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METHODS FOR RECONCILING THE MICRO AND THE MACRO IN FAMILY DEMOGRAPHY RESEARCH: A SYSTEMATISATION[1]

THE NEED TO BRIDGE THE GAP BETWEEN THE MICRO AND THE MACRO PERSPECTIVES IN FAMILY DEMOGRAPHY RESEARCH

In the second half of the 20th century, scientific study of population changed its paradigm from the macro to the micro so that attention became focused mainly on individuals as the agents of demographic action. This shift in research paradigm, described as 'the shift from studies on structures to studies on processes' (e.g. Willekens 1991, 1999), might be attributed to the increasing interest of demographers in research of individual behaviour on the one hand, and the progress in both data collection and analytical methods on the other hand. The former is a natural consequence of changes in family-related behaviour which progressed rapidly since the 1960s, whereas the latter might be linked to developments in survey-based social research, and progress in computational techniques and quantitative methods. Among them, development of the methods for longitudinal data collection and

[1] We prepared a short version of this work as an invited paper (Vignoli & Matysiak 2009) presented at the scientific meeting of the Italian Statistical Society of 23–25 September, held in Pescara (Italy), during the session organized by Letizia Mencarini ("*Methodological developments and data availability for integration of micro/macro and social network dimensions of socio-demographic behaviour*"). The Italian Statistical Society has already devoted two sessions during its scientific meetings to this debated issue, the first organized by Antonella Pinnelli in 1995 ("*Micro and macro dimensions of demographic behaviours: theoretical frameworks and models*"), the second by Antonio Santini in 2000 ("*Micro and macro analyses in demographic studies*").

We are especially grateful to one of the reviewers of this journal, whose comments helped us to improve the paper.

analysis, and in particular event-history analysis, constitute a path-breaking step in the studies on human behaviours. This new approach led to a set of research on individual behaviours much wider than is afforded by classical macro-demographic analysis, and enabled a move from the mere description of phenomena to their interpretation (Courgeau and Lelièvre 1997, Salvini and Santini 1999).

The strong shift from the macro to the micro led to a series of negative effects, however. 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 access to individual-level data and the development of event-history analysis techniques led to an explosion in the number of micro-level studies. The micro-level evidence they provide is generally fragmented and often provides contradictory results. The reason for this is that micro-level studies focus on a specific situation, constituting only a piece in the overall puzzle of contemporary fertility and family dynamics. Third, not much effort has been made towards drawing conclusions from the micro-level studies to explain the macro-level outcomes. This is not in fact an easy undertaking due to the micro-level interactions of the 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 emphasise 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.

METHODOLOGICAL INDIVIDUALISM

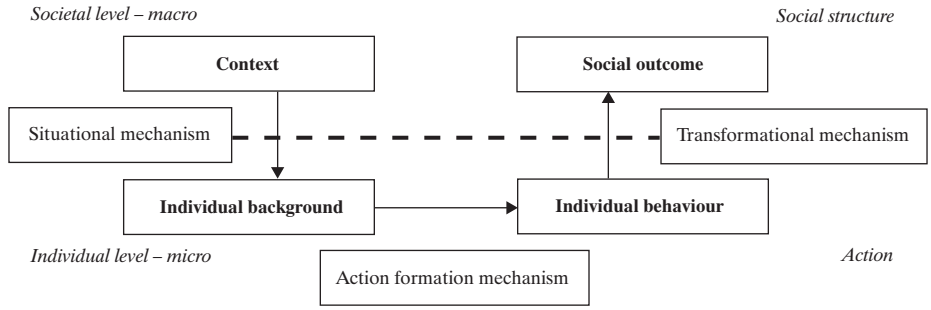
The major inference of *methodological individualism* is that understanding individual behaviour is crucial for explaining the social phenomena observed at the macro level. Various versions of this doctrine have developed across disciplines. They range from the more extreme, which suggest that social 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. Figure 1 presents the three mechanisms corresponding to this process: (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.

Figure 1. General theoretical model for the explanation of social outcomes



Source: Coleman (1990) adapted by Hedström and Swedberg (1999).

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.

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 (De Rose 1995, Blossfeld 1996, 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. For instance, Testa and Grilli (2006) studied the influence of regional contexts on ideal family size using cross-sectional data from the 2001 Eurobarometer survey. They showed that family size ideals are lower among those cohorts of young women who reside in regions where the fertility of older cohorts was lower as well. The authors attribute this result to an intergenerational transmission of fertility ideals.

