

## Chapter 2

# FROM THE MACRO-MICRO OPPOSITION TO MULTILEVEL ANALYSIS IN DEMOGRAPHY

**Opening.** If educational science, examined in the previous chapter, was the first social science to develop a fully multilevel approach, one must also bear in mind that it is one of the most recently constituted social sciences. It was only in the late 1960s (Travers, 1969) that education emerged from the prevailing earlier discipline of pedagogy, whose focus was on the adjustment of teaching practices rather than on studying the processes linking teacher to student—the goal of education as a social science (Filloux, 2001). Demography, in contrast, has a far longer history. It traces its origins back to the “political arithmetic” of the late seventeenth century, illustrated by the work of John Graunt (1662/1977); in the nineteenth century, it pulled away from the other social sciences derived from the same source. The present chapter adopts a long-term perspective in order to discern the links between those historical stages and the aggregation levels—and to show the place of multilevel analysis in demography’s evolution over the centuries.

We will show the privileged position of analysis at the aggregate level—most often, an individual country—from the inception of demography to the mid-twentieth century. This analysis was informed by methodological holism, which produced (1) population censuses, performed at regular intervals to obtain an instantaneous view of the population, and (2) comprehensive measurements of the events experienced by its members. There was no room for the individual in the analyses and tables derived from these censuses, which were attached to civil-registration statistics: the analyses and tables showed relationships external to the life of individuals, who expressed the constraints laid down by the society in which they lived. These constraints can remain identical for long periods; when they change, they can do so very gradually, adjusting to new economic or social conditions, or rapidly in periods of crisis such as a war or an economic recession. This effect occurs in a historical time-frame, which justifies the use of period analysis, and in a homogeneous national space, which justifies the analysis on aggregate data.

The lagged effects of World War II—on marriage, for example—cast doubt on the effects identified by period analysis. The use of fictitious cohorts displaying the behaviours observed in a given period led demographers to postulate the existence of a fictitious cohort that—in such demographic-recovery periods—would make a life-long effort to catch up on a lag it never actually experienced (Henry, 1966). Likewise, the effects of period events may impact the lives of individuals much later than at the time of their occurrence—hence the need to develop an other approach accommodating those effects.

Cohort analysis initially enabled demographers to introduce the time lived by individuals and to illustrate more clearly the effect of wars or economic crises on the deferral of the events studied to better times. The implementation of such an approach, however, required very restrictive hypotheses: the homogeneity of the population studied and independence between events. These hypotheses allowed the use of individual data from civil-registration records in aggregate form to compile cohort tables. However, survey data, using much more abundant and detailed information than the civil-registration records, showed that the hypotheses did not hold up and needed to be waived.

Event-history analysis offered a solution to these difficulties, by examining the entire life of a sample of individuals: demographers could now analyse the interferences between the events experienced by individuals and the effects of individual characteristics on the events. The focus of the analysis thus shifted from society as a whole to the individual, situated in a heterogeneous society and experiencing interdependent events. This led to methodological individualism. However, the analysis centred not on the individual in all his or her complexity, but on a statistical individual, subjected to a specific process by the events and characteristics examined.

Whereas the aggregate level analysis demonstrated processes at work at the population level, the individual level analysis showed the mechanisms underlying individual behaviour. But are the two approaches entirely antagonistic? Might it not be possible to interlink them in order to improve our knowledge of human behaviour? Somewhat later than education, demography tried to gather individual data and aggregate data into a single model: Mason *et al.* (1983) and Wong

and Mason (1985) conducted multilevel analyses—of fertility and contraception respectively—through a simultaneous study at the individual and aggregate levels: the aggregate levels consisted of the individuals' countries of residence. The authors used data from the World Fertility Surveys performed in several developing countries. Such analyses were later extended to a variety of segmentations (villages, ethnic groups, regions, etc.) and to fuller models than the logistic regressions used in these early examples. We will show how this led to the introduction of multilevel event history models, which are still under development and continue to raise many issues examined here in detail.

