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Modelowanie dynamiki przemian ludności w warunkach wzrostu znaczenia migracji międzynarodowych

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The role of international migration in the modeling of population dynamics

Abstract

The first aim of the book was to review and assess population dynamics models. It was established that existing models, including multiregional ones, do not allow for neat inclusion of international migration into the process of modelling population change. They are not adapted to simultaneous modelling of the populations of many countries and, at the same time, to modelling regional populations in these countries. This observation, when combined with the constatation that the role of international migration has been growing in the last fifteen years, lead us to another aim of the book: construction of a multiregional multilevel model of population dynamics, which would take into account international migration, avoiding practices questionable from a methodological point of view. The preparation of the model entailed elaboration of the mathematical framework, preparation of the computer software and assembling data for 14 Central and Eastern European countries, on which the model was tested.

The last aim of the work was the use of the model in the numerical assessment of the impact of international migration on the dynamics of the regional and national populations of countries of Central and Eastern Europe. It has to be stressed however, that the book has a methodological (development of new forecasting tools) rather than empirical character and the assessment is aimed, above all, at the demonstration of the functioning of the model.

The structure of the book is as follows. Chapter 2 is devoted to the methodological reconstruction of population dynamics models and presents demographic (Chapter 2.3), geographical (Chapter 2.4) and multiregional (Chapter 2.5) traditions. Chapter 2.6 contains a critique of the state of the art in the modelling of population dynamics in 1990s and identifies key issues which have to be tackled in future. Expounded, in particular, are the impact of European integration and of the increasing role of international migration on population dynamics and, in consequence, its modelling.

The problem of constructing a new multilevel multiregional population dynamics model capable of generating population projections and forecasts for many countries on a subnational level is discussed in Chapter 3. The chapter begins with a review of existing methods of forecasting supranational populations (Chapter 3.1), as well as a discussion of

problems arising from the inclusion of international migration into forecasting models (Chapter 3.2). A new multilevel multiregional population dynamics model MULTIPOLES (MULTIstate POpulation model for multiLEvel Systems) is then presented (Chapter 3.3).

Chapter 4 describes the implementations of the MULTIPOLES model for fourteen countries of Central and Eastern Europe (Austria, Belarus, the Czech Republic, Estonia, Germany, Hungary, Lithuania, Latvia, Moldova, Poland, Romania, Slovakia, Slovenia and Ukraine) covering over 150 regions altogether. The problems of the construction of a Regional Population Information System in which both input data and projection results are stored are discussed. Sources of demographic data are characterised and problems of the estimation of missing data analysed. The chapter ends with some critical remarks on the quality and precision of the data used, in particular the data on international migration and stocks of population.

The application of the MULTIPOLES model in the assessment of the impact of international migration on population dynamics in the countries of Central and Eastern Europe is presented in Chapter 5.

Chapter 6 contains the main conclusions of the book. They will be summarised below.

Contemporary population dynamics models originate from two methodological traditions: the geographical and demographic. The demographic tradition focuses on mortality and fertility and the process of reproduction of the population. The most advanced models, arising from the demographic tradition are cohort-component models, which for years served as a basic tool in the preparation of population forecasts. The geographical tradition originates to a large extent from models based on Markov chains, and focuses on the spatial redistribution of the population. These two traditions merged in the concept of multiregional demography proposed in the late sixties and early seventies by Andrei Rogers and developed in the last 30 years by himself, Phil Rees, Frans Willekens and many others. Models currently in use are very advanced from the methodological point of view. They are used as the main regional forecasting tool in many countries across the world, and in particular in Europe and North America (Rogers 1995).

The review of the development of models of spatial dynamics and the redistribution of population was the basis for a critical assessment of their usefulness under the condition of increasing European integration and, in particular, the increasing role of international migration in population dynamics. The main conclusion of the review was that the existing models are not complex enough to accommodate all key demographic processes observed in the contemporary world. First, in most cases, they are not prepared to handle international migration. Second, they ignore the need for the modelling of a group of countries, rather than a single country, which is important, given the strong migration interaction between certain countries. Third, following Eurostat concerns, there is an apparent need for multicountry regional forecasts based on a unified methodology and set of assumptions. This problem, of a practical rather than methodological nature, is important for a large, highly integrated supranational organization, with decisionmaking powers and ambitions to create regional policies of almost continental scope.