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 unob-

served community-level factors or even by introducing some contextual indicators into models in order to explicitly study their impact on family-related behaviours. Here we give an example of two studies whose findings show contrasting influences of macro-level factors on individual fertility timing. The first is by Schmitt (2008), who introduced contextual indicators at the individual level, thereby estimating a single-level hazard model. The other, by Adserà (2005), who used a multi-level event-history model.

Both of these studies explored the impact of regional unemployment on childbearing, employing data from the European Community Household Panel (ECHP 1994–2001). Schmitt referred to four European countries (Germany, France, the United Kingdom, and Finland). In the study, the regional unemployment rate was included in the model specification at the individual level, alongside various characteristics of a woman. The empirical findings demonstrated that the regional unemployment rate did not affect fertility in Finland, Germany and, the United Kingdom, but was positively related to the propensity to have the first child in France. Introducing regional information at the individual level did not allow to properly account for the role of the context, however. This limitation was overcome by Adserà (2005), whose study yielded opposite findings. It 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.

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 summarise 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.

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 two of these meta-studies. The meta-analysis of divorce risks was conducted on 120 individual-level studies (Wagner and Weiss 2006). The authors found a great heterogeneity of divorce risks within as well as between countries. They demonstrated that countries characterised by rigid marriage norms display stronger positive effects of premarital cohabitation on marital instability and a weaker association between parental divorce and the divorce risk of the offspring than countries where marriage norms are weaker. In the other meta-study, Matysiak and Vignoli (2008) 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 depending on the 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 (Rindfuss et al. 2003, Kögel 2004, 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.

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 two examples of micro-simulations. The first 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 second was designed for the purposes of projecting future macro-level outcomes (Wachter 1997).

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 percentage 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.

There are also micro-simulation models which have been designed for the purpose of projecting future population outcomes. One such complex micro-simulation model – SOCSIM – was built at the University of California, Berkeley (Wachter 1997). It was designed to provide insight into the future size and structure of kin networks and consequently to allow an assessment of the availability of support for the elderly in ageing populations. Unlike standard macro-level population projections, it provides information not only on the old-age dependency ratio, but also on kin relationships (children, grandchildren and siblings, as well as step- and half-kin). The power of the SOCSIM model was illustrated by Wachter (1997), who argued that projecting kin relationships is particularly important in countries experiencing rapid increases in divorce and remarriage rates. While these changes in the patterns of union formation and dissolution do not affect the old-age dependency rate, they do lead to a situation in which each person is connected to more members of the younger generation (children, stepchildren, grandchildren and step-grandchildren) who are possible resources of support when needed.

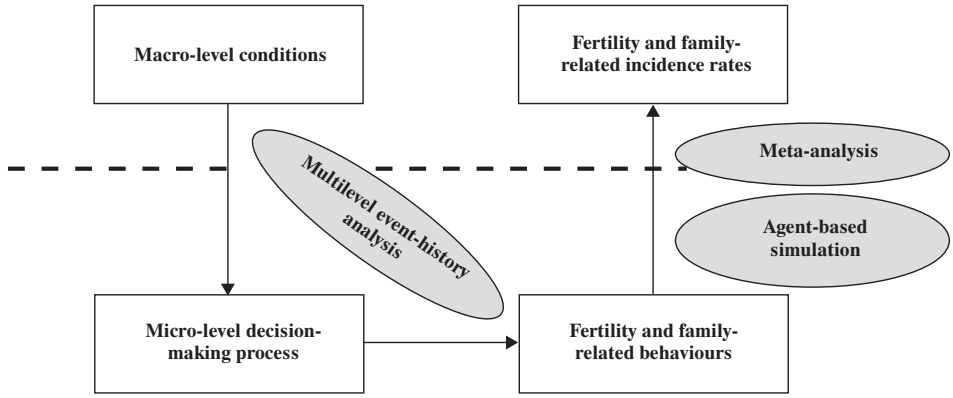
TOWARDS AN EMPIRICAL IMPLEMENTATION OF THE THEORETICAL MODEL: IMPLICATIONS FOR DATA COLLECTION AND AN AVENUE FOR FUTURE RESEARCH

The concepts and relationships presented in this paper are summarised in Figure 2, 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, as well as time-series

Figure 2. Theoretical model for the explanation of family and fertility dynamics complemented with the most suitable methods for its implementation



Source: own elaboration.

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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In the second half of the 20th century, 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.

Keywords: family demography, methodological individualism, multi-level event-history models, agent-based computational models, meta-analyses.