DEMOGRAPHY, A FULLY FORMED SCIENCE OR A SCIENCE IN THE MAKING? AN OUTLINE PROGRAMME

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I.N.E.D | *Population (english edition)*

2007/1 - Vol. 62
pages 39 à 45

ISSN 1634-2941

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Demography, a Fully Formed Science or a Science in the Making? An Outline Programme

In this article, we examine D. Tabutin's view that "demography has certainly become a science in the true sense of the word, with its body of research objects, methods and paradigms." We also attempt to understand why he nevertheless goes on to state that "demography [is] marking time, and still just as hesitant when it comes to understanding and explaining." We then go on to (1.) explore the subject matter of demography, (2.) sketch out a more precise programme for the discipline, (3.) examine its paradigms and (4.) stress the value of a more axiomatic approach, which would reinforce its scientific pertinence and hence its reliability.

1. The object of demography

Is the concern of demography "the behaviour of human populations, from individual to society level", as Tabutin's article states? If demography went down this road, it would end up embracing everything. There is a need, we feel, to resist the temptation to spread ourselves too thinly; we must strive, on the contrary, to focus our research on the specific object of demography.

This was defined long ago as the trio *fertility, mortality and migration*. Yet by defining its specific object in this way the aim was not to restrict demography to the study of *births, deaths and migratory movements*, but rather to circumscribe *the perspective* adopted by demographers to study the transformations in a population. These transformations are many and varied, but they are partly the result of *growth* in that population, its *decline*, or *stabilization*. The specific perspective of demography is that population growth, decline and stabilization may ultimately be explained by a particular combination of fertility, mortality and migration.

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Translated by Julia Key.

This sort of explanation is not causal. It can be compared with Galileo's explanation of the acceleration of bodies in free fall: such acceleration may be explained, he maintained, by a particular combination of the distance covered and the time elapsed. Yet neither time nor space is the cause of the acceleration of a free-falling body. Nevertheless, it is the combination of these two which gives us the universal *form* of all natural acceleration. Space and time are the *parameters*(1) by which such acceleration may be explained.

The same holds true for the specific object of demography. Fertility, mortality and migration are the set of *parameters* by which we seek to understand the basic form of growth, decline or stabilization of any given population.

As for the empirical *factors* (or causes) influencing population growth, decline or stabilization, they are surely countless and extremely varied, at both individual and social levels (Courgeau, 2003). But rather than exploring them all, as Tabutin's article recommends, demographers ought to consider only those which are thought to have an impact on the combination of fertility, mortality and migration in this population; it is therefore the particular *perspective* of demography, its specific object, that directs the empirical investigations, laying down a clear pathway through the jungle of facts.

2. An outline programme

Having established the specific object of demography, or its particular *perspective* on population change, we can clearly see the two main tasks facing the discipline. The first – as we have just mentioned – is to determine the factors influencing the combination of fertility, mortality and migration in a given population at a certain point in time, in the hope of controlling its growth, decline or stabilization. The second, yet more ambitious, is to ascertain the general *structure* of the combination of *fertility, mortality and migration*, in other words the *principle* of all demographic growth and decline (just as the *law* of Galileo gives us the principle of all natural acceleration). As far back as 1760, Euler sought to establish the bases of such a principle, which were then generalized by Lotka in 1939, and subsequently by Preston and Coale in 1982. These developments show us the way forward. They enable us to establish what Bourgeois-Pichat (1994) termed the "fundamental equation of population dynamics", although this is only valid under the hypotheses of the cross-sectional paradigm, which we will examine below.

These two tasks outline an agenda for demography which holds nothing new but which dictates that demographic research be centred on the further development, both empirical and theoretical, of its specific object. In contrast, if this specific object is lost to sight, and replaced with the "behaviour of human populations, from individual to society level", as Tabutin proposes, one could be led to believe that, in order to explain a demographic phenomenon, all

(1) The term is taken from F. Suppe (1989).

observable population phenomena must necessarily be analysed. Furthermore, this approach overlooks the theoretical mission of demography, an integral part of its scientific status.

