Charles University in Prague

Faculty of Science

Study program: Demography

Mgr. Fariza Tolesh

Population prospects of Kazakhstan till 2030

Populační perspektivy Kazachstánu do roku 2030

Doctoral Dissertation

Supervisor: RNDr. Tomáš Kučera, CSc.

Prague, 2012

Charles University in Prague

Faculty of Science

Doctoral Dissertation

Prague 2012

Fariza Tolesh

Disclaimer

The results of the population forecasts for Kazakhstan presented in this dissertation are not valid in the event of war, natural disaster or major economic crises.

Population prospects of Kazakhstan till 2030

Abstract

Population change affects national income, national expenditure, and the demand for services such as education, health and transport. Therefore, information about future population size and structure obtained with the help of population forecasts, which can be used for a wide range of decision-making purposes, is of paramount importance. The primary aim of this dissertation is to produce three different types of population forecasts for Kazakhstan till 2030 and by comparing and analysing the differences to find out the most important factors determining the population development process in the country. Kazakhstan is a country with significant size and regional diversity which makes it relevant to consider those dimensions in population forecasting. Most southern oblasts of the country have a young population structure meaning that much of future population growth, particularly of working age, will come from these regions. Also, native population tends to concentrate in rural areas, while industrialized cities are mostly populated by non-natives with considerably different nuptiality and fertility behaviour. Despite such regional and residential demographic differences, presently the country is experiencing an overall increase in birth rates. Many claims are made that this upward fertility trend will continue in the future, however no quantitative population forecasts, or indeed any other evidence, have been produced at the source of these claims. In this study we attempt on the basis of the current demographic situation's analyses to find out most probable future population development patterns in Kazakhstan and to identify whether regional dissimilarities really make any great difference in the forecast results or not.

Keywords: population, development, forecast, projection, Kazakhstan

Contents

LIST OF FIGURES **6**

LIST OF TABLES AND MAPS **9**

INTRODUCTION **10**

1 LITERATURE REVIEW **14**

2 CONCEPTUAL AND THEORETICAL FRAMEWORK **18**

2.1 Basic concepts and terminological remarks 18

2.2 Outline of relevant population related theories 19

2.2.1 Demographic transition theory 20

2.2.2 Second demographic transition 22

2.2.3 The theory of epidemiologic transition 26

2.2.4 The mobility transition 28

3 DATA AVAILABILITY AND QUALITY **30**

4 POPULATION FORECASTING APPROACHES AND TECHNIQUES **34**

4.1 Basic approaches 34

4.1.1 Approaching the subject: Alternative views to population development 34

4.1.2 Approaching the object: Forecasting in a hierarchical regional system 41

4.1.3 Approaching the process: The scope and phasing of forecasting 42

4.2 Cohort-component projection model 45

4.3 Forecasting components of population development 47

4.3.1 Fertility forecasting methods 48

4.3.2 Methods of mortality forecasting 49

4.3.3 Forecasting migration 51

5 IDENTIFICATION OF THE POPULATION SYSTEM **54**

5.1 Recent population dynamics 54

5.1.1 Population size and structure 55

5.1.2 Fertility 61

5.1.3 Mortality 67

5.1.4 Migration 73

5.2 The system delimitation and specification 81

6 **CONSTRUCTION OF THE MODEL** 88

6.1 Fertility 88

6.2 Mortality ... 93
6.3 Migration ... 98

7 **FORMULATION OF ASSUMPTIONS AND FORECASTING MODEL PARAMETERS** ... 107

7.1 Fertility ... 107
7.2 Mortality ... 112
7.3 Migration ... 115

8 FORECAST RESULTS ... 120

8.1 Population size ... 120
8.2 Age and sex structure ... 122
8.3 Urban/rural distribution ... 124
8.4 Accuracy issues ... 126

CONCLUSION ... 128

REFERENCES ... 131

ANNEX ... 139

List of figures

Figure 1 A diagram of the demographic transition model 20
Figure 2 The state of the demographic transition in Kazakhstan, 1950-2010 22
Figure 3 Model of First and Second Demographic Transitions 25
Figure 4 Linear curve types 35
Figure 5 Geometric curve types 35
Figure 6 Parabolic curve types 36
Figure 7 Modified Exponential curve types 36
Figure 8 Gompertz curve types 37
Figure 9 Logistic curve types 37
Figure 10 Single region population system 40
Figure 11 Multiple region population system 40
Figure 12 Stages of population forecasting 43
Figure 13 Population forecasting methods 47
Figure 14 Population of Kazakhstan, 1920-2010 56
Figure 15 Kazakhstan's population pyramids, 1959-2010 58
Figure 16 Kazakhstan's regional population distribution by age and sex, 2010 59
Figure 17 Kazakhstan's regional population by ethnic composition, 2010 60
Figure 18 TFR and Mean age at childbirth by oblasts of Kazakhstan, 1999 and 2010 63
Figure 19 ASFR by five-year age groups (per 1000 females), Kazakhstan 1989-2010 64
Figure 20 ASFR by five-year age groups and urban/rural places of residence (per 1000 females), Kazakhstan 1999 and 2010 64
Figure 21 ASFR by five-year age groups (per 1000 females), Kazakhstan 1989 and 1999-2010 65
Figure 22 ASFR and percentage distribution of fertility rates in selected oblasts, Kazakhstan 1999 and 2010 66
Figure 23 ASFR by ethnicities (per 1000 females), Kazakhstan 1999 and 2005 67
Figure 24 Life expectancy at birth by sex, Kazakhstan 1980-2010 68
Figure 25 Life expectancy at birth by sex and urban/rural place of residence, Kazakhstan 1999 and 2010 69
Figure 26 Trends of life expectancies at age 60 in Kazakhstan, 1985-2010 69
Figure 27 Life expectancy at birth by sex and regions of Kazakhstan 1999 and 2010 70
Figure 28 Infant mortality by urban/rural place of residence, Kazakhstan 1983-2010 71

Figure 29 Infant mortality by regions of Kazakhstan 1999 and 2010 72
Figure 30 Age-specific probabilities of dying per 1000 persons, Kazakhstan, 1990 and 2010.. 73
Figure 31 Natural increase and net-migration, Kazakhstan, 1990–2010 76
Figure 32 Internal migration in Kazakhstan (thousands), 1991–2010 77
Figure 33 Proportions of migrants and non-migrants, by age and sex Kazakhstan (1999, 2008) 79
Figure 34 Directions of internal migration in Kazakhstan by regions, 1999 81
Figure 35 Directions of internal migration in Kazakhstan by regions, 2008 81
Figure 36 Aggregation of urban fertility regions, TFR, Kazakhstan, 1999-2010 89
Figure 37 Aggregation of rural fertility regions, TFR, Kazakhstan, 1999-2010 90
Figure 38 Aggregation of urban fertility forecast regions, ASFR, Kazakhstan, 1999-2010...... 91
Figure 39 Aggregation of rural fertility forecast regions, ASFR, Kazakhstan, 1999-2010 92
Figure 40 TFR for urban/rural main aggregated fertility forecast regions, Kazakhstan, 1999 - 2010 93
Figure 41 ASFR for urban/rural main aggregated fertility forecast regions, Kazakhstan, 1999 and 2010 93
Figure 42 Life expectancy at birth by sex and urban/rural place of residence, Kazakhstan, 1999 - 2010 94
Figure 43 Life expectancy at birth by sex and urban/rural place of residence, Kazakhstan, 1999 and 2010 94
Figure 44 Life expectancies by sex and urban/rural place of residence and regions, Kazakhstan, 2010 95
Figure 45 Probability of dying at exact age 0 urban/rural place of residence and regions, Kazakhstan, 1999-2010 96
Figure 46 Probability of dying at exact age 45 by sex and urban/rural place of residence, Kazakhstan, 1999-2010 96
Figure 47 Probability of dying by sex and urban/rural place of residence, Kazakhstan, 1999 and 2010 97
Figure 48 Probability of dying by sex and urban/rural place of residence, Kazakhstan, 2010.. 97
Figure 49 Life expectancies for aggregated mortality forecast regions by sex and urban/rural place of residence, Kazakhstan 98
Figure 50 Probability of dying for aggregated mortality forecast regions by sex and urban/rural place of residence, Kazakhstan 98
Figure 51 Share of migration types by regions, Kazakhstan, 1999 and 2010 99
Figure 52 Share of regions in migration types, Kazakhstan, 1999 and 2010 99
Figure 53 Intensity of immigration by regions and sex, Kazakhstan, 1999-2010 101
Figure 54 Age and sex structure of immigration, Kazakhstan, 1999 and 2010 101
Figure 55 Age and sex structure of emigration, Kazakhstan, 1999 and 2010 102
Figure 56 Net international migration rate by age and sex, Kazakhstan, 1999-2010 102
Figure 57 Age and sex composition of international migrants by regions, Kazakhstan, 2004-2010 103
Figure 58 Aggregated age schedule of international migrants by sex, Kazakhstan 103

