

Future Population Development in Kazakhstan

A. Jazybayeva

Abstract—This paper presents two approaches for projecting population in regions of Kazakhstan. The first approach is a multistate method, the second is a component method. The lack of age-specific inter-regional transition data was overcome by adopting method of entropy maximization. In fertility assumptions clustering method was used, in mortality assumptions principal component method along with clustering was applied.

Keywords—Clustering, entropy maximization, multiregional projections, principal component method

I. INTRODUCTION

DESPITE the proverb ‘no man is a prophet in his own country’ this work deals with population projections of administrative regions of the Republic of Kazakhstan for time horizon 10 years. The results of regional population prognosis can produce feedback effect and can be used by governmental and local authorities in planning tasks, allocation and distribution of different types of resources. For example, pension system, insurance system, building of educational facilities and medical hospitals, all spheres of life oriented and depending on the dynamic and changing structure of population require regional population prognoses. At the same time demographic prognoses are highly uncertain and suffer from inaccuracy.

II. CURRENT SITUATION IN REGIONS OF KAZAKHSTAN

16 administrative regions can be divided into four groups by economic development: oil-and-gas producing regions in the western part of Kazakhstan; industrial regions in the central, northern and eastern parts; agricultural regions in the south and north of Kazakhstan; new and old capitals of the country. Regional disparities among administrative divisions are expressed in many indicators. For example, the lowest population density equal to 2.4 people per sq km belongs to Aktyubinskaya oblast whereas South-Kazakhstan oblast has population density in 8.45 time higher, namely 20.3 people per sq km, and Almaty, the former capital has population density 4550 comparable with London’s population density 4761 people per sq km. Taking into account increasing trend of interregional migration the two capitals absorbed only in 2008 year 48 percent of interregional migration.

At the same time in spite of strong process of urbanization age-specific fertility rates revealed steady increase in all regions during the period 1999-2008. In 2008 Kostanaiskaya oblast obtained total fertility rate 1.69, whereas South-

Kazakhstan oblast achieved 3.93. In 2009 regional differences in total fertility rates decreased, the lowest total fertility rate was 1.70, whereas the highest total fertility rate was 3.80 in Mangystau oblast.

III. METHODOLOGY

Data for projections were provided by the Agency on Statistics of the Republic of Kazakhstan. Jump-off populations are presented by populations of regions on 1 January 2009. Fig. 1 gives initial population age structures for two contrasting provinces of Kazakhstan: North-Kazakhstan oblast and South-Kazakhstan oblast.

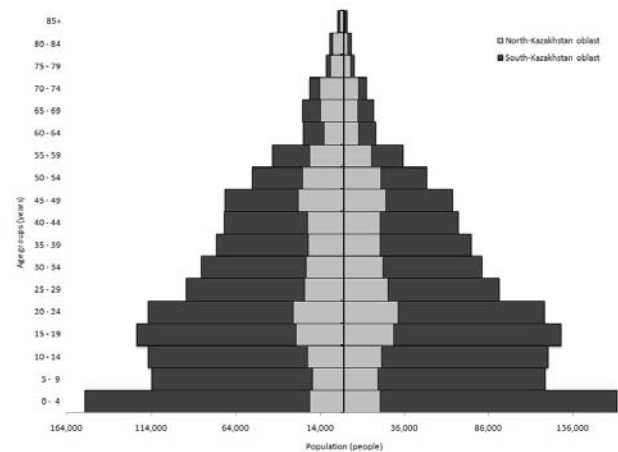


Fig. 1 Initial population age structures of North-Kazakhstan oblast and South-Kazakhstan oblast.

Source of data: Agency on Statistics of the Republic of Kazakhstan

The regional projections are conducted using two approaches: multistate projection and component method. The software of the International Institute for Applied Systems Analysis (IIASA) named Population Development Environment Analysis (PDE) was applied as population projection model with interacting states.

