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# Counting the population. The multiplier method in the seventeenth and eighteenth centuries

*Jean-Marc Rohrbasser**

Most countries count their populations by census.INSEE conducted the second round of the new French census in January 2005. But this was not always the case. In the seventeenth and eighteenth centuries, an indirect enumeration technique, called the "multiplier", was preferred. Jean-Marc Rohrbasser explains how the method works and cites examples of its use, from France to China.

The first French census was conducted in 1801. The idea of counting the population from house to house, recording the list of members of each family, had been around for a long time. However, the authorities feared adverse reactions from the population, who were wary of censuses conducted for tax or military purposes. Consequently, the idea emerged in the eighteenth century of conducting partial, localized censuses and then extrapolating the total population of the kingdom by using the "multiplier" method. For a monarch of the Ancien Régime, the stakes were high: showing that the population had increased was proof of good government [1].

## How the multiplier works

The multiplier method is based on the idea that there are quantities which form a simple and relatively constant ratio with the total population: for example, the number of houses, families, or men of age to bear arms, or the number of births, deaths and marriages in a year.

To obtain the population from an indicator such as these, we simply need to know the ratio between them and multiply accordingly. For example, if we know that there are five people per house on average, and 600 houses have been counted on a given territory, the estimated population of that territory is 600 multiplied by 5, i.e. 3,000. In the seventeenth and eighteenth centuries, it was established that a territory of 25 people recorded an average of 1 birth per year. Therefore, the annual number of births reported in a given territory was simply multiplied by 25 to obtain the total population. For example, the estimated population of a town where 100 births were recorded in a year was 100 x 25 = 2,500.

In the seventeenth and eighteenth centuries, multipliers were preferred to censuses not only because of the wariness of the population, but also because of technical problems. Censuses were considered not only expensive in time, money and manpower, but also inaccurate. Jean-Baptiste Moheau, one of the first authors to study the French population, stressed the changing nature of any population: "a head count of the inhabitants of a kingdom would not tell us its exact number, unless it were conducted at the same time in all places. Once the count is done, it is no longer true, and the appearance or disappearance of a few individuals changes the state of affairs" [2]. Moheau also

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feared that too many people processing the data would further increase errors.

## Choosing the right multiplier

The arithmeticians of the seventeenth and eighteenth centuries debated at length about which indicator was the best multiplier. Moheau considered the annual number of births to be the "easiest and most accurate" indicator for assessing the total population. In his opinion, births are the "product of the population and since, within a certain period, they renew its mass, they have a necessary relationship with it, and as such can be used to measure it". Moheau considered deaths - advocated as a multiplier by other scientists of the time - to be less reliable, since "human mortality is not as regulated as fertility".

In any case, annual fluctuations in births and deaths required a count over several years to obtain an average. How many years needed be taken into account? Moheau considered ten years to be an appropriate period since "in that period, we find the same variations that a longer space of time would provide".

But how is the value of the multiplier set? The multiplier is determined in a given community or group of communities (towns, parishes, etc.) where two values are known: the actual number of the population, established by a local census, and the number of houses or births, counted at the same time or known from another source. The ratio between these two quantities is then calculated to obtain the multiplier for the communities being assessed. Moheau was aware that the communities had to be representative, by being "chosen at random in different lands, or so that their situations combine and compensate each other". Moheau proposed the multiplier of 25, i.e. 25 inhabitants for one birth, as "a general rule for assessing the population".

Moheau's work settled an acrimonious debate in the eighteenth century. While the physiocrats, highly critical of the government, were convinced that France was constantly losing population and had barely 16 million people, Moheau's computations revised this figure strongly upwards and showed that, on the contrary, the population of France had increased. According to Moheau, between 1715 and 1774, the year in which he was writing, the population grew from 18 to 20 million, an increase of one-ninth [2].

Moheau's figure for 1715 was fairly close to that of Vauban, who had estimated the population of the kingdom at just over 19 million in 1707 [3]. Vauban also used the multiplier technique. Using the country's total cultivated area and the quantity of grain that could be produced per unit of area, he calculated the total production of grain and, based on per capita grain consumption, the total population.

*Table - Population of England and Wales circa 1695 (Gregory King's estimate)*

| | Number of inhabited houses | Number of people per house | Population |
|---|---|---|---|
| London | 105,000 | 4.57 | 479,850 |
| Other towns, boroughs, villages and hamlets | 1,195,000 | 4 | 4,780,000 |
| Total England and Wales | 1,300,000 | - | 5,259,850 |

*Source: Glass 1965 [4].*

Two-and-a-half centuries after Vauban and Moheau, these estimates were confirmed by the extensive historical demography survey undertaken by Louis Henry at INED in the late 1950s. Based on registers from a broad sample of parishes, Louis Henry estimated the population of France at approximately 21.5 million in 1700 and 28.5 million on the eve of the French Revolution [4]. That is only slightly higher than Moheau's estimates.