Figure 59 In-migration destination shares by urban/rural place of residence and sex Kazakhstan, 1999-2008 104
Figure 60 Out- migration destination shares by urban/rural place of residence and sex, Kazakhstan, 1999-2008 104
Figure 61 Share of regions in interregional in and out-migration, Kazakhstan, 1999&2008 .. 105
Figure 62 Age and sex structure of interregional migrants, Kazakhstan 1999 and 2008......... 105
Figure 63 Aggregated age schedule of interregional urban migrants by sex, Kazakhstan 106
Figure 64 Aggregated age schedule of interregional rural migrants by sex, Kazakhstan 106
Figure 65 Percentage distribution of fertility rates in Kazakhstan, Turkey and France........... 110
Figure 66 Age-specific fertility rates: Low, medium and high variants and 2011,Kazakhstan110
Figure 67 Age-specific fertility rates: Low, medium and high variants and 2011 by forecast units............ 111
Figure 68 Probability of dying by sex: High, medium, low variants and 2011 112
Figure 69 Probability of dying by sex and urban/rural place of residence: High, medium, low variants and 2011............ 113
Figure 70 Net international migration: Kazakhstan 1990-2030 (medium variant) 116
Figure 71 Net urban/rural migration by sex (medium variant) 117
Figure 72 Actual and assumed interregional migration, 1991-2030 (medium variant) 118
Figure 73 Actual and forecasted population of Kazakhstan: medium variants of three types of forecasts............ 121
Figure 74 Differences between the state level Kazakhstan forecast and other forecast types . 121
Figure 75 Trends in the proportion of major age groups: High, medium and low variants..... 123
Figure 76 Population pyramid: Medium, high and low variants and 2011.............................. 123
Figure 77 Actual and forecasted urban/rural population: two types of forecasts (medium variants) 124
Figure 78 Urban/rural population pyramid: two types of forecasts (medium variants)........... 125
Figure 79 Total dependency ratio: two types of forecasts (medium variant)........................... 126

List of tables and maps

Table 1 TFR by regions and urban/rural places of residence, Kazakhstan, 1999 and 2010 ... 62
Table 2 Ethnic composition of population in Kazakhstan (%), 1897–2010 ... 75
Table 3 Pearson's correlation coefficient between economic indicators of regions for the period of 1999–2007 ... 78
Table 4 List of variables used in the cluster analysis ... 83
Table 5 SWOT analysis ... 86
Table 6 Proportion of migrants from population by regions and migration types, Kazakhstan, 1999 and 2010 ... 100
Table 7 The total fertility rate: Medium, low and high variants ... 108
Table 8 The total fertility rate: Medium, low and high variants by forecast units ... 109
Table 9 Expected change of life expectancy at birth by sex (Kz) ... 114
Table 10 Expected change of life expectancy at birth by sex and urban/rural place of residence Kz(U,R) ... 114
Table 11 Expected change of life expectancy at birth by sex and urban/rural place of residence forecast unit ... 115
Table 12 Shares of regions in international migration, 2011-2030 (medium variant) ... 117
Table 13 Shares of regions in interregional migration, 2011-2030 ... 118
Table 14 Net interregional migration by sex and regions, 2011-2030 (medium variant) ... 119
Table 15 Population growth rates, Kazakhstan 2012-2030 (three forecast types and variants) ... 121
Table 16 Median age and total dependency ratio by sex (Kazakhstan, medium variant) ... 124
Map 1 Regions of Kazakhstan ... 55
Map 2 Population density in Kazakhstan, 1999 ... 57
Map 3 Population density in Kazakhstan, 2010 ... 57
Map 4 Rural fertility forecast regions, Kazakhstan ... 84
Map 5 Urban fertility forecast regions, Kazakhstan ... 85
Dend. 1 Fertility rural clustering ... 83
Dend. 2 Fertility urban clustering ... 84
Dend. 3 Mortality clustering ... 85

Introduction

The future is inherently unknown and in most regards – unknowable, however people are always fascinated about it. At all levels – local, national and global many professionals, politicians as well as ordinary people are concerned about political, socioeconomic, cultural and environmental consequences of demographic changes which might, perhaps, explain growing interest in population forecasts and projections.

Various factors influence demographic situation in the country often in unpredictable ways and the present population size and structure is fundamental in determining the prospects of the socioeconomic development, political stability and national security. Due to the current age and sex composition and because of the swiftly spreading attitude of “egoistical individualism” among young generations the age-structure of the population of Kazakhstan is most likely to change in the future. The rise of the birth rate which could be noticed nowadays is most probably of a temporary character and in all likelihood it is the result of population momentum of the second wave of so called “Baby Boom” of the mid 1980s combined with realization of the births postponed during the transition period. Certainly, the present boom of births will somehow put off for several decades and overlay the massive retirement of the first wave of baby-boomers in 10-15 years; however it does not mean that Kazakhstan has evaded ageing of its population in the later future.

In such circumstances, the development of socioeconomic policies and measures that will help to reduce the negative effects of coming changes of the size and age structure of Kazakhstani population requires deep and systematic study. And any amendments in policies and strategies related to production and consumption of goods and services, social infrastructure, housing, health care and pension systems, education etc. are impossible without knowledge of the future demographic situation in the country. Population forecasting is one of the constituent elements of planning and decision-making. It allows us to identify the possible shifts in socioeconomic development and plays an important role in the evaluation of long-term plans

Forecasting future population size and structure is one of the most important tasks of any national statistics but unfortunately not all of them are capable of producing official forecasts and/or projections yet, because of many different reasons. Population forecasts usually may differ in their time horizon, geographic coverage, methods applied and their use. Geographic coverage can range from local areas like counties or cities to the entire world. Local-area forecasts tend to use shorter time horizons, typically around 10-20 years, whereas national forecasting can extend decades into the future. Usually a small region forecasts include such characteristics as educational and labour force composition, urban/rural places of residence, ethnics or household type. In contrast, forecasts made for large areas and longer terms typically output more limited number of variables, primarily population broken down by age and sex.

The diversity of types of forecasts is driven by the diversity of users' needs (Lutz et al 1996). Commercial organizations often use forecasts for marketing research and generally want population classified by socioeconomic categories such as income and consumption habits (in addition to age and sex) and by place of residence. Government planners may be concerned with population aging and its potential social and economic impact. They may, therefore, desire longer-term forecasts, and want to know more about the health status and living arrangements of the elderly (O'Neill et al 2001).

With regard to an application of population forecasts in planning and decision making activities by institutions related to social, economic and political fields is not yet wide-spread in Kazakhstan as it might be desired. This may be related to the fact that, although, the Agency on Statistics of Kazakhstan is decennially conducts nationwide Census of Population, however it does not carry out any official forecasts. Apart from the international institutions, there are only several private vendors making forecasts or more precisely, projections, but they are not sufficient enough to meet the current and future needs in qualitative and accurate population forecasts in Kazakhstan.

The four major institutions producing population projections for nearly all of the world’s main countries and regions, including Kazakhstan, and disseminating their results are the United Nations (UN), United States Census Bureau (USCB), the World Bank (WB), and the International Institute for Applied Systems Analysis (IIASA). For some reasons the Institutions offer markedly different results. For example, according to the UN’s projection population of Kazakhstan will reach approximately 18,5 million in 2030 whereas the U.S. Census Bureau’s International Data Base suggests slightly more than 20 million people for the same year.

The explanation for such significant difference in the results could be found in methods applied by the institutions or in the accuracy of data used, in any case, the main point is that except giving general descriptions of their methodology, neither UN nor the USCB provide a detailed accounting of the reasoning underlying the specific assumptions made for different countries and regions of the world (O’Neill et al. 2001) and also they do not take into account peculiarities of demographic situation of a country under study in terms of historical trends and regional diversifications.

Therefore, it is absolutely necessary for any country to develop its own sphere of population forecasting, to prepare professional demographers and acquire experience by continually producing forecasts and that may, in time, permit to meet the requirements in relevant and appropriately done forecasts, which will certainly, extend their use by policymakers and other users, and also, lead to improvements in decision making process.