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## 1. INTRODUCTION

Although the word *demography* first appeared in print in the nineteenth century in Guillard's *Éléments de statistique humaine, ou démographie comparée* (1855), its origins can be traced back to what in the seventeenth century was known as *political arithmetic*, a term introduced by Petty in the 1670s (Dupâquier, 1983) and the title of his book published in 1690. The earliest application of thorough going statistical methods to the study of populations was in fact the work of Graunt (1662/1977), where for the first time the information contained in the Bills of Mortality was treated as a source for measuring the population of a country or region. This was a revolutionary idea at a time when the events of human existence such as birth, illness and death were believed to be the prerogative of god and hence not admitting of scientific inquiry.

Let us take a closer look at how Graunt envisaged this political arithmetic. In common with most of the natural sciences at the time, the approach was essentially descriptive, the purpose being to produce accurate measurements of a state's population and of the various phenomena responsible for keeping it at a given level. It is important to appreciate that no reliable census of the population existed at this time, so that the only means of estimating the population of a city, let alone a country, was by making highly speculative calculations. Contemporary estimates of the population of London, for example, varied between two million and six million. The first task was thus to produce a more reliable estimate of this population based on the sources available at the time (the Bills of Mortality and the Bills of Baptism) and with a careful and critical examination of their quality. Working with what he judged to be the most credible hypotheses, Graunt demonstrated that the population of London was close to 380 000 and not the millions previously thought.

As the above shows, although essentially descriptive in approach the new science found it necessary from the outset to propound hypotheses about the populations and events that formed its field of inquiry. The idea that prevailed in the eighteenth century was that a kingdom's population stayed more or less unchanging through history, and although epidemics, wars and natural catastrophes and so forth caused localized and short-term variations, these were quickly made good by the return of prosperity and the concomitant increase in births. By working on larger and larger populations, compensations would operate, revealing greater regularity and effacing these localized variations. In *The Divine Order* (1741/1979), Süssmilch interpreted this regularity

as the action of Providence, a view that well illustrates the importance of the religious outlook in the early development of political arithmetic. Later on, however, rationalist thinkers suggested that human phenomena might be subject to laws as strict as those which had been discovered in the natural sciences.

The existence and assumed form of these laws provide the starting point for our discussion. The lack of censuses in the seventeenth and eighteenth centuries obliged the early analysts to make hypotheses about the relationships which existed, at a given point in time, between the events observed (births, marriages and deaths) and the populations in which they occurred. A question that began to be explored was that of the variation in a population consequent on the births and deaths it experiences. When Euler (1760) said that he had assumed that the total number living in one place remains the same, or that it increases or decreases uniformly, he was in effect anticipating the concepts of stationary or stable populations that were not formalized until the start of the twentieth century (Lotka, 1939).

In the nineteenth century, the main impetus for the study of populations came from Quetelet with his theory of the "average man", but it was the sociologist Durkheim who did most to elaborate a theory for the quantitative analysis of human behaviour, based on clearly stated hypotheses and the method of concomitant variations. The same methodology was in fact presented fifty years later in Landry's (1945) treatise on demography, although the latter contains no reference to this famous precursor. This method implies adoption of a period approach, which is examined in the first part of this chapter. The main source for this approach are population censuses, which provide "snapshots" of the population under observation at nearly regular intervals.

Although the distinction between "historical time" and "individual time" was not at first clearly understood, some analysts had already made use of sources which followed individuals over their lifetime, such as data concerning tontines or annuities (Deparcieux, 1746). Later on, it began to be suggested that the period perspective employed by most authors might not be the only one possible (Delaporte, 1941). It was after the Second World War that demographers showed how this approach, based on hypotheses which completely ignored individuals' experience of time, produced results whose interpretation was problematic. Their solution was to develop methods of longitudinal analysis that could follow individuals over their entire lifetime and for which civil registration materials and population registers were the most important sources. So as to observe the various phenomena in isolation, this new paradigm treated them as mutually independent and occurring in populations that were assumed to be homogeneous. This approach is explored in the second part of this chapter.

These hypotheses of independence and homogeneity were challenged, however, by the growing volume of survey results that provided more detailed information than population registers and civil registration sources. A need was increasingly felt for methods that could handle the interdependence of phenomena and the heterogeneity of populations. This change came at the

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