## The population of England and Wales in 1695

Across the Channel, an Englishman, Gregory King, attempted to estimate the population of England and Wales on the basis of the number of houses or hearths recorded in the tax statistics of 1695. He treated the capital separately from the rest of the country. The number of houses was multiplied by 4.57 (number of people per house) in London, and by 4 in the rest of the country (table) [5]. Not particularly forthcoming as to the origin of these multipliers, King writes only that they were "in accordance with our observations of the assessments of marriages, births and burials in several places in the kingdom," which is vague to say the least. His computations gave a total population for London and the rest of the country of 5.3 million (table). But King considered this result fairly uncertain: "the real number of the population of England is not only uncertain, but also very difficult to calculate, because of great negligence and omissions in all public registers and assessments." To correct what he considered to be an underestimate, King added 10% to the population of London and just over 1% to the population of the rest of the country, and proposed a final figure of 5.4 million [5]. Three centuries later, Wrigley and Schofield estimated the population of England at the time to be 4.9 million, a difference of only 10%! [6].

Therefore, as the arithmeticians of the time already knew, France was four times more populous than

England at the beginning of the eighteenth century: the two countries had respective populations of around 20 million and 5 million. Both now have 60 million.

## An eighteenth-century debate: the population of China

The population of China was a subject of debate among arithmeticians in the eighteenth century. The main indicator they used was the number of men of age to bear arms. According to *Confucius Sinarum Philosophus, sive Scientia Sinensis*, a book by French Jesuit Philippe Couplet published in 1687, they numbered approximately 59 million. To obtain the total population from the number of men able to bear arms, the most commonly used multiplier at the time was the one proposed by astronomer Edmund Halley in 1693. The census conducted in the town of Breslau between 1687 and 1691 had given a figure of 9,000 men aged between 18 and 56 out of a total population of 34,000 [7]. By applying this ratio of 9:34 (i.e. 3.78 people for each man of age to bear arms) to the 59 million Chinese of age to bear arms according to Couplet's count, the arithmeticians arrived at a total population of 223 million for China at the end of the seventeenth century.

In 1741, a Prussian pastor, Johann Peter Süssmilch, applied population density, in addition to Halley's multiplier, to China. The idea is a simple ratio between the area of a territory and its population. Süssmilch used Vauban's calculations, according to which France could feed 25 million people in 1707 [3]. Since China's area was six times that of France, its population should also be six times larger. But Süssmilch estimated that in China, the same area could feed a population one-fifth larger. A sixth of the Chinese territory could thus feed 30 million people, not 25 million people, so the total population of China would be 30 million multiplied by 6, i.e. 180 million. Süssmilch concluded that this figure "would tally precisely with the mandarins' numbers, namely that 200 million is not impossible for China" [8].

By using administrative censuses of China from the Ming (1) and Qing dynasties, the historian Ho Ping-ti recently estimated the population of China at 62.5 million in 1542 and 143.5 million in 1741 [9]. By interpolation between those two dates, the Chinese population would have been around 105 million at the end of the seventeenth century. The estimates by the arithmeticians of the eighteenth century were therefore often excessive.

The multiplier method is still used today by archaeologists to estimate the population of a territory in prehistoric times. They count the number of fires, camps or dwellings on the basis of archaeological remains, and estimate the population by applying a multiplier representing the average number of people per dwelling, based on observations of contemporary or historical populations with a similar way of life.

* * *

Apart from the highly specific case of archaeology, multipliers are no longer used because other more reliable methods of estimating the population exist, such as censuses and population registers (see box). However, the same principle of proportionality as in multipliers underpins the measures used today to describe and compare populations. Birth, death and other rates are the reverse of multipliers. The 25 multiplier, i.e. 25 people for 1 birth, is simply the reverse of an annual birth rate of 40 births per 1,000 head of population (or 0.04% or 1/25). In France the birth rate is currently just under 13 per 1,000, which represents a birth multiplier of 77 (13/1,000 = 1/77). Applying this multiplier to the annual number of births - approximately 760,000 - gives a population of 60 million. But instead of seeking to extrapolate the population from a number of births, which requires a known multiplier or birth rate, we now seek to estimate the birth rate by comparing the number of births to the population. The multiplier is no longer an intermediate assessment tool; it has become the target of assessment.