Thus, the general aim of this dissertation is, to produce three separate population forecasts for the county within a 20 years horizon. Hence, the principal objective of the present study focuses on comparison of results of these independently done forecasts however based on the similar approach and methods, and by that to give a detailed insight into the process of population development in Kazakhstan and help to identify the leading factors of demographic change. Besides, the generation and production of our own forecasts may help to lay the foundation for the professional estimations of the future population in Kazakhstan and start to fill the existing gap in this field.

In addition, this dissertation deals with collection and inspection of data on main components of demographic change - fertility, mortality and migration on the state as well as regional levels. It is essential to study and analyse these demographic indicators to develop models describing their dynamics. Various literary sources were examined on this issue substantially of international provenance, hence, the dissertation is scientifically relevant as a part of the forming domestic theoretical framework on population forecasting in Kazakhstan.

The consideration of urban/rural places of residence and regional diversities in producing forecasts of different types labeled as Kz(U,R) and Kz(16r) is a very important feature of this study. In Kazakhstan, owing to historical, social and economic factors population is distributed rather unevenly between regions, moreover, nearly half of the population lives in rural areas and mostly concentrated in southern, south-west and some in western parts of the country. As it is characteristic, rural population have younger age structure resulting from higher birth rate than urban population and in this regard the case of Kazakhstan is no exception. Furthermore, depending on region, ethnic composition also tends to vary considerably as well as do the levels of economic development. Also, many new trends have arisen during the transition period with socioeconomic reforms and consequently they have strongly influenced population development components such as fertility, mortality and rural-to-urban migration.

Therefore, based on above mentioned criteria and using available data we attempt to study the following questions:

- What are the major characteristics determining population development and change?
- Do regional and residential differentials make difference in forecast outcomes?
- And if yes, will these differences persist in the future?
- What is the most probable future population of Kazakhstan and its sex and age composition?

It deserves to be noted, that it is the first time when such kind of population forecasts for Kazakhstan are going to be conducted and published. From this point of view, the present dissertation can be considered as a pioneer study.

In addition to this introduction, the dissertation consists of eight chapters. Chapter 1 reviews the recent literature dedicated to the issue of population forecasting. The basic concepts, terminological remarks and outline of relevant population related theories are given in Chapter 2. In Chapter 3 I will comment on quality and characteristics of the data and sources. The aim of Chapter 4 is to describe the existing approaches, methods and models that are usually employed in population forecasts. In Chapter 5 identification of the population system will be done as well as the description of recent population dynamics is given with measurements and analyses of population categories for which forecasting will be done. Also this chapter gives the reasoning of choice of population categories and examination of their relevance using cluster and SWOT analyses. In the sixth chapter we will concentrate on construction of the model by finding out fertility, mortality and migration schedules and patterns. Chapter 7 will be devoted to formulation of assumptions for future course of population components by regions and urban/rural place of residence over the next 20 years. The key results will be summarized with analyses of differences between the three forecast types along with addressing the issues of accuracy in the final Chapter. The very last Section will conclude the discussion.

Chapter 1

Literature overview

As was mentioned before population forecasting constitutes a relatively new area of demographic research in Kazakhstan and consequently the literature that has been published is very limited at the national level however on the international scale a great deal of attention was paid to the subject. The review that follows gathers the literature that has been undertaken on this topic and provides a summary of historically important works which have contributed to population forecasting methodology.

Population forecasting is an important element of a comprehensive long-term socioeconomic development planning. The history of population forecasting was largely determined by the practical needs and requirements of a various state agencies and government for population data who understand the role of demographic factors in the development of the society and also by the level of scientific researches in the economical, statistical and mathematical spheres.

The first attempts to make a population forecasting were limited by the estimation of the so-called doubling period of the population. In the early XVII century the doubling period of the British population was calculated as 280 years by J Graunt, later W. Petty suggested a smaller increase and defined the period as 360 years. Petty's follower an English economist and statistician G. King in the mid of the XVII century took as a principle of population forecasting the hypothesis of population growth in the arithmetical progression. On the basis of this hypothesis he forecasted the population of England for 600 years ahead, but later it turned out to be inaccurate because in 1800 the population was 1.5 times greater than he suggested earlier.

At the end of XVIII century the Swiss-Russian mathematician L. Euler worked out that the doubling period of a population is 12.5 years. Although, such rate exceeds the population growth rate of any country, however, his theoretical considerations were very important for the development of population forecasting.

In 1790 was published the thesis "Statisticheskoe izobrajenie Rossii" ("Statistical picture of Russia") by well-known at that time statistician I. Herman. In this work he presents a prediction of the doubling period of the Russia's population using its 2-percent annual growth rate, and again, this prediction was also quite inaccurate.

During the Soviet era, the first population forecast was made in 1920 by the S. Strumilin, who was among those, who first applied in his forecast the consistently growing rate of natural increase and was able to obtain strikingly correct outcomes. The discrepancy between the forecasted and the actual size of the population on the eve of World War II was only 3%.

Unlike European situation, political crises of the first half of the XX's century, which than led to deep economic and social complications in all countries of the Soviet Union, resulted in retardation of further development of forecasting methodology and popularization of population forecasts' usage.

However, after the dissolution of the Soviet Union, each country took its own path of development. Some were intensely engrossed in ordering, reforming and improving of the basic state of affairs for country's existence and for the subsequent survival as the case of Kazakhstan, while, others have a long time ago understood the utter importance of application of population forecasts and projections in decision-making processes and were working vastly on this field, which is the case of Russia.

The Russian demographic school is one of the advanced in the Post-soviet domain, with extensive works by S. Soboleva (1988), A. Volkov (1988) and A. Boyarski (1976) devoted to the different issues of demographic forecasting.

Although, amount of actual and accumulated knowledge as well as of practical experience can differ from school to school, however, expanding communication between national institutions and organizations results in diminishing the differences of applied methods and theoretical framework.

Since the mid-XX century the dominant approach for forecasting population from global to local levels has been cohort-component method. Almost all modern population forecasting is based on some form of the "cohort components" method of projection (Bogue, 1980). Initial populations for countries or regions are grouped into cohorts defined by age and sex, and the forecasting proceeds by updating the population of each age- and sex-specific group according to assumptions about three components of population change: fertility, mortality, and migration. Each cohort survives forward to the next age group according to assumed age-specific mortality rates (O'Neill et al., 2001).

The idea of this approach was first suggested by the English economist E. Cannan in 1895. Later, in 1930's P. Welpton of the Sripps Foundation for Research on Population Problems, Miami University, Ohio further developed the method of components. Mathematically it was formalized by P. Leslie and first applied by F. Notestein (1945).

Although, the cohort-component technique is widely used (Klosterman, 1990), there are other alternative methods of forecasting population such as e.g. extrapolation. Before the above mentioned method had been formalized, the aggregate time series model was already adopted by Pearl and Reed in 1920's and later re-introduced by Leach (1981). Despite the fact, that some argue that simple extrapolation and more sophisticated aggregate time series methods still have much to offer forecasting methodology (Lee et al 1995, Pflaumer 1992), such methods may in fact be more accurate than the cohort-component method over short time horizons i.e., up to a decade (Pflaumer, 1992; Rogers, 1995). In addition to these methods there is microsimulation model, which treats, unlike cohort-component method, each individual independently and uses repeated random experiments instead of average probabilities (van

Imhoff and Post (1998). Also, in order to account for the place of residence, Rogers (1975) using the cohort component framework developed multistate cohort-component model.

Among other authors the works of J. Alho (1985), Spencer (1997) and Kupiszewsky M. (1989) on description of forecasting methodology certainly deserve our attention. A vast research and detailed overview of population forecasting approaches as well as methods also can be found in the publications of Keyfits. The methodological issues of regional population forecasting are discussed by T. Kucera (1998) in his dissertation work.

In regard to race/nationality/ethnicity forecasts or projections there not much available literature. In such works very different methodology is being used by different countries, agencies and authors which are Munz and Ulrich (1997) for Denmark, Sweden and Germany; Statistics Netherlands (1999) in the Netherlands; Le Bras (1997) in France. Also forecasts have been produced by ethnicity/birthplace for particular groups or regions such as Aboriginal populations (Australian Bureau of Statistics,1998), native Indians in Canada (Nault et al,1995), ethnic groups in Gui Zhou in China (Wang and Guo, 1997) and gypsies in Czechoslovakia (Kalibova,1990). The USA probably has the longest tradition and the largest literature on race/ethnic group forecasts, and also has produced the most detailed forecasts by race (Storkey, 2002).

Most of the forecasts that are carried out for a range of categories (besides age and sex) and birthplace groups have used a component method with separate assumptions of fertility, mortality and migration. As a result, to undertake such forecasts a huge amount of data is necessary, which probably explains the limited literature on the topic.

