Methods for Reconciling the Micro and the Macro in Family Demography Research: A Systematisation

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Abstract In the second half of the twentieth century, the scientific study of population changed its paradigm from the macro to the micro, so that attention focused mainly on individuals as the agents of demographic action. However, for accurate handling of all the complexities of human behaviours, the interactions between individuals and the context they belong to cannot be ignored. Therefore, in order to explain (or, at least, to understand) contemporary fertility and family dynamics, the gap between the micro and the macro should be bridged. In this contribution, we highlight two possible directions for bridging the gap: (1) integrating life-course analyses with the study of contextual characteristics, which is made possible by the emergence of the theory and tools of multi-level modelling; and (2) bringing the micro-level findings back to macro outcomes via meta-analytic techniques and agent-based computational models.

1 The Need to Bridge the Gap Between the Micro and the Macro Perspectives in Family Demography Research

After mid-twentieth century the scientific study of population changed its paradigm from the macro to the micro so that the main focus of attention has been devoted to individuals as the agents of demographic action. Event-history analysis was born from the need to develop a comprehensive theoretical framework for studying events

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that occur within the life-course (Courgeau and Lelievre 1997). This new approach led to a much wider set of research into human behaviours than classical macro-demographic analysis. It also allowed to shift the research from the mere description of phenomena to its interpretation, avoiding the risk of ecological fallacy (Salvini and Santini 1999).

Apart from numerous benefits this shift from the macro to the micro brought also some disadvantages. First, for many years the importance of the social and economic context in which individuals live was disregarded and its potential effect on fertility and family behaviours was ignored. Second, the improvement in the access to the individual-level data and development of the techniques of event-history analysis led to an explosion in the number of micro-level studies. These micro-level studies are generally fragmented, however, and often provide contradictory results. Third, more progress is needed as regards the inference about the macro-level outcomes from the micro-level studies. Drawing conclusions from the micro-level studies on macro-level phenomena risks atomistic fallacy as micro-level studies focus often on a specific situation, constituting only a piece in the overall puzzle of understanding contemporary fertility and family dynamics. Additionally, inference can be complicated by possible interactions of micro-level processes.

Recently, a renewed interest in linking macro- and micro-level research has been recorded in many disciplines of social science (e.g. Voss 2007). Scientists now emphasize that bridging the gap between micro- and macro-approaches in family demography research is a prerequisite for a deeper understanding of contemporary fertility and family dynamics. This new trend is reflected in two international demographic research projects conducted within the EU Framework Programmes: Mic-Mac (Willekens et al. 2005) and Repro (Philipov et al. 2009).

Sharing this view, in this contribution we outline the directions for research and the analytical methods which will facilitate successful reconciliation of the micro and the macro in family demography research. In what follows we propose to bridge the macro-to-micro gap by: (1) integrating life-course analyses with contextual characteristics, feasible owing to the emergence of the theory and tools of multi-level modelling; and (2) bringing the micro-level findings back to macro-outcomes via meta-analytic techniques and agent-based computational models. Before we proceed with our analytical suggestions, we briefly present the concept of methodological individualism which initially drove the shift from the macro to the micro level in family demography research.

2   Methodological Individualism

The major inference of methodological individualism is that understanding individual behaviour is crucial for explaining the social phenomena observed at the macro level. Various versions of this doctrine have developed across disciplines. They range from the more extreme, which suggest that social outcomes are created exclusively by individual behaviours, to the less absolute, which additionally assign

an important role to social institutions and social structure (Udehn 2002). Such a moderate version of methodological individualism was proposed by Coleman (1990) and adopted in demography (De Bruijn 1999: 19–22).

According to Coleman, the relation between an individual and society runs both from the macro to the micro level and from the micro to the macro level. There are three mechanisms corresponding to this process are: (1) the situational mechanism in which context influences individual background; (2) the action formation mechanism within which individual background affects individual behaviour; and (3) the transformational mechanism which transforms individual actions into a social outcome (see also Hedström and Swedberg 1999; Billari 2006).