Reinstating the specific object of demography thus presents a twofold challenge – that of guarding against the fragmentation of demographic research while also protecting its scientific status. Tabutin maintains that "demography has certainly become a science in the true sense of the word, with its body of research objects, methods and paradigms." We believe rather that demography is a science in the making. In the sections that follow we will examine what more must be done to complete the process. We thus hope to fulfil the request from the editorial committee of *Population* for a viewpoint on the future of demography.

Two points merit particular attention. The first concerns the ways in which the phenomena observed within a population are related to the set of key *parameters* (*fertility, mortality* and *migration*) used in demography to explain population growth, decline or stabilization. There are several different ways of relating these phenomena to the specific object of demography, and each of them follows a *paradigm*. For demography to become a fully formed science, it is important to identify these paradigms correctly, to use them well, to improve them and to exploit their potential fully.

3. The paradigms

The specific object of a science – its "scientific object" in the sense of G.G. Granger (1994) – does not initially have an explicit, general definition. Sciences such as physics and biology, for example, evolve as a series of successive explanations of their object, as illustrated by the transition from Newtonian physics to Einstein's general theory of relativity. In the same way, the object of demography is made clear through successive paradigms, which describe the various types of relationship between the phenomena observed and the scientific object.

Once again, Tabutin clearly states that there are paradigms in demography, but he does not further specify what he understands by this term, which has many different meanings, and he certainly does not link them to the object of the discipline. This is what we will attempt to do here.

Firstly, the notion of paradigm that we use here differs slightly from those proposed by Kuhn (1970), and in fact answers the following question: how can we move from *events experienced* to *scientific object,* as we understand it here? The process of elaborating answers to this question is what generates the various paradigms that have appeared throughout the history of demography; the following detailed analysis of the relationships between scientific object and phenomena observed will show clearly the vital role they play.

It is simply not possible to expand upon the various paradigms in a short commentary such as this (Courgeau, 2003, 2004, 2007), but we will point out more precisely how they differ and what features they share.

According to the cross-sectional paradigm, social phenomena are independent of individuals and can be explained by various economic, political, religious and social characteristics, among others, of the society in which these individuals live. From this one can derive, firstly, a fundamental equation of population dynamics, linking variation over time of cross-sectional measurements of fertility, mortality and migration – which are mutually independent – and, secondly, an aggregate regression method to link these phenomena to various characteristics of the population.

With the longitudinal paradigm, the aim is to study the occurrence of one single event, during the lifetime of a generation or cohort, in a population that retains the same characteristics for as long as the phenomenon persists. As with the cross-sectional paradigm, the population must therefore be considered homogeneous, and the phenomena mutually independent. This time, however, the only comparisons are between homogeneous groups followed throughout their life course. We have a new type of fundamental equation: macro-simulation methods can be used to simulate the evolution of such a population, and longitudinal analysis methods to study their trajectory over time.

The event history paradigm holds that, over the life course, individuals follow a complex trajectory which depends at any given time on their previous life course and on any information they may have acquired in the past. The population then becomes heterogeneous, and demographic phenomena become interdependent. In view of this interdependence, a fundamental equation of any sort is no longer possible, although micro-simulation methods serve as both theoretical and empirical models applicable to demography, and event history analysis methods link demographic phenomena to one another, as well as to various characteristics of the population.