Forecasts of population size and structure are central to social and economic planning, from the provision of services in the short term to policy development in the long term (Hyndman and Booth, 2008). One of major challenges in developed countries relates to population ageing which is closely connected to fertility fluctuations. In order to “amend” consequences of rapid ageing such as labour shortage many European countries increased immigration thus making it a major driver of population change in many industrialized countries. Therefore, all three components of demographic changes should receive thorough consideration as well as uncertainty issue of population forecasts.

Traditionally, forecasters when dealing with uncertainty rely on a deterministic approach informed by expert opinion, with three potential scenarios that are meant to provide a range of possible future outcomes and can be made separately for fertility and mortality, and then the scenarios will be combined to forecast the total population.

The practice of computing more than one forecast variant is standard among statistical agencies (Keilman and Cruijsen 1992). It goes back at least to 1947, when Whelpton (1936) and colleagues published their forecast for the United States. Statistical agencies follow this practice because they want to account for the fact that the future is inherently uncertain, and that different forecast assumptions will lead to different forecast outcomes (Keilman, 2005). There are some drawbacks connected to this traditional approach, which relates to the fact that statistical distributions are not included in the forecasting model, hence, no probabilities are attached to the variants and this poses a problem for the user of the forecast, who has to select one of the variants as input for his analysis (Keilman, 2003).

Therefore, researchers in recent years have been taking steps toward correcting some of the problems associated with deterministic forecasts by creating stochastic (probabilistic) forecasting mode that better deal with the uncertainties (Okita et al, 2009). The development of stochastic approach is the latest major contribution to mathematical statistics, the origins of which date back to the 1930s. Key developments in this area include Lee and Carter (1992), which provides a methodology for making a stochastic forecast of mortality rates in the United States using singular value decomposition with only a few parameters. Lee (1993) expands the method to apply to the less predictable fertility rates by also incorporating additional constraints on the potential fluctuations in the total fertility rate, and Lee and Tuljapurkar (1994) combines the fertility and mortality forecasts using a cohort component model to make a stochastic forecast for the United States population. Lee (1999) provides further justifications for using the stochastic approach for population forecasting. For other countries, Hyndman and Booth (2008) produce a forecast for Australia, and Keilman, Pham, and Hetland (2002) examine the case of Norway (Okita et al, 2009)..

However, there are some temporary downsides to it too. Often users have difficulties understanding statistical products that derive from complex mathematical-statistical applications; for a statistical-demographic technique to be useful, necessarily it must be communicable to users and fully meet the understanding of users, which will take some time (see e.g., Goldstein, 2004). On the other hand, the new outlook that uncertainty of population forecasts is a fundamental aspect is already widespread (see e.g., Keilman, Pham, and Hetland, 2002; Long and Hollmann, 2004; Lutz and Goldstein, 2004).

The issues of uncertainties in population forecasts are also extensively studied in the works of J. M. Hoem (1973), A. Isserman (1977). A great deal of attention has been focused on analysis and evaluation of the accuracy of population forecasts and sources of errors also by Keilman (1990), Long (1995), Smith and Sincich (1992), Stoto (1983), Swanson and Tayman (1995).Apart from that, there is a great deal of literature which has been written about population forecasting methodology by Pittenger (1976), Shryock and Siegel (1973) and others.

Chapter 2

Conceptual and theoretical framework

Generally, in the international literature terms "population forecast" and "population projection" are treated as synonyms, and as a result their formally similar but diametrically different outcomes are frequently interpreted in the same way, usually as forecasts. Therefore, bearing in mind this fact and in order to avoid any terminological, methodological and application misinterpretation we present more detailed discussion of the terms in the first section of this chapter.

The outline of relevant theories contains four theoretical concepts. They are describing and justifying general developmental changes of selected components relevant to current and future character of population reproduction in Kazakhstan. The concepts of four transitions: demographic revolution, and the second demographic, epidemiological and mobility transitions are overviewed in the second part of this chapter. Then they will be further elaborated and converted into the theoretical background of our research in the later stages.

2.1 Basic concepts and terminological remarks

Usually most population forecasts are done by the request of a user who is not closely acquainted with specific demographic terms and it is essential for a presenter to remember this fact. Generally, there are three mostly used terms involved in population statistics: *population projections*, *population forecasts* and *population estimates*. These three terms are clearly defined in [Smith et al. 2001], from which the following definitions are cited.

Population projection is the numerical outcome of a particular set of assumptions regarding future population trends. Some projections refer only to total population, but many make further classification by age, gender and other characteristics. What is important is that population projection is conditional statements about the future. It only shows what would happen if specific assumptions were to hold true. But it does not predict whether those specific assumptions actually will hold true. Therefore, *population projections* are always right if they are numerical error free.

On the other hand, a *population forecast* is the projection that the analyst believes is most likely to provide an accurate and plausible prediction of the future population. Population forecasts are unconditional statements that reflect the analyst's views regarding the optimal combination of data resources, projection techniques and methodological assumptions. Unlike population projections, *population forecasts* can be evaluated by the relatively small or large errors with which they approximate the future. According to Smith et al., *population forecasts* can also be viewed as predictive *population projections* while most *population projections* are only illustrative rather than predictive.

Population Estimates are much too different with *population projections*. The most fundamental difference is that *population projections* refer to the future whereas *population estimates* refer to the present or the past.

Most statistical agencies claim to produce *projections,* however, *a projection* becomes a forecast if it is asserted that the assumed fertility, mortality and migration will in fact take place. As Keyfitz (1972, p. 347 and 353) states, "a demographer makes a projection, and the reader uses it as a forecast". This is especially true since a large number of agencies generally prepare "high", "medium", and "low" projections and label the "medium" variant as most plausible while considering the "high" and "low" variants as the approximate range within which future population would fall. What we will do in this dissertation is in the category of *population forecasts.*

2.2 Outline of relevant population related theories

The characteristics of the population such as size, age structure, and vital rates are fundamental for forecasting purposes, since the current age-sex composition has a direct influence on future age-sex distribution through the components of change which can be accordingly differentiated by age and sex. Besides, disaggregation of the population by regions and urban/rural place of residence is also essential due to the fact that population by these categories may strongly differentiate with respect to rates of fertility and mortality.

Although, with some certain effort the characteristics of the base population can be known with sufficient accuracy, however correctness of the forecasted future trends of vital rates is always questionable. Therefore, these vital events should have to be estimated with consideration of the historical trends, current socioeconomic situation and certainly theories attempting to explain the nature and causes of occurring events.

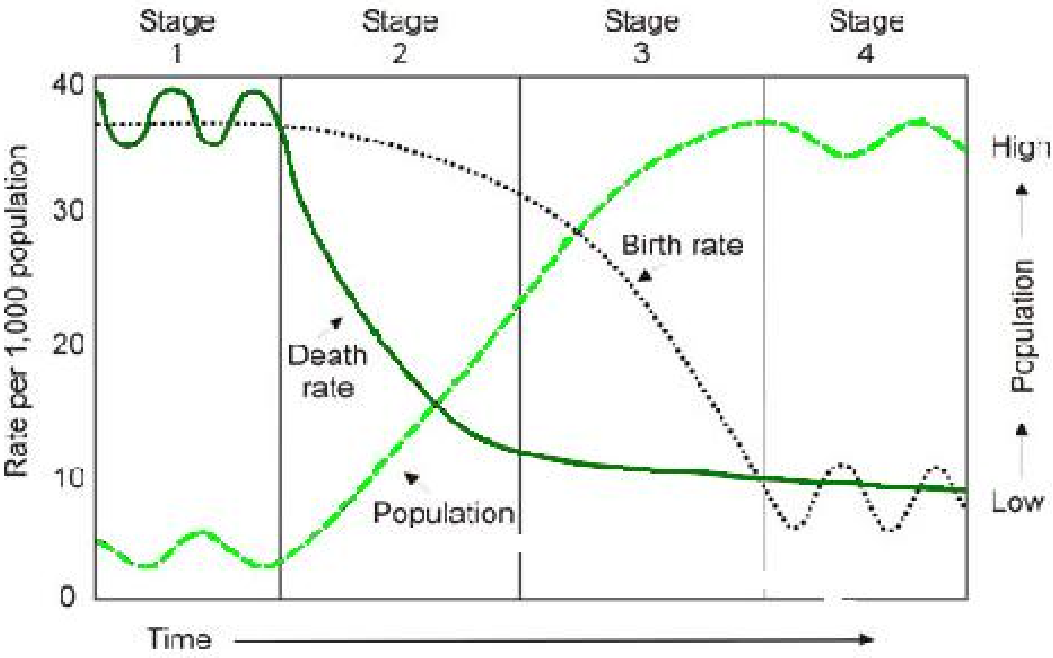
The status of theory in demography has been problematic and according to Keyfitz, many important theoretical relations derived from perfectly valid research cannot be usefully incorporated in forecasts (for details see Keilman, 1990). However, there are several recognised theories in demography such as the first demographic transition theory, the theory of the second demographic transition, epidemiological transition and certainly, apart from them exist some other theories and models in demography. In the following section the theoretical framework that tries to explain the changes and variations occurring in demographic processes will be provided.