Using of multiregional model requires full origin-destination migration matrix. The entropy maximization method [4] was adapted for inferring absent age-sex specific interregional transition migration data among regions from available aggregated internal migration in- out-moves regional data. Deriving process was divided into two phases. On the first phase the three face algorithm was applied to disaggregate flow matrix by sex. On the second phase One-face, One-edge algorithm was applied for disaggregation by age using age structure of interregional migration at the national level.

A. Jazybayeva is 3-rd year PhD student in Department of Demography and Geodemography, Charles University in Prague (e-mail: a.jazybayeva@gmail.com).

The multistate approach used in the PDE software considers international migration as net migration and pays more attention to interregional movements, where out-flow interregional movements distinguishes from in-flow interregional movements with taking into consideration how regions influence each other by migration flows, and what every region gains from specific regions or how many people loses for benefit of other regions.

In contrast, component approach combines interregional and international migration together, but in order to avoid net migration this method distinguishes in-movements from out-movements, namely in-flow presented in numbers and out-flow calculated through of rate.

Both approaches are grounded on three variants: constant, high and low variants. Constant variant is based on fixed next 10 years mortality and fertility corresponding to the year 2008.

The high and low variants are founded on changing fertility and mortality, whereas migration and transitions due to their high uncertainty are assumed to be fixed corresponding to the year 2008. In order to derive region specific assumptions clustering procedure was applied for fertility regional assumptions, and combination of factor and cluster procedures put into practice for mortality assumptions.

IV. FERTILITY AND MORTALITY ASSUMPTIONS

A. Fertility assumptions

Since the clusters of regions on the past 10 years development of age –specific fertility rates do not correspond to clusters received through of grouping of regions with similar age-specific fertility rates in the year 2008, the clusters with fertility level according to the year 2008 were chosen as a basement (Fig. 2).

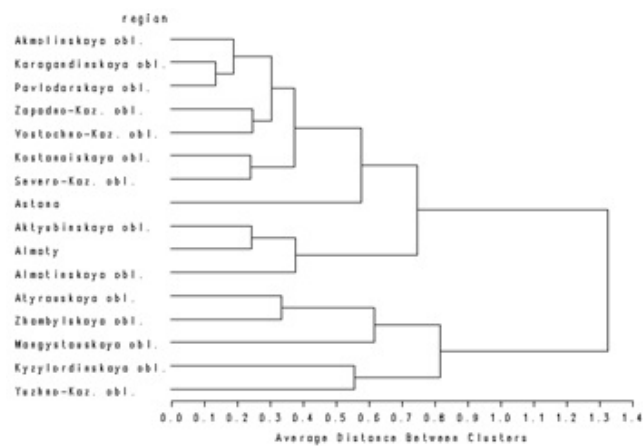


Fig. 2 Average link clustering of regional age-specific fertility rates, 2008 year

Assumptions about future development of fertility were made separately for each cluster for both variants and applied individually to regional age-specific fertility rates. The process of demographic transition including women education

and labor force participation etc. will result in slight fertility decline for regions with total fertility rate above replacement level, whereas regions with low fertility will try to converge to replacement level.

B. Mortality assumptions

Distinctive characteristic of mortality in Kazakhstan is that male mortality much higher than female mortality. Although spatial pattern of female mortality repeats in general spatial pattern of male mortality, nevertheless regional disparities in mortality levels by regions are bigger for males than for females. Principal component analysis was applied to male mortality rates to extract three factors, afterwards clustering on the basis of these factors revealed mortality clusters (Fig. 3). Assumptions were derived for every cluster using past 10 years development of mortality in regions, while high and low variants were defined by variability inside cluster. In contrast to fertility mortality assumptions did not changed the shape of curves of age-specific mortality rates and were reflected on the lowering of level mortality according to common for all countries across the world trend of declining mortality.