Finally, the multilevel paradigm goes beyond the opposition between the holism of the cross-sectional or longitudinal approach and the methodological individualism of the event history approach, for it holds that human behaviour can only really be understood by bringing different levels of aggregation into play. Each of the previous paradigms offered only a narrow focus on its own objects, and each of them has been proven perfectly consistent with regard to these objects, as a number of demographic analyses have demonstrated over time. Yet equally, the reason why it is difficult to move from one paradigm to another is that such objects differ, at least in part. In particular, these objects are linked in different ways to the phenomena observed, and the assumed relationships between them are highly dependent upon the paradigm used: objects considered in absolute time (civil calendar) versus objects considered in relative time (individual calendar); population homogeneity under the cross-sectional and longitudinal paradigms, versus heterogeneity under the event history paradigm; independent phenomena under the longitudinal paradigm yet a high degree of dependence under the event history paradigm; non-existence of levels versus existence of levels under the multilevel paradigm, etc. This explains the inconsistencies sometimes observed, depending on the type of

analysis performed, but at the same time reveals that certain findings may in fact be complementary – a multilevel analysis may complement a cross-sectional, longitudinal or event history analysis.

A multilevel approach would therefore seem to offer a useful synthesis of the previous paradigms, in that it replicates some of their results and provides an explanation of them – certain effects are linked to society, while others are more related to the individual. In the light of this, the truth of the following statement becomes self-evident:

> "The human fact can indeed be scientifically understood only through multiple angles of vision, but on condition that we discover the controllable operation which uses these angles to recreate it stereoscopically." (Granger, 1994)

Yet we believe it is still too early to affirm that demography has already explored all possible angles of vision; the links between types of behaviour observed at different levels of aggregation have not yet been properly investigated. For example, individuals acting in isolation might alert a whole community to a problem affecting all of its members, which may in turn result in political measures at a higher level, and so forth.

4. An axiomatic approach

Our second key point concerns the need for an axiomatic approach to demography to strengthen its scientific validity. An *axiom* is nothing other than a principle; it sets out the general conditions without which the phenomena one is seeking to explain would not be what they are, or would not take place in the way that they do. The Galilean *law* governing the acceleration of bodies, as mentioned above, is one example of an axiom, as are the well-known axioms of Euclid. One might say that the three parameters of *fertility, mortality* and *migration*, i.e. the scientific object of demography, are in themselves a first step towards what we might call the "axiomization" of demography, for it is indeed this trio that provides us with the conceptual framework by which we may hope to grasp the principle of all population growth, decline or stabilization. The basic *form* of quantitative transformations in any given population lies in a particular combination of fertility, mortality and migration; without this form, none of the quantitative transformations observed would be possible. We still do not know, however, what this combination is.

A scientific discipline generally includes several complementary axioms or principles to explain more fully the phenomena studied. The axiomization of demography is not confined to the search for the *fundamental* equation of all population growth, decline and stabilization. More specific axioms should also be on the agenda, and clarifying the *paradigms* that we mentioned above will help us to discover them.

What differentiates a theory from an axiom? The word *theory*, as we know, suffers badly from "multiple meaning syndrome" – it is now habitual to consider any freely conceived explanatory hypothesis as a "theory" if it can subsequently be tested by means of observation and statistical calculation (*confirmatory*

analysis). An axiom, on the other hand, is necessarily the *result* of observation[2], since it defines the general conditions *implied* by the phenomena one is seeking to explain; *the conditions without which these phenomena would not be what they are, or would not take place as they do.* Only the phenomena can tell us what they imply[3], they are the necessary route to axioms. Galileo's *law* is one such example.

In the light of this, it is easy to see how a more axiomatic approach can also reinforce the scientific pertinence of demography, and hence its reliability. Such a shift involves refocusing empirical research on what is *implied* by phenomena, a more demanding empirical task than simply *confirming* or refuting – with the attendant uncertainties – successive explanatory models. Yet at the same time, it *inserts* theoretical research in empirical investigation, and rescues theory from the confusion of ideas in which it is all too often confined[4].

(2) Although not what is usually said of axioms, this was firmly asserted by the fathers of modern science (Francis Bacon, Galileo, René Descartes, Isaac Newton, etc.). For more on this, see R. Franck (2007).

(3) This is the true meaning of classical *induction*, which has been distorted by the philosophical tradition born of David Hume.

(4) For more on how to combine empirical investigation and theoretical research, see R. Franck, ed. (2002).

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