2.2.1 Demographic transition theory

Despite the fact, that demography is a science short on theory, it has produced one of the best-documented generalizations in the social sciences: the demographic transition (Kirk, 1996). As a part of the process of modernization, it has been observed that countries advance from a situation of relatively low population growth produced by the coexistence of high levels of fertility and high levels of mortality to a new state where both fertility and mortality levels are low. It is known that the first definition of the demographic transition was given by F. Notestein in his article published in 1945, although he did not refer to his generalization as a 'transition'. The expression 'transition' was first used in the book published in 1934 and entitled La Revolution Demographique by Adolphe Landry.

There are distinguished four and/or five stages in the demographic transition (see Figure 1). In stage one death rates and birth rates are both high and depend on changes of natural events, such as drought and disease, and population is more or less constant with high proportion of young age groups. At this stage children are mainly viewed as contributors to the general process of a household maintenance, and parents treated them as helpers and labour force which required very little expenses.

Figure 1 - A diagram of the demographic transition model



Source: pdsblogs.org

In stage two death rates fall while fertility is still high which leads to increase in population numbers, so-called "population explosion" takes place as a result the age structure of the population changes. In stage one the majority of deaths concentrated in the first several years of life, but with falling numbers of deaths many children had chances of survival, hence the age structure of the population becomes increasingly youthful and more of these children enter the reproductive cycle of their lives while keeping the high fertility rates of their parents. The bottom of the "age pyramid" widens first, accelerating population growth.

Main reasons of mortality decrease could be related to changes and modification in agriculture which results in improvement of food supply. Also, public health and general personal hygiene gets better due to growing scientific knowledge of the causes of disease and the improved education and social status of mothers, however there were not much medical breakthroughs.

The third stage leads the population to stability since mortality is relatively low and now fertility is also falling. Decline of birth rates could relate to the fact that the value of children changes considerably, people start to realize that there is no need and no use in many children because at this time it became obligatory to give children education which means that they need more clothing, they need books, toys and school keeps them out from domestic work and instead of help parents get more burdened by high numbers of children. Besides, education becomes widespread among women so many of them start to work. Working women have less time to raise children and valuation of women beyond childbearing and motherhood becomes important. Another major factor in fertility decline is improvements in contraceptive technology, their availability and knowledge of how to use them. Proportion of children in the age structure of the population decreases whereas the share of elderly people starts to rise. During the period between the decline in number of children and rise in old age dependency there is a demographic window of opportunity that can potentially produce economic growth through an increase in the ratio of working age to dependent population; the demographic dividend.

In stage four fertility rates are as low as mortality and population is high and stable. The original Demographic Transition model has just four stages; however, some theorists consider that a fifth stage is needed to represent countries that have sub-replacement fertility. Most European and many East Asian countries now have higher death rates than birth rates.

As with all models, this is an idealized picture of population change. The model is a generalization that applies to the countries as a group and may not accurately describe all individual cases. The detailed path followed by a particular country will depend on the magnitude of the disparity observed between the levels of fertility and mortality.

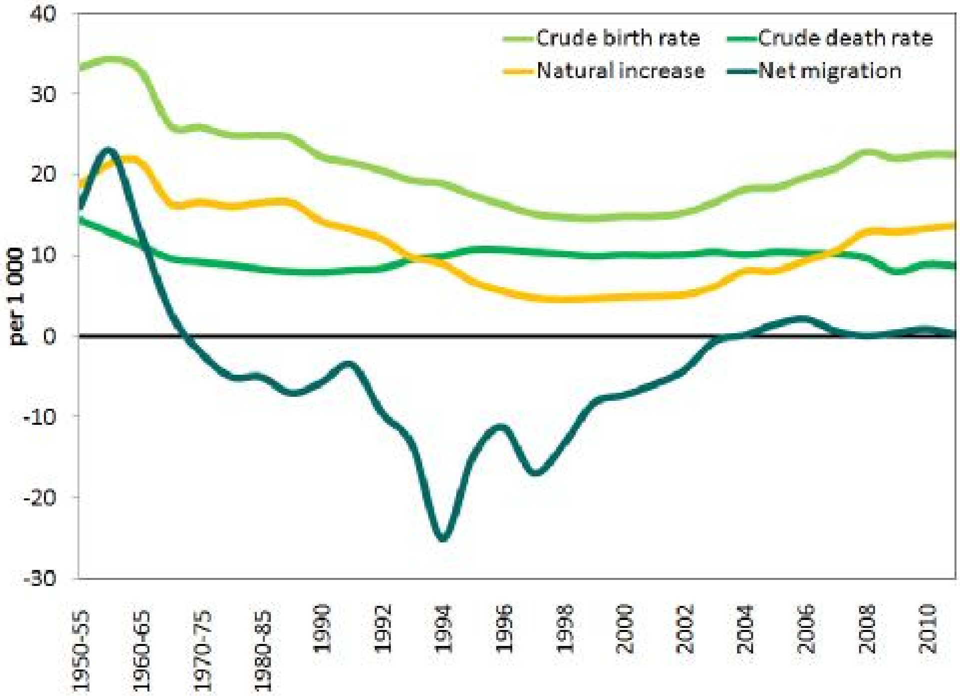
The Kazakhstan's path of the demographic transition is depicted in Figure 2. There are no easily accessible and reliable figures for the period prior to 1950s which could have allowed having more complete picture of the situation. In general, Kazakhstan's demographic transition is somewhat close to the classical path but not without deviations. These deviations could be related to the country's very dramatic and full of tumultuous events history.

During the post-war decades Kazakhstan experienced a period of considerable natural growth which is also known in demographic history as "baby-boom" effect. Usually, after the baby-boom period occurs the period of decline till the time when these baby-boomers reach the reproductive age, which also happened in Kazakhstan. Since the mid 1960s a sharp decline of number of births took place till the beginning of 1970s then followed the period of more or less stable and moderate increase from 1970 until the dismantling of the USSR. The primary cause of the sustained fertility decline in the county could be attributed to declining family size preferences among ethnic Kazakh population.

The dissolution of the Soviet Union led to a dramatic decline in the economic output and living standards throughout the post-Soviet world, including Kazakhstan. The deep economic crisis of the early post-Soviet years was accompanied by a no less dramatic drop in fertility. TFR during 1990s fell well below replacement level. After the early post-Soviet period, the economic and political situation in the country gradually stabilized and growth resumed.

Kazakhstan, richly endowed with oil, natural gas, and other mineral resources, has experienced vigorous economic growth and a commensurate rise in incomes and since the 2000s the country is enjoying fertility enhancement which is most probably related to the population momentum phenomenon and could be temporal in character.

Figure 2 - The state of the demographic transition in Kazakhstan, 1950 - 2010



Source: stat.kz

In general, it is not easy to clearly determine which stage of which demographic transition (detailed description of the Second demographic transition is given in the following section) Kazakhstan is currently undergoing, because features of both transitions could be found in the present demographic situation of the country. Despite relatively high birth rates of the last several years and still high mortality rates which are characteristic of the demographic revolution, many other indicators such as growing mean age of population, divorce rates, mean age at birth, share of elderly people and changing family values and attitudes demonstrate that overall demographic situation in Kazakhstan is tend to have rather unexpected changes in the future than the present situation might suggest.

2.2.2 Second demographic transition

According to the first demographic transition theory mortality decline after experiencing changes in demographic behaviour influenced by progress in society (Kirk, 1996). According to Notestein (1945) the impact of the modernization process in people’s lives and in society as a whole the long-term demographic balance had to be established at low levels of both mortality and fertility and we would move from one long-term quasi-equilibrium to another. However, agreeing with Bongaarts, who said that: ‘if fertility in contemporary post-transitional societies had indeed levelled off at or near the replacement level, there would have been limited interest in the subject because this would have been expected. However, fertility has dropped below the replacement level - sometimes by a substantial margin - in virtually every population that has moved through the demographic transition. If future fertility remains at these low levels, population will decline in size and age rapidly (Bongaarts, 2001).'