Individual life choices are at the centre of this theoretical model. Individuals do not live in a vacuum, however, but are embedded in a social environment – i.e., in a macro-context. This context is a multi-level and multidimensional "structure of institutions that embody information about opportunities and restrictions, consequences and expectations, rights and duties, incentives and sanctions, models, guidelines, and definitions of the world" (De Bruijn 1999: 21). Such information is continuously being transmitted to individuals who acquire, process, interpret, and evaluate it. In this way, the context influences people's life choices, reflected in occurrence or non-occurrence of demographic events, which are subsequently transformed into a social outcome that is observed at the macro level.

An improvement in the availability of longitudinal data as well as the development of event-history analysis tools allowed social researchers to achieve a deeper insight into the action-formation mechanism, or at least into the manner in which the individual background influences people's behaviours. Much less attention has so far been paid to exploring the situational and transformational mechanisms. Below we elaborate on ways these macro-to-micro and micro-to-macro gaps can be closed in empirical research by using the most suitable analytical methods available. Alongside the presentation of these methods, we document a series of examples from literature. For consistency in the general reasoning of this paper, all illustrations refer to the field of family demography.

3   Bridging the Macro-to-Micro Gap: Multi-Level Event-History Analyses

Life-course theory and event-history techniques, which aim to explore people's life choices, have become standard practice in family and fertility research. However, these approaches ignore the fact that individuals are by their very nature nested in households, census tracts, regions, countries, etc., and that these situational contexts affect people's decisions. In light of the conceptual framework proposed by Coleman (1990), this significantly limits our ability to understand human behaviours (Pinnelli 1995; De Rose 1995; Blossfeld 1996; Santini 2000; Rosina and Zaccarin 2000).

Furthermore, such approaches also cause technical problems, as applying single-level models to hierarchically structured data leads to a bias in the model estimates. The reason for this is that single-level models assume the independence of observations which are in fact dependent, as they are nested within one unit. For instance, households residing within the same neighbourhood are likely to have similar characteristics.

The most influential approach that has been created to account for the hierarchical structure of the data is multi-level modelling. Multi-level models see individuals as behavioural agents, embedded in social units (tracts, regions, countries, etc.). They allow the analyst to detect the effect of the context on individual behaviour as well as to identify the macro-characteristics which are mainly responsible for the contextual effect (Borra and Racioppi 1995; Micheli and Rivellini 2000; Zaccarin and Rivellini 2002). The natural implication of these methods is that they blur the artificial boundaries between micro and macro analyses (Voss 2007). Multi-level event-history analysis in particular represents a challenging and so far not much explored opportunity for bridging the gap between analysis of events unfolding over the life-course (the micro approach) and the contextual (macro) approach in family demography research. However, while the methods (and corresponding software packages) are relatively well-established, data availability is a critical point.

In order to conduct a multi-level event-history analysis, longitudinal individual data should be linked with the time-series of contextual indicators. This requires data on the migration histories of the individuals, together with all their other life-course careers, as well as time-series data for contextual indicators. Consequently, this method has so far mainly been employed on cross-sectional data.

Only recently have some researchers started to investigate the influence of macro-level factors on family-related behaviours from a longitudinal perspective. Still fewer have allowed for a hierarchical structure by taking into account the unobserved community-level factors or even by introducing some contextual indicators into models in order to explicitly study their impact on family-related behaviours. As an example we refer to the study by Adserà (2005), who used a multi-level event-history model in order to explore the impact of regional unemployment on childbearing, employing data from the European Community Household Panel (ECHP 1994–2001). The study was conducted on a pooled dataset for thirteen European countries and included information on the country-level gender unemployment gap and the long-term unemployment rate, which was introduced into the model on a higher level than the individual one. Adserà's results clearly indicate that a higher gender gap in unemployment and a higher long-term unemployment rate slow down the transition to motherhood and higher order births.

To summarise, the existing macro-to-micro studies generally make use of data from a national, a regional, or even a municipal level. The available literature not only indicates the differences between countries or regions in the timing of fertility or in fertility intentions, but also demonstrates that a proper accounting for context may change the influence of individual-level factors (Philipov et al. 2009). Consequently, future research should give better recognition to multi-level event-history approaches.