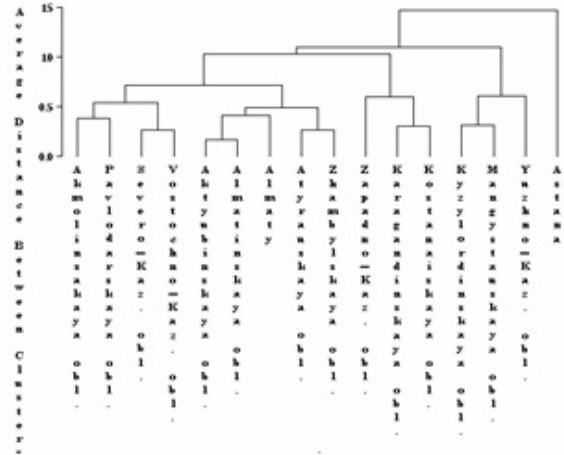


Fig. 3 Average link clustering of regional mortality, 2008 year

V. RESULTS

Results depend on the initial age structure of regions: how old or how young generations prevail in regions, besides in assumptions it was suggested fertility shift to older ages, while it is clear from initial population structure that these generations are less numerous. Since assumptions were oriented by past steady fertility increase and mortality decline in all regions both methods show anticipated increase of populations in regions of Kazakhstan, nevertheless multistate method gives little cautious results since pays attention to strong specific interregional migration flows (Fig. 4).

The Fig. 5 shows projected populations of regions by the year 2019 using constant variant of multistate method. It is obvious that if fertility and mortality will be constant on the level of the year 2008 that means the country will have one outsider, South-Kazakhstan oblast, whose population density already is the highest in comparison with other provinces, will

be increased. At the same time proportions of elderly people are comparatively small, pension burden, modern lash of tax system in developed countries, could be comparatively lightweight. In general both approaches are sensitive to assumptions, and have suggestive character. This prognosis is not the ultimate truth. It is a common practice around the world to regularly renew previous population projections by modifying and improving methods, assumptions and scenarios.

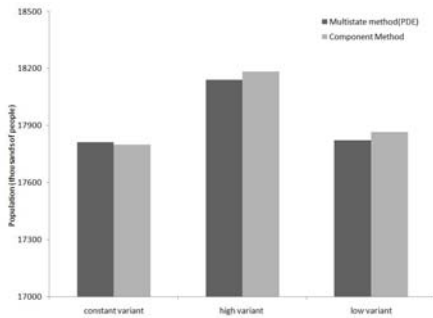


Fig. 4 Constant, high and low variants for both approaches

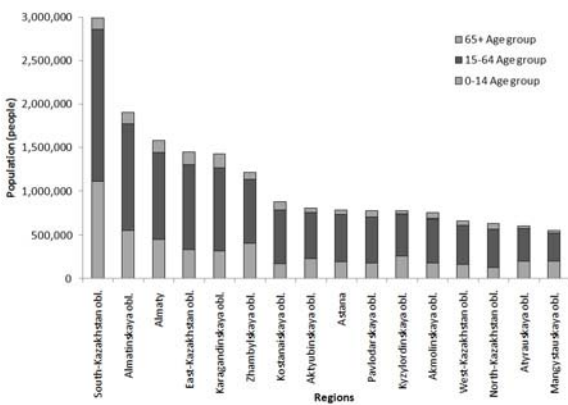


Fig. 5 Constant variant of multistate projections

VI. CONCLUSION

Expected growth of human capital in the next decade can reimburse the past population decline that could be important for the country with low population density. Twenty years ago after the breakdown of Soviet Union in 1991 Kazakhstan declared independence. Economic, social and ecological problems caused increase of mortality, especially for working ages and infant mortality, as well as fertility drop and significant outflow of emigrants leaving the country, and resulted in decline of population. In 1997 the existing at that moment 19 administrative regions were transformed into 14 regions plus old and new capitals. In the same year Kazakhstan announced pronatalist policy with baby bonus system that in combination with ethnic migration policy helped to increase fertility, while economic growth affected increase of life expectancy at birth and attracted strong inflow of immigrants from neighboring Asian countries with higher fertility with subsequent changes in ethnic composition of population in regions and possible fertility increase for future

decade, while according to United Nations projections Kazakhstan has favorable future prospects for mortality decline. Next steps for sustainable regional population development can be seen in diminishing pressure of pushing factors of internal migration, supporting single and working mothers, sex equality and improving living conditions of people in remote settlements.

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