Indeed, the industrialized countries have reached a new stage in their demographic development which is characterized by full control over fertility when couples lack the motivation to have more than one or two children and very low levels of fertility which results in a new demographic imbalance. And this new imbalance was taken as a basis for a new, the second phase in the overall demographic transition in western world. As van de Kaa states: ‘the essential difference between the first and second demographic transitions is that while the first, the traditional demographic transition, was a long term consequence of the decline in mortality, the second transition should be interpreted as a consequence of fertility declining way below the levels long thought plausible.’

The idea of the Second Demographic Transition (SDT) was originally suggested by Lesthaeghe and van de Kaa (1986) and by van de Kaa (1987) who were themselves inspired by a short article of Philippe Aries presented at the IUSSP-seminar Determinants of Fertility Trends: Major Theories and New Directions for Research and entitled “Two Successive Motivations for the Declining Birth Rates in the West”. In this paper, the French social historian Aries argued that the centuries long slow ascent of the “king-child” (cf. Aries, 1962) had come to an end somewhere in the 1960s and 70s, and that the motivation for fertility control was no longer linked to an altruistic reflex of parents wanting to give their smaller offspring more and better chances in life. Instead, a new motivation for fertility control had gained preponderance and it was seated in a greater preoccupation of the adult dyad with itself and with matters related to self-fulfillment (Lesthaeghe and Neidert, 2006).

Another source of inspiration for the SDT were observations of authors’ themselves of very significant changes that had undergone in the patterns of fertility and family formation since the mid-1960s. It was getting clear that fertility levels were not going to stabilize at or around replacement level, or that fertility would follow swings conditioned by business cycles or cohort sizes. Moreover, the reasons of those changes were not economic factor, but rather deep change in preferences leading to broader life style options and new choices (Lesthaeghe and Neidert, 2006). It means that the Western world experienced a “cultural shift” from material to non-material preoccupations (Inglehart and Welzel, 2005). While birth control during the FDT was a matter of avoiding births of higher parities occurring at older ages and thereby safeguarding the opportunities of the already born children, however during the SDT it is a matter of postponing childbearing in function of more pressing competing goals such as prolonging education, achieving more stable income positions, increased consumerism associated with self-expressive orientations, realizing a more fulfilling partnership, keeping an open future, etc (Lesthaeghe and Neidert, 2006).

Lesthaeghe and Moors(1995, p. 22) and Lesthaeghe and Surkyn (1988) recognise multiple sources for the motivations underlying and the values associated with the demographic characteristics of the SDT which are:

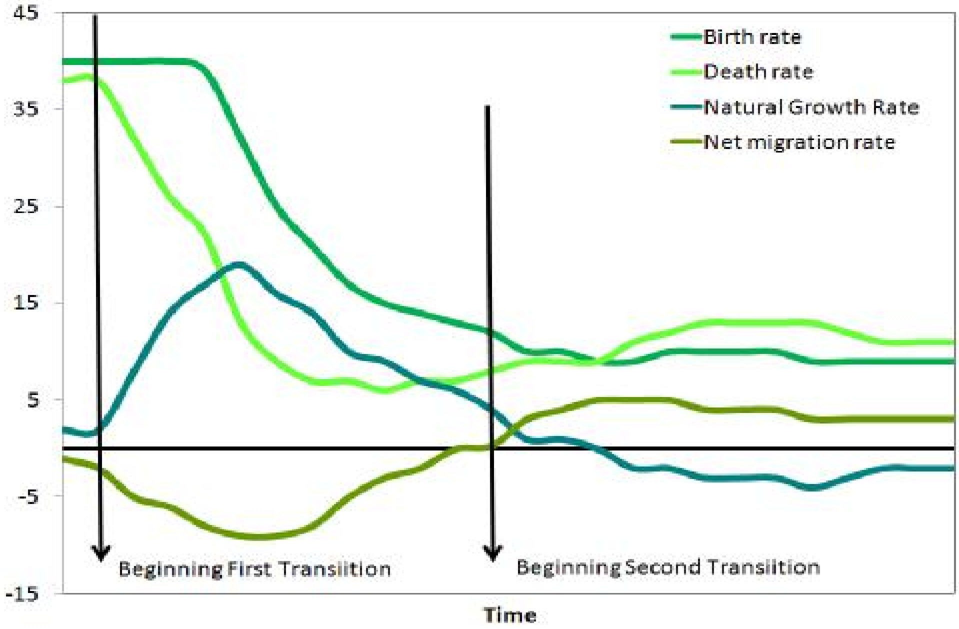
- Secularization or the disappearance of religious service attendance, the abandonment of traditional religious beliefs (heaven, hell, sin …), and the decline in individual religious sentiments (prayer, meditation …).

- The "new political left" with high scores on Inglehart's post-materialism, voting for Green parties in Europe, high protest-proneness and greater distrust in institutions, and anti-authoritarianism in general.
- Egalitarianism, with an emphasis on gender equality, tolerance for all minorities including sexual ones, rejection of class distinctions, and a stronger preoccupation with North-South equity associated with "world citizenship".
- Individual autonomy with respect to ethics, and particularly the accentuation of free choice in all domains of interference with life and death (abortion, euthanasia, suicide).
- Accentuation of expressive values, showing an enhanced preoccupation with individuality and self-actualization. Typical indicators here are the ranking of traits such as "imagination" and "independence" above all other qualities to be stressed in the education of children, and the preference for intrinsic work qualities (interesting job, allowing initiative, challenging, permitting social contact …) over material ones (good pay, vacations, promotion …)
- Tolerance for unconventional or relativist ethics, both in the marital domains (e.g. casual sex) and in that of civil morality more generally.
- A retreat from classic forms of social capital and community involvement associated with religious or political orientations in favour of self-elected friendships.
- Family antecedents: the experience of parental divorce or of family reconstruction after such a divorce frequently lead to earlier home leaving, more single living, a stronger preference for cohabitation, and even to a higher probability of lone parenthood
- Economic differentiation: new living arrangements may accommodate different economic conditions. For example, cohabitation often seems associated with a weaker or more insecure financial position than marriage. By contrast, a lack of partial financial independence of young adults and/or a tight private housing market is conducive to prolonged residence in the parental home and less cohabitation.

In addition to the spectacular decline of period total fertility rates in Europe immediately after 1965 which no one had predicted, an unexpected rise in the life expectancy at birth, especially at advanced ages, also greatly surprised demographers. Based on these empirical observations van de Kaa broadened the concept of the SDT by including mortality and international migration (see Figure 3). Certainly, the graph presented is only prospective model of future.

According to van de Kaa international migration during the FDT could have served as a safety valve to release some of the pressure on resources caused by far too rapid population growth on the continent. Concerning the second part of the model he states that in the industrialized countries experiencing the second transition the death rate will exceed the birth rate for quite some time to come. This because the former will further increase as a result of the ageing process, while the latter will remain low as a consequence of the fact that the number of women of reproductive age will be comparatively small and the number of children born to them will, most likely, remain below replacement level (van de Kaa, 2001).

Figure 3 – Model of First and Second Demographic Transitions



Source: van de Kaa (1999)

The decline of fertility noticeably affected the age structure of most countries in Western Europe which resulted in great labour shortages that these countries decided to solve the problem through the recruitment of guest workers, mainly from Southern Europe, Turkey, and Arab countries. When launching the recruitment programmes policy makers did not expect that most of the guest workers had come to stay, moreover, through the practice of family reunification a steady stream of new entrants joined the migrants already present. Furthermore, with constantly rising number of political asylum seekers, migrants, who come in the guise of internationally recognized refugees, tourists overstaying their visa, undocumented migrants brought in through trafficking, seasonal labourers, or economic migrants allowed entry under an official immigration scheme; immigration became even more of a determinant of population growth in Europe.

Almost all the countries have taken some steps to curb their number but, on the whole, with limited effect. The advanced industrialized countries will, for a very long period to come and whether they like it or not, be countries of immigration. They will, individually and jointly, attempt to keep the influx of migrants under some sort of control. Net migration in the most industrialized countries of the world is, consequently, assumed to remain positive but fairly modest and migration will be a crucial factor in their population structure and growth (van de Kaa, 2001).

Based on the empirical evidence van de Kaa concludes that at any point in time each country or region has its own demographic heritage and cultural endowment. The reaction to the diffusion of innovative forms of behaviour will depend partly on how well new ideas can be incorporated into existing patterns and traditions (Micheli, 1996; van de Kaa, 2001). Also the economic, social, and cultural conditions with which people are confronted when making life style decisions matter a great deal (van de Kaa, 2001). The case of Kazakhstan is briefly described above in section about the Demographic Revolution.