4   Bridging the Micro-to-Macro Gap: Meta-Analyses and Agent-Based Computational Models

Despite the problems with data availability, the contextual influence on action formation is already quite well understood. By contrast, the transformational mechanism (the transfer from the micro to the macro level) is as yet largely unexplored. At the same time, the rapid development of micro-level studies increases the need to summarize the existing individual-level empirical evidence and to relate them to the macro-level outcomes. In this section, we elaborate on two possible ways of bridging the micro-macro gap from the bottom up, namely meta-analysis and agent-based computational models.

4.1   Meta-Analytic Techniques

Meta-analysis, also referred to as a quantitative literature review, can facilitate drawing general conclusions from micro-level findings. This methodology, relatively new in the social sciences, was developed in order to synthesise, combine and interpret a large body of empirical evidence on a given topic. It offers a clear and systematic way of comparing results of different studies, standardised for the country analysed, the method applied, the control variables employed, the sample selected, etc.

In order to conduct a meta-analysis, papers researching a topic of interest are collected in a systematic manner. Estimated coefficients are selected across studies and recalculated in a standardised way into comparable indicators (i.e. effect sizes). The effect sizes constitute the units of statistical analysis, and can be combined into single summary indicators or analysed using regression techniques. The quintessence of this approach is quantifying the effect of interest on the basis of the available micro-level empirical studies.

Meta-analysis has only recently been adopted in family demography research. The very few such studies in this field include meta-analyses of: the aggregate relationship between a population's age structure and its fertility as hypothesised by Easterlin (Waldorf and Byun 2005), the impact of modernisation and strength of marriage norms on divorce risks in Europe (Wagner and Weiss 2006), and the micro-level relationship between fertility and women's employment in industrialised economies (Matysiak and Vignoli 2008). In order to give a better insight into the meta-analysis method, we elaborate shortly on the meta-study by Matysiak and Vignoli (2008). It aimed to synthesise micro-level findings on the relationship between fertility and women's employment in industrialised economies. Two effects were analysed: that of women's work on fertility (90 studies) and that of having young children on women's employment entry (55 studies). The authors found that the micro-level relationship between the two variables is still negative, but its magnitude varies across countries, differing in their welfare policies, the labour market structures and the social acceptance of women's work. This variation in

the magnitude of the micro-level relationship explains the existence of the positive cross-country correlation between fertility and women's labour supply, which has been observed in OECD countries since the mid-1980s (Engelhardt et al. 2004).

Meta-analysis certainly is a useful tool for summarising and synthesising the abundant micro-level research. Its unquestionable strength is that effect estimates produced within its framework have higher external validity than those obtained in individual studies owing to the generality of results across various research papers (Shadish et al. 2002). Nevertheless, a weakness of this method lies in the assumption that the micro-to-macro transformation can be achieved through a simple summation of individual-level actions into a macro-level outcome. According to Coleman (1990), the complex interactions between and within social groups, as well as the heterogeneity of individuals, preclude such a simple aggregation. Since demographic choices are made by interacting and heterogeneous individuals, this assumption, implicit in meta-analysis, may not be valid.

4.2 Agent-Based Computational Models

Agent-based computational models come as a solution to this problem. They seem to be the most powerful tool which is available for transforming the micro results to the macro-level outcomes and which allows to account for heterogeneity among individuals and for the complexity of individual-level interactions (Billari and Ongaro 2000; Billari 2006). It includes micro-simulation, which models macro processes on the basis of empirical models (i.e. event-history models, or even multilevel event-history models), as well as formal models of demographic behaviours, which operationalise decision-making processes at the micro level and simulate their outcomes in terms of macro-level indicators. The additional advantage of agent-based computational models is that they allow study of the impact of policy interventions on demographic behaviours, taking into account policy side effects as well as the interactions of policy with other elements of the social system (Van Imhoff and Post 1998). Below we give one example of micro-simulation that was run with the goal of, among others, assessing the macro-level consequences of an increase in women's employment on fertility (Aassve et al. 2006).