### From the multiplier to the updated census

In France, no general census of the population was conducted prior to the Revolution, because in the seventeenth and eighteenth centuries, the multiplier method was preferred. At the beginning of the Revolution, the new government decided to hold regular censuses. The first censuses, conducted in the 1790s, were failures and did not lead to the publication of national results. The first genuine census was not produced until 1801, under the Consulate. A total of 33 others have been conducted since, every five years until the Second World War, then at varying frequency, at intervals ranging from six to nine years. The last census, the 34th, introduced a completely new method of rotation over a five-year cycle: the first round was conducted in January 2004 and the second in January 2005 [10].

Censuses, now used in most countries of the world, are not the only way to count the population. In some countries, every municipality keeps a population register that it updates continuously by adding newborns and arrivals, and removing the deceased and departures. This system is conditioned on the assumption that everyone settling in or leaving a municipality declares their change of address. This system is used in the majority of the 25 European Union countries, except for six: France, Greece, Ireland, Malta, Portugal and the UK. In northern Europe, from Belgium to Finland, population registers are kept in a centralized computer system and linked to other national data. The total population at any given time can be checked simply by searching the central register. For this reason, some countries, like Denmark, no longer conduct censuses.

(1) The Ming dynasty ruled China from 1348 to 1664.

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## Clarification

### The future population of France's overseas territories according to the UN: a calculation error?

*François Héran*

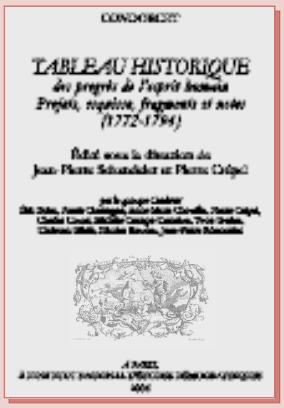
The last issue of *Population and Societies* (408, January 2005), on the United Nations' population projections for the next three centuries, described the case of France in these terms: "according to the UN's calculations, on the basis of an initial fertility rate of approximately 1.9 children per woman in metropolitan France and 2.2 in the French overseas territories, 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 territories!" Readers have questioned that estimate, on the grounds that a fertility rate of 2.2 cannot generate such high population growth, even after 300 years.

There is no calculation error, however. The UN's population projections were performed separately for each overseas department and territory. It is Guiana that makes the numbers soar. If the fertility rate of 3.83 children per woman (85% higher than the replacement rate) were extended over some 12 generations separated by 26 years, Guiana would have an annual growth rate of 2.4%, enough to increase its population from 164,000 now to 200 million in three centuries' time…

The UN's numbers fit for the other overseas territories. On the assumption of unchanged fertility rates until 2300, 90% of the population of France would live in the overseas territories, and Guianese would make up 90% of the overseas population. In short, a small minority will eventually become a majority if its growth rate remains higher.

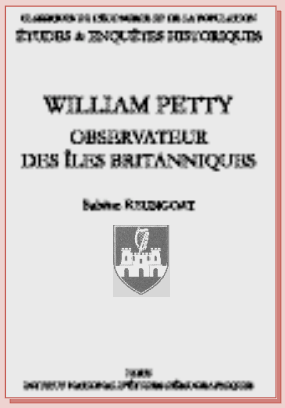
Mathematically correct, this calculation produces a result that is sociologically absurd, as we duly pointed out - with the result that the UN decided not to include the assumption of constant fertility in its final publication. The aim was therefore not scaremongering, but, on the contrary, to show that current fertility differentials, in France and elsewhere in the world, are set to narrow.

## *INED republishes two books on population by seventeenth- and eighteenth-century scholars (www.ined.fr)*




Condorcet (1743-1794) worked for more than 20 years on his *Tableau historique des progrès de l'esprit humain* (historical picture of the progress of the human mind), a subtle reflection on the factors likely and unlikely to improve the human condition and possible scenarios for the future. This book contains the original drafts of 1770 and 1780, the fragments written in 1793 and 1794 and a critical edition of the *Esquisse d'un tableau historique* (outline of a historical picture), intended as a prospectus for the Tableau. Several years after the *Esquisse* was published, Malthus wrote his *Essay on Population*… in opposition to Condorcet's theories

• *INED, 2004, 1,317 p., distrib. Puf, € 58* •




William Petty (1623-1687) proposed the first realistic estimates of the population of the British Isles on the basis of a thorough analysis of existing statistics. He analysed the mechanisms of population growth and attempted to formulate the mathematical laws governing mortality and fertility. This book follows the reasoning of this exceptional man and proposes a critical analysis of his work on population, in particular his methods of collecting and processing sources. It sheds light on the beginnings of English political arithmetic at the end of the seventeenth century.

• *INED, 2004, 342 p., distrib. Puf, € 22* •

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