2.2.3 The theory of epidemiologic transition

The "epidemiologic transition theory" was first suggested by A. Omran in 1971 which attempts to account for the extraordinary advances in health care made in industrialized countries since the 18^{th} century and focuses on the interactions between the change patterns of health and disease and their demographic, economic and sociologic determinants and consequences. In the epidemiological transition theory all societies experience three "ages" in the process of modernization: the "age of pestilence and famine", during which mortality is high and fluctuating, with an average life expectancy at birth between 20 to 40 years; the "age of receding pandemics", during which mortality declines considerably and life expectancy rises steadily from under 30 to over 50; and the "age of degenerative and man-made diseases" when mortality continuous decreasing and approaches stability at a relatively low level, with the average life expectancy exceeding 50 years and while the disappearance of infectious diseases increases the visibility of degenerative diseases, and man-made diseases become more and more frequent.

Omran distinguishes three main determinants of the transition from infectious to degenerative disease predominance which are: firstly, ecobiologic determinants which indicate the complex balance between disease agents, the level of hostility in the environment and the resistance of the host. Secondly, socioeconomic, political and cultural determinants which include standards of living, health habits and hygiene and nutrition which are also included here because their improvement in western countries was a byproduct of social change rather than a result of medical design. Thirdly, medical and public health determinants are specific preventive and curative measures used to combat disease; they include improved public sanitation, immunization and the development of decisive therapies. Medical and public health factors came into play late in the western transition, but have an influence early in the accelerated and contemporary transitions (Omran, 1971). According to the epidemiologic transition the reduction of death rates in the industrialized countries during the 19^{th} century is explained mainly by the role of ecobiologic and socioeconomic determinants because the influence of medical factors was negligent at that time when many pandemics of infection had already started receding. Medical improvements and technologies rather have more significant and salient impact in currently developing countries with delayed epidemiologic transition models.

During the epidemiologic transition due to relatively high susceptibility of children and young females to infectious and deficiency diseases, the recession of pandemics and improvements in survivorship had the most advantageous effect on these groups of population even though all age groups benefited from the shift in disease patterns and the increase in life expectancy.

In the early stage of the epidemiologic transition fertility may increase as probability of surviving of reproductive aged females rises faster than of infants and children, however, as infant and childhood survival improves it starts to have reducing effect on birth rates due to several factors such as biophysiological factors i.e. the increased chance that a live birth will survive infancy and early childhood and result in prolonged lactation tends to lengthen the mother's postpartum period of natural protection against conception; socioeconomic factors when with improvement of socioeconomic conditions (nutrition, sanitation) decreases risk of childhood death as a result the role of children changes in the social and economic system, they become burden to parents rather than benefit which reduces family size. Also there are psychological or emotional factors which relates to decreasing number of children in family when parents make investments of energies and emotions to few children they have and provide them with better protection, care and education.

Related to peculiar variations in the pattern, the pace, the determinants and the consequences of population change Omran differentiates three basic models of the epidemiologic transition: the classical or western model, characteristic for Western Europe and northern America with slow, progressive improvement of mortality and gradual fertility decline which accompanied the process of modernization in these societies. In the classical transition socioeconomic factors were the primary determinants of change and population growth was minimal due to slow recession of famines and pandemics and already fallen fertility trends.

The accelerated model of the epidemiologic transition, which can be attributed to Japan and Eastern Europe, is characterised by later start but quicker termination. A major distinction of the accelerated model is that most of the countries fitting this model had begun a slow process of modernization prior to the drop in mortality in the twentieth century, which was determined by sanitary and medical advances as well as by general social improvements and population growth was well controlled and with abortion intensifying rapid fertility transition.

Finally, in many developing countries the transition started even later with relatively recent and yet-to-be completion. Although slow, unsteady decline in mortality began in some of these countries shortly after the turn of the century, only few states experienced rapid and truly substantial declines in mortality since World War II, while many other countries, mainly in Africa, were unable to reach a pace of progress sufficient to reduce the gap separating them from developed countries. Furthermore, during the 1980s and 1990s, this pace began to slacken and in some cases all progress even ceased and worse still, the arrival of AIDS often caused severe reversals and towards the end of the 1980s, life expectancy levels suddenly dropped with concomitant still high levels of fertility.

In case of Kazakhstan the second the accelerated model of the epidemiologic transition could be applied. The country with its current mortality level could be put into the "age of degenerative and man-made diseases", however death rates have rather small pace of decrease and are relatively high at levels, the average life expectancy indeed exceeds 50 years, but difference between female and male indicators is very substantial. Besides, although the incidences of infectious diseases have considerably decreased during the last 20 years but they are far from disappearing and still keep existing with increasing visibility of degenerative and man-made diseases.

2.2.4 The mobility transition

There have been various attempts to link the demographic transition theory to changing patterns of population mobility and modernization process and inspired by Ravenstein’s work on migration laws, in 1971 Zelinsky developed a hypothesis of the mobility transition (Zelinsky, 1971). In his explanation of the model Zelinsky acknowledges economic growth as being crucial as well as historical backgrounds and evolutionary processes. He supposed that once the forms of transportation and means of electronic communication improved accordingly some forms, patterns and type of migration differentiate too which are described in five stages of mobility transition theory.

In the first stage, the pre-modern transitional society characterised with high levels of fertility and mortality and low natural increase where very little residential migration occurs mostly in the forms of social visits, commerce, land utilization, warfare or religious motives.

The second stage, the early transitional society when mortality rapidly decreases and significant growth of population occurs resulting in massive movements from countryside to cities and from rural areas to colonization frontiers and to foreign countries. These international migrants are mainly made up of skilled workers, technicians and professionals.

In the third stage, the late transitional society, fertility considerably declines as well as natural growth rate. This stage is an important phase of the mobility transition when urban-to-urban migration surpasses rural-to-urban movements, also emigration declines.

The fourth stage, the advanced society, characterised by stabilization of fertility and morality at low levels and moderate rate of natural growth or none at all. Movements from city to city or within a single metropolitan area further increases as well as international migration of professionals and skilled workers with direction and volume of flows depending on specific circumstances.

In the last stage, future superadvanced society, fertility trend is hard to predict and probably slightly higher level of mortality to present patterns. Some decline in residential migration and possible strict control of any kinds of population movement within a country as well as international.

Zelinsky's mobility transition model which was derived from experiences of developed countries in Europe is also can be treated as a diffusionist model, which assumes that the migration experience tends to spread progressively from relatively developed zones to less developed zones. Also, in his model Zelinsky attempts to integrate within one single analytical framework various kinds of labour mobility, internal and international, long-term as well as circular movements of population fueled by improvements in transport and communication, flows of knowledge, a perceived lack of local economic opportunities, and growing level of welfare. Since, Zelinsky's mobility transition is a universal model it assumes that all societies undergo the same kind of processes and this universalistic pretensions become its strength as well as its main weakness. There is evidence that the sequence of mobility change proposed by Zelinsky on the basis of the European experience does necessarily exactly apply to contemporary developing countries (Skeldon 1992). Also the demographic transition and associated mortality and fertility declines have shown considerable diversity in different historical and geographical settings (Hirschman 1994). Furthermore, contemporary developing countries tend to experience much faster demographic transitions than was the case in northern Europe (Kirk 1996:368).

Despite the criticism Zelinksy's mobility transition model which hypothesizes that there is a complex and non-linear relationship between occurrence of specific forms of migration and more general socio-economic and demographic development processes remains one of the most empirically realistic hypotheses compared to other migration models.

Historically Kazakhstan was a country with population mainly leading nomadic lifestyle with constant movements depending on a season, only starting from the period when country became part of the Soviet Union people were forcibly settle and from that moment the mobility transition could be relevant to apply to Kazakhstan. Thus omitting the first stage of the mobility transition it might be assumed that the country is somewhere in the end of the third stage with urban-to-urban migration surpassing rural-to-urban movements and gradually increasing volume of internal movements, also during the last decade the role of international migration has been declining in the country with very insignificant net gain.

Chapter 3

Data availability and quality

The data that will be used in this dissertation are compiled in the vital statistics registry maintained by the Statistical agency of the Republic of Kazakhstan. The national statistical agency is the main institution responsible for collecting, analyzing, publishing, and disseminating official socioeconomic statistics.

The demographic data collection system in Kazakhstan is based on the registration of events and periodic censuses. The data on births and deaths are registered at the local administrative level of an internal passport control system while migration data are obtained by the processing of the documents supplied by the internal affairs bodies and containing statistical records of arrivals and departures, these being compiled regularly at the time of registration of the population by place of residence.