The arguments for taking international migration into account in the modelling of population change and dynamics are derived from two basic assumptions. If we assume that population processes have a systemic character, then international migration may be interpreted as an interaction between elements of the population system, that is between national and regional populations. Such a perception of population processes is neither new nor unique (Zlotnik 1992). Another assumption is par excellence practical: forecasting errors arising directly from ignoring international migration are very large: Rees et al. (1999) (see also Table 3 in this book) show the magnitude of errors using the example of Eurostat forecasts for the 1980s. Clearly, the key issue in the process by which forecasting errors could be reduced is the incorporation of international migration into population dynamics models. The best way to do this is to use a matrix of flows between countries, rather than net migration, and to use emigration rates where possible.

The above postulates were taken into account when MULTIPOLES, a new multiregional multilevel model of population dynamics, was constructed. MULTIPOLES simultaneously models population change in countries and regions, taking account of international migration between modelled countries, as well as from outside the system. The author of this book is aware of only one model of similar capacity, namely ECPOP developed by Phil Rees in 1992 for the member states of the EU (Rees, Stillwell, Convey 1992; Rees 1996). ECPOP was based on data from the REGIO database. Other, much simpler models covered only

populations of entire states, neglecting the regional dimension to population change. Some models, which took regional division into account (i.e. DEMETER or EUROPOP discussed in Chapter 2.1) gave consideration to net international migration only.

The construction of the MULTIPOLES model is the key achievement of the presented book. From the methodological point of view, the model originates from a multiregional cohort-component family of models and was designed using state-of-the-art multiregional demographic modelling. The model can be used for the projection or forecasting of multinational populations by region, age and gender. It generates the results on supranational, national and subnational levels at the same time. It is, therefore, an ideal forecasting tool for a period of unification of the nations of Europe, an increasing role of international migration in population dynamics and increasing globalisation of economic and in consequence also of demographic processes.

The model was labelled as multilevel as it handles migration on three geographic levels. First, on the lowest level, interregional, intranational migration is taken into account. On the second level, international migration between modelled countries is considered. Finally on the highest geographic level, migration between each of the modelled countries and the rest of the World is taken into account. On the two first levels the model uses occurrence-exposure rates, whereas on the third level net migration is used. The model is multiregional in the sense of the word used by A. Rogers, who sees the population as a system, and migration as a link between elements thereof.

In the MULTIPOLES model it was decided that, whenever possible, observed schedules of demographic events should be used instead of hypothetical model schedules. The consequences of such a decision were that much effort was required by the data collection and the creation of the Regional Population Information System. Such an approach was rewarded by a reduction of uncertainty and error generated by difficult-to-verify assumptions on the distribution of demographic events.

The Regional Population Information System (RPIS) is, to the knowledge of the author, one of very few databases (the others being Eurostat's REGIO and the Dutch CBS's database) collecting regional demographic data for a large number of countries. The RPIS is also unique because it covers Central and Eastern Europe. Most of the data were obtained in various

forms from national statistical offices, verified and adjusted to the common standards of the RPIS. Data from the Council of Europe and other institutions were used as well. Acknowledgements and expressions of my gratitude to all those who supplied the data and helped me in any other way can be found in Chapter 7 of the book.

The most difficult part of the data collection and verification was the assembling of the reliable data on international migration, in particular the matrix of flows between modelled countries. The key problem arises from the fact that data on the same flow, reported by sending and receiving country differ substantially.