The first study was conducted in two steps. First, using the British Household Panel Study, the authors estimated a multi-process hazard model of five interdependent processes: childbirth, union formation, union dissolution, employment entry, and employment exit. They found the employment parameter in the fertility equation to be strongly negative. The micro-simulation conducted in the second step showed, however, that increasing the hazard of employment entry by 10% and decreasing the hazard of employment exit by another 10% led to a decline in the proportion of women having their second child before the age of 40 by only 0.2% points. This was much less than one could have expected from the analysis of the parameter estimates in the fertility equation. The underlying reason was that employment affected fertility also in an indirect way: it had a positive impact on the time spent

in a union, which in turn facilitated childbearing. In short, the negative direct and the positive indirect effect of employment on fertility cancelled each other out, resulting in very small general effects of employment on fertility. This study clearly demonstrated that interpreting parameters from a hazard model alone is not enough to conclude on the subsequent macro-level developments. The interactions between the processes should also be taken into account.

5 Towards an Empirical Implementation of the Theoretical Model: Implications for Data Collection and an Avenue for Future Research

The concepts and relationships presented in this paper are summarised in Fig. 1, which illustrates the theoretical model of methodological individualism in the context of family demography research (see also Muszyńska 2007: 169; Philipov et al. 2009: 17). The scheme of the theory is supplemented with information on analytical methods that could support formation of a comprehensive explanation of the mechanisms and factors driving change in family-related outcomes, as observed at the macro-level. In short, multi-level event-history models are suggested for operationalising the situational and action formation mechanisms, while meta-analyses and agent-based computational models are viewed to be the most suitable for quantifying the transformational mechanism.

We believe that in the future it will be possible to implement this full theoretical model in a single study in the field of family demography. The major challenge to be faced at that stage will be collection of suitable data. Today, in fact, the gap between the analytical tools available and the proper data seems to be the most important barrier preventing population scientists from following the research framework suggested. Conducting a multi-level event-history analysis requires data on the migration histories of individuals together with all other life-histories,
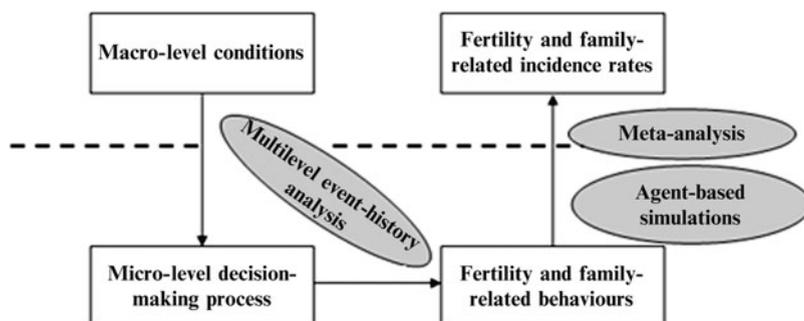

Fig. 1 Theoretical model for the explanation of family and fertility dynamics complemented with the most suitable methods for its implementation

as well as time-series contextual data. Similarly, performing a micro-simulation requires information on several individual life-histories that are often closely connected. To date, such data are not available. It should be noted, however, that substantial advancement in this direction has been made within the Generations and Gender Programme (GGP) (Vikat et al. 2007; Kveder 2009). Its international harmonised database will include individual life-histories of respondents residing in over twenty developed countries. It will additionally be supplemented by the Contextual Database, which contains high quality data at the national or regional level (Spielauer 2006). Furthermore, other contextual indicators can be found in the Family Database developed by the OECD or in the EDACWOWE Portal developed within the RECWOWE (Reconciling work and welfare in Europe) project. A serious drawback of the GGP is its very limited scope of information on migration histories of the respondents, which impedes the possibilities of linking the longitudinal individual data with the time-series of contextual indicators. In future data collection programmes, care should be taken to eliminate this shortcoming.

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