Gathering of the data and checking on the correctness and quality is the responsibility of the district or municipal statistical sections. Then, once a month the data are submitted to the oblast statistical departments. Data entry on the database, including coding, checking and sorting, is performed monthly in the oblast statistical departments. The primary database file, once processed (coded and sorted), is forwarded to the Information Computing Centre of the Kazakhstan Statistical Agency.

The Statistical Agency is also responsible for conducting censuses and maintaining the registration system. The last census in Kazakhstan was conducted in 2009. In addition, the Agency is responsible for tabulating and publishing an annual report of information on major economic and demographic categories generated by the registration system.

Quality of data is considered to be a function of the process of data collection, storage, and analysis. Some aspects of data quality in Kazakhstan such as timeliness, reliability and accessibility, are still appear to be problematic. The most acute is the situation with timelines, there are constant delays in the release of raw and processed data, and the most recent example is 2009 census results. When data are not released on time, it limits the extent to which it can be used to inform policy and decision-making as well as limiting the time available for further analyses. Delays in the transmission of routine service data from the local level to the district, region and national level also hinders data use. Moreover, recording of vital events with inadequate coverage also emerges as a major issue, especially at the local rural level.

The improvement of socioeconomic situation in Kazakhstan creates reasonable conditions to display interest for more superior necessities of the society including national statistics. It is, certainly, crucial for any country to collect clear, timely, reliable and relevant data for analyses of economic and demographic events. Despite the concerns upon the reliability of mortality statistics as well as of data on migration and some signs of insecurity in the fertility figures, the overall quality of the demographic data have experienced some improvement since the demise of the Soviet system, Kazakhstan has increased the availability and level of detailing of the demographic statistics. However, the specificity and quality of data by population components deserve more detailed overview and our closer consideration.

Migration data are part of country’s demographic statistics. Information on migration is necessary for current and prospective calculations of the size and composition of the population and for studying demographic processes. For these and other reasons it is important to have reliable data on migration at international level as well as internal. But the accuracy of migration statistics in the country is far from being satisfactory. First of all, the system of registering and recoding migrants entering and leaving the country is not yet well-developed; there are thousands of unregistered people living and working illegally from the near abroad in the county and even more of those who have left Kazakhstan not being properly registered.

Another serious problem is with the accuracy of measurement of internal migration. In Kazakhstan it is extremely difficult to control and fix internal movements of the population. Only in the capital city - Astana and Almaty employers require to have so-called ‘propiska’ – a compulsory registration in the corresponding city in order to get a job, other than that, government does not strictly necessitate or impose a fine on people with no registration or registered in one region, but living and working in the other. Such state of affairs leads to great inaccuracies of statistics on internal migration and hinders reflection of true situation in the country. Furthermore, the quality and quantity of available data decreases at the district and locality levels. This is evidenced by the frequent discrepancy in the data for the number of departures from one territory and the number of arrivals there from the other regions. There is even less precise recording of movements from urban to rural and rural to urban directions.

Unlike natural events the collection of data on migration is a challenging task. Even in developed countries with their well-established data collection and registration system it is impossible to avoid discrepancies and inaccuracies. The difficulty of recording migration is explained, mainly, by the fact that birth and death are unrepeatable events in the life of a person and even though marriage and divorce can happen several times, however, not as often as change of place of residence. Factors pushing people from one place and pulling to another are very closely connected to the economic and political situation in the country and the breakup of the Soviet Union and subsequent transition to the market economy resulted in massive surge of population movements, mostly, out of the country and within it. An accurate documentation of migration at that period and nowadays is hard to accomplish with just forming data collection system of a recently independent state which is still developing and trying to improve the quality and consistency of procedures for vital registration and population enumeration throughout the country

The greatest errors in Kazakhstan tend to have statistics on mortality, more specifically, the estimates of infant and child mortality, attribution of cause of death and recording of deceased illegal migrants. Problems of accuracy and consistency exist with both Soviet and post-Soviet statistics.

One of the major problems of mortality data in Kazakhstan relates to the underreporting of infant mortality. After gaining independence the country's Agency on Statistics have seventeen more years used the old Soviet definition of live births, which states that in order to consider an infant as a live-born it should breath and infants under 28 centimeters in length and weighing less than 1000 grams who died within the first week of life were excluded from both the numbers of live births and infant deaths. In contrast, the standard international definitions of the United Nations and the World Health Organization (WHO) consider as live births infants who exhibit any sign of life upon delivery.

Such diversity of definitions led to a rather significant understatement of the infant mortality rates in official Soviet publications as well as in post-Soviet statistical sources of the country. Nowadays, in order to analyse mortality it is necessary to adjust the official infant mortality data of the Soviet period and data obtained using the old Soviet definition to the data collected following the international standards of definitions.

Furthermore, in the Post-soviet countries, including Kazakhstan it is rather problematic to carry out any individual research or make independent analyses because with few exceptions, only aggregate data are available and more detailed data are viewed as the property of government statistical agencies and there is a lack of tradition of making more detailed demographic data publicly available.

In addition to that, there are complications with proper attribution of cause of death and it can probably be explained by several reasons. Firstly, since the fall of the iron curtains many professionals left Kazakhstan including experienced medical specialists who were educated and trained in the strict medical schools of the Soviet era, whereas, nowadays, with flourishing market economy and market attitude towards every aspect of life including education system, the knowledge and practical experience of young medical stuff leaves much to be desired. As a consequence, due to doctors' carelessness and incompetence there have been many tragic incidents and fatal accidents throughout the country. Medical examiners often fail to properly diagnose a case and doctors frequently misreport the cause of death because usually the person diagnosed and receiving treatment from one illness can have a whole bunch of the other diseases and may die from the complications of some of these diseases.

Secondly, the compulsory cause-of-death certification was introduced in 1925; cause-of-death data have been routinely compiled in the civil registration systems and certification by medical personnel was stipulated by regulation for urban areas and gradually extended to rural areas (Merkov, 1965). This requirement was accompanied by the introduction and development of a cause-of-death classification scheme (Stetsenko and Kozachenko, 1984; Meslé et al., 1992). The classification system which is currently in use (the *Kratkaya nomenklatura prichin smerti*) includes only 195 categories thus, it is far less detailed than the WHO International Classification of Diseases (ICD) and also its correspondence to ICD categories is not always straightforward (Anderson, Silver, 1997).

Since the beginning of the economic improvements in 2000s, Kazakhstan become a desirable destination for hundreds of migrants from near abroad, especially, for people from Central Asian countries such as Uzbekistan and Kyrgyzstan and most of these migrants enter the country illegally and therefore, often agree to accept jobs with poor working conditions and for a crummy salary. In case of death of such an illegal migrant it becomes problematic from mortality statistics' point of view, since such deaths usually will be discovered, while the base population by definition is unrecorded and regions with large numbers of unregistered immigrants are therefore likely to suffer an upward bias in recorded mortality rates (Becker, Urzhumova, 2004).

Certainly, these are not the only problems of mortality statistics in the country and it should have to be always kept in mind that accepting reported mortality data at its face value can lead to erroneous conclusions and changes in data quality can obscure changes in real demographic behavior or outcomes.

The quality of demographic statistics published during the Soviet era as well as in the post-Soviet period remains problematic, especially with regard to the migration and mortality statistics, however, it seems likely that Kazakhstan's data on fertility are quite reliable by the standards of developing and transition nations.

Certainly, there can be some incidence of fertility underreporting when for example, births occur within domestic premises in some remote district or rural area and it may take some time before parents reach regional centre to register a newborn. Such incidents happened rather often during the Soviet period, but nowadays with implementation of one-time maternity aid and child support parents do not postpone child's registration. Moreover, since recently, the birth registration can be carried out right in the maternity hospital.

It is also worth to mention the situation with abortion. Throughout most of the twentieth century, the principal method of birth control in Kazakhstan was abortion (Popov, 1993). Data on abortion are notoriously underreported in the country. This is because the procedure is often illegal and, even if legality is not an issue; women are frequently reluctant to report its occurrence (Westoff, 2000).

Chapter 4
Population forecasting approaches and techniques

There are various approaches and techniques available in literature for forecasting population by different characteristics. Some are very sophisticated and rigorous while others are simpler, certainly each method and approach has its own advantages and disadvantages and its use is primarily determined by the availability of data, purpose of the forecast, forecast horizon and peculiarities of an area under the study. The current chapter considers mainly several widely used approaches to forecasting population by regions and urban/rural place of residence. In addition to approaches, a review of characteristics of mathematical methods, in particular of the cohort-component methods and of other methods related to forecasting its