The MULTIPOLES model was used in the assessment of the impact of international migration on the magnitude and structure of populations of countries and regions in Central and Eastern Europe. Two simulations were run, the results of which were contrasted. In both simulations age-specific rates of fertility, mortality and internal migration remained unchanged. In the first simulation the scenario of international migration was adopted. The preparation of this scenario was preceded by a short review of theories of international migration. It was concluded that direct application of these theories for forecasting international migration is very difficult because of the narrow scope of explanation of each of the theories, and their fragmentation. In the second simulation it was assumed that there is no international migration. The comparison of the results of the two simulations, which can be found in Tables 17 and 18, shows how significant and far reaching the impact of international migration on populations is. Importantly, it was possible to quantify the difference international migration makes in each country and each region over a 25-year period. Due to migration Germany will gain over 10% of the starting population. On a regional level, international migration changes in some cases the character of population development from population decline to population increase. This is very typical for the German regions. In practice, it shows that neglect of international migration in population dynamics models leads to fundamental errors, as the model is not even able to show correctly the direction of the population change in some regions, not to mention the magnitude of changes. This allows for the formulation of a categorical statement to the effect that population dynamics models must take account, not only of internal, but also of international migration.

The above is not the only application of the MULTIPOLES model. Previously, it was used for the forecast of the elderly population (Kupiszewski, Kupiszewska 1999), and for forecasting

the labour force (Kupiszewski 2001b) in Central and Eastern Europe, as well as for multivariant forecasts of regional populations in Austria and surrounding countries. The model has therefore been fully tested.

Construction of a population projection model finishes a certain stage of research and at the same time ushers in questions as to which parts of the model could have been resolved better. In the case of MULTIPOLES, a number of problems remained unsolved. The first is the lack of an approved and empirically-tested algorithm of the recruitment of migrants from regions in the country of origin, and of the regional allocation of those migrants at the destination. The number of publications on the subject is limited and they do not cope with the generalisation of local variations, something which is indispensable for the creation of an algorithm. Eventually the MULTIPOLES model resembles the forecasts of Eurostat, in using "neutral" algorithms of recruitment and allocation, based on a migrant quota proportional to the regional populations respectively at source and destinations. The research by van der Gaag and van Wissen (1999) shows that this is a justified solution for the regional distribution of migrants at the destination. In future, because of the significant numbers of migrants, the verification of the algorithms used, and their improvement, will be a very significant step towards the improved quality of demographic forecasts.

Another possibility for improving the accuracy of forecasts is to feed much more information on international migration into the model, for example to take account of interregional international migration (i.e. migration from a region in one country to a region in another). At the moment, the poor shape of the statistics on international migration makes this suggestion purely theoretical, but demand from the research community and policymakers may, over time, result in a change of practices at national statistical offices, as is discussed later on.

Another issue is the way regions are defined in the projection process. Usually these regions consist of large, demographically heterogeneous, administrative units. It is possible to consider the change in the composition of these regions and to make them up from a number of small administrative units which have similar demographic characteristics. The projection or forecast would be prepared for homogeneous agglomerates of these small administrative units, and then projected populations would be recomposed to estimate the projected populations of initial regions - large administrative units. A problem which will have to be

solved is control of the magnitude of the error generated by disaggregation of the initial population and then aggregation of projected populations.

The poor quality of statistical data has a profound impact on the quality of population forecasts. In the book we have discussed both the significance of the quality of data on international migration and the significance of the exactness of the estimation of benchmark populations for the quality of population forecasts. Only adoption of a unified definition of international migration (i.e. the UN definition) may improve the situation and reduce the error introduced by inadequate or incomparable counts of international migrants. This is a political, rather than scientific, problem. Over ten years the attempts to unify the migration statistics in the EU were completely unsuccessful, with no sign of success on the horizon. In this situation, consideration should be given to how the available data could be recalculated to offer as uniform information as possible. This should be the subject of a separate major research programme.

Errors in the statistics on international migration have direct impact on the estimation of benchmark populations. A very good example of such mishandling is that of the Polish statistics. Persistent ignoring of large scale emigration from Poland in the 1980s and 1990s resulted in increasing differences between *de facto* and *de jure* populations and creates a completely false picture of the Polish population, in terms of numbers, regional distribution of population and age and sex structures. Sakson (1998a) showed that *de facto* and *de jure* populations differ by several percent and the difference in values of certain demographic parameters in some cases exceeds the ten percent threshold. In consequence, the demographic rates are charged with substantial error.

The book has solved some issues in the modelling of population dynamics and has exposed a number of problems, which still remain unchanged. These problems range from the methodology of population dynamics models to the issue of inadequate data, and will require substantial research efforts.