would have decreased rapidly. On the other hand, when countries reach a life expectancy of about 60 years (infant and child mortality now being low) changes in the general mortality rate and the fertility rate become independent of each other. We have observed that in most countries this is now the case. So a drop in the mortality rate (if it happens) will have the same effect as in France, and will therefore drive an increase in population.

2. As France publishes its population pyramid and (q-type) mortality rate by age each year, the annual net migration for each age can be determined by comparing the population figure for any given age with that of one year younger in the previous year. If we fix mortality at each age at its 1950 level, it is thus possible to make a "reverse projection" from 1950 to 2015 (based on the assumption that life expectancy has remained the same), since we know the fertility and migration rates for each age.

Therefore, if the drop in the mortality rate continues, the global population will continue to rise despite low fertility rates. Moreover, if we succeed in attaining immortality (as the transhumanists envisage) even with a very low birthrate, the population will continue to increase. However, the United Nations has assumed that decreases in mortality will continue in all countries. Worldwide, in 2100, life expectancy will reach 82.5 years, compared with 71 years in 2015. In Sub-Saharan Africa, it will rise from 58 years to 78, which is a considerable jump. In the United States, people will, on average, live for 90 years rather than the present 79 years. And there lies the rub. For the past four years, life expectancy in the United States has been falling slightly, lagging three years behind Western Europe, where it continues to increase, but slowly. Debate over changes in mortality rates has run and run in the United States. Many doctors and biologists, in the wake of the gerontologist S. Jay Olshansky of the University of Chicago, think that mortality rates will not decline. However, demographers side with Samuel Preston of the University of Pennsylvania is thinking that the crisis is temporary. In their view, there is no reason for the United States not to reach the level of Japan, which is the world champion in the life-expectancy stakes, which currently stands at 83 years.

Areas of growth

Up to this point, our discussion has treated the global population as if it were a homogeneous reality. But in Alfred North Whitehead's terms, it is more a pseudo-real category or quantity. No one has ever seen it, and no one can change it. It is a conceptual construct, bringing together very diverse populations. Therefore, instead of thinking about population growth on a global level, we must look at growth in certain groups of countries where it is possible to take action, country by country. From this point of view, one group of countries is clearly different from the others. In terms of fertility rates and population growth, there are only two problematic parts of the world remaining: tropical Africa and, to a lesser extent, part of western Asia (Pakistan, Afghanistan, and Iraq). Currently, West, East, and Central Africa – that is all the countries between the tropics of Cancer and Capricorn – account for a quarter of all global population growth. In 2050, according to the United Nations' medium-variant projection, these same countries will be the source of four fifths of global population growth, or 40 million out of an additional 50 million people in the world.

But this vast area is not homogeneous either (neither in terms of resources or in terms of population density in relation to arable land). The Sahelian strip, from Senegal to Somalia, already has little arable

land for the size of its population, and suffers from low and irregular rainfall. The countries bordering the Gulf of Guinea are significantly better off, but are already fairly densely populated. As for the countries either side of the Equator (with the exception of Rwanda, Burundi, and Uganda, on the Great Lakes), they have great agricultural potential and low or very low population densities. It is therefore in the Sahel region that the problems are concentrated, and to a lesser extent on the Gulf of Guinea.

The following table shows the demographic changes expected in some countries of the Sahel region from 2017 to 2050 in millions of inhabitants, along with the expected annual population growth between 2049 and 2050.

Population of selected Sahel countries and of Nigeria (in millions)

Country	Population 2017	Population 2050	Growth 2049–2050
Senegal	16	34	0.6
Mali	18.5	44	1
Burkina Faso	20	43	1
Niger	21.5	68.5	2
Chad	15	33.5	0.6
Nigeria	190	410	8

Countries in the Sahel region, which currently have 90 million inhabitants, should have 223 million in 2050. Given their low agricultural potential, it seems unlikely that they will be able to feed their populations. And given that they are currently among the poorest countries in the world, it seems unlikely that they will be able to develop sufficiently to export goods or raw materials in exchange for food. There are therefore two solutions: either a rapid drop in fertility rates, or large-scale emigration. Niger has the highest fertility rate in the world (7.2 children per woman), and the other four Sahel countries are not far behind. This is largely explained by a lack of education for girls and pressure from patriarchal families. As these populations currently only represent 1.2 percent of the global population, help from the rest of the world (or at least from a sufficient number of large countries) to develop women's education and autonomy could soften this somewhat gloomy demographic future.

The case of Nigeria seems to be similar, but this country has more opportunities (both agricultural and economic) like other countries

around the Gulf of Guinea. Further south, the countries of Central Africa may also still have high population growth in 2050, but their economic and agricultural potential is extensive and they are sparsely populated. In Gabon, the Central African Republic, and the Republic of the Congo, population density is less than fifteen inhabitants per square kilometer. The Democratic Republic of the Congo (DRC) is a bit more densely populated with sixty inhabitants per square kilometer, but its population could easily double or triple given its huge potential. This is an observation rather than a recommendation, unlike with the problems posed by the Sahel.

Future migration

If fertility rates in the Sahel region do not decrease quickly enough, migration remains an option. In a recent book entitled *La Ruée vers l'Europe*[3] (*The Scramble for Europe*), Stephen Smith extrapolates from the doubling of Africa's population between now and 2050 and predicts extensive migration towards Europe, as if populations moved in a similar fashion to fluids or air masses circulating from high pressure to low pressure. But we have just seen that Africa is far from being homogeneous, and by separating groups of countries as we have just done, it now seems that our biggest problem does not stem from the 1.1 billion Africans alive today, but from the 90 million people in the Sahel region. If their fertility rate cannot be controlled, will they scramble towards Europe, as Stephen Smith puts it?

Demographically, nothing is more difficult than predicting the next migration flows. However, we know that these often take the same route as previous migrations. If the excess population in the Sahel region is looking for an outlet, it will undoubtedly follow the route taken for centuries in the direction of the Gulf of Guinea. In the countries bordering the Gulf, there are large resident communities that have come from the north who can make their compatriots welcome. Already today, migrations within Africa are ten times bigger than those to other continents. Conversely, traveling in the other direction via the Sahara is difficult. Historically, the populations of North Africa have carried out slave raids on the south. More recently, Algeria unceremoniously expelled Malian and Nigerian workers. The Maghreb is on the front line and Europe lies right behind it, separated by the Mediterranean. Before reaching Europe, there would be major obstacles.

3. S. Smith, *La Ruée vers l'Europe*, Paris: Grasset, 2018.

However, the arrival of numerous migrants from the Sahel risks destabilizing the countries surrounding the Gulf of Guinea. (The civil war in Côte d'Ivoire gives a foretaste of this, with the nationalist reaction of local populations creating the concept of "ivoirité" ["Ivorianness"]). Their current rapid economic development risks being halted and there could be a chain reaction that in the long run could have repercussions in Europe and the rest of the world. However, we must bear in mind that due to a lack of resources, connections, and even a lack of images of what their life might look like in a far-off country, the poorest tend to migrate to somewhere close to home. A reminder of this is the tragic migration of the Rohingya. They survive crammed into an area of Bangladesh close to the border with their country, Myanmar, and only a relatively small number have attempted to reach other countries. Likewise, the refugees of Darfur, Somalia, and the southeast of the DRC have not ventured far from the border of their own countries. The same can be said of Syrian refugees, eight million of whom have remained within Syria, three million in Turkey, one million in Lebanon, 500,000 in Jordan, and perhaps as many in Iraq. Fewer than a million, or about 8 percent of them, have sought refuge in Europe. The same situation predominates for refugees from Afghanistan, of whom only a very small proportion arrives in Europe.

Climate migrants

The political consequences of the recent arrival of refugees in Europe follow the same trajectory as outlined above. It is not the number of refugees that threatens the European Union, but the reactions to their arrival that destabilizes existing political systems. Another threat, climate migration, is subject to the same analysis. Astronomical estimates of the number of climate migrants have circulated for the past twenty years. They are the work of biologists and climate scientists who have used physical models without paying any attention to the way societies work.[4] Therefore, most estimates are based on the number of people currently living less than a meter above sea level. However, people who are forced to move due to rising sea levels or violent climatic events are usually poor farmers or fishermen. They are comparable to the Rohingya or the Sudanese, Congolese, and Somalians in African refugee camps, in that they would not risk long-distance migration but would take refuge closer to home. Numerous studies undertaken in Bangladesh and the Mekong Delta support this.

4. One of the first people to cite figures was the environmental scientist Norman Myers. Writing in *BioScience* in 1993, he quoted 150 million climate refugees in 2100.

In Vietnam, the government has put in place relocation programs on the hills bordering the Mekong river valley and its banks. In Bangladesh, it has been observed that poor farmers forced off their land have taken refuge in the closest towns, feeding a rural exodus that is already very substantial. During the droughts of the 1980s, the inhabitants of the Sahel also moved to nearby cities, and went neither to the Maghreb in the north nor to Europe. Therefore, worsening climatic conditions result in internal rather than international migration. Again – as in the case of potential migration from the Sahel towards the Gulf of Guinea – there is a risk of serious political unrest, but it will at first be limited to the countries that suffer directly from climate change. Eventually, due to a chain reaction, it will spread to neighboring countries, but large-scale international migration will not follow.

Internal migration in response to worsening climatic conditions

The political consequences of climate change have not been widely studied as a whole. More generally, the links between population and politics go beyond questions of migration. There is a particularly complex relationship between political crises and a continued high level of fertility.

Fertility and political crisis

The five Asian countries with the highest levels of fertility are all sites of serious unrest – even civil war –, as can be seen in the following table.

Highest fertility rates in Asia 2010–2015 (in descending order)

Asian country	Fertility
Afghanistan	4.4
Iraq	4.3
Palestine	3.9
Yemen	3.8
Pakistan	3.4

On the other hand, the five countries with the lowest fertility rates are peaceful: Taiwan, Singapore, South Korea, Hong Kong, and Japan all have rates below 1.45 children per woman.

The same link between political violence and high fertility rates can be seen in Africa, where the six countries with the highest fertility rates are, in descending order:

Highest fertility rates in Africa in 2010–15 (in descending order)

Country	Fertility Rate
Niger	7.2
Somalia	6.1
DRC	6.0
Mali	5.9
Chad	5.8
Burundi	5.6

Again, to varying degrees, these are countries that are plagued by political instability (Burundi), civil war (Somalia), insurrectionist uprisings (Boko Haram in Niger and Chad, and jihadi groups in Mali), or serious internal unrest (DRC). While it cannot be said that there is a direct causal link between demographics and politics, there are numerous facts that would explain this correlation. First, in the case of unrest, education is disrupted. Boko Haram, the jihadis and the Taliban, for example, destroy girls' schools or even kidnap the girls themselves. Family planning and the availability of modern contraception are affected by insecurity, and we must not forget the increase in the number of rapes by armed gangs.

Another possible cause also exists. Rapid population growth is not followed by an increase in facilities. Schools are overcrowded, disrupting education, and roads are congested. But the principal cause is more social, or even anthropological. When the number of children is high, so is the number of heirs. In societies with preferential inheritance systems, those who receive nothing can be easily recruited by those who want to cause trouble. In the first generation, when the drop in infant mortality increased the number of children likely to inherit, inheritance systems were able to absorb the increase, but the countries mentioned above are now having a second generation of very large families.

Stephen Smith has looked at this area, but once again has emphasized a global vision of imbalance. He maintains that since young people are more numerous than the old, they have dispossessed them of their authority and power. As young people have a reputation for being more aggressive and violent, this will result in political unrest. Here again, he has jumped to a conclusion too quickly and with too much of a biological slant, as if youth were synonymous with violence. It seems fairer to look at the interactions

within families, where it is not parents who are stripped of their power, but large numbers of young people who are financially and materially dispossessed. It is basically the same story as the Cadets de Gascogne in France. As preferential inheritance – most often in favor of the eldest son – was practiced in Gascony, the other sons would join the army or populate the first transatlantic colonies. Today, young people from countries with high fertility rates pursue education in the hope that their skills will help them to find employment. But the employment market cannot absorb them, to the extent that they turn towards movements that want to change the system. The names of such movements are symptomatic of this, with "Taliban" meaning "students", and "Boko Haram" considered to mean "Western education is a sin."

However it comes about, the relationship between high fertility rates and political unrest is a major threat for the future if disorder spreads to countries that we have not already considered. This could lead the future growth of the global population – undoubtedly overestimated by the United Nations, as we have shown – to accelerate instead of slowing down.

Keywords
Demography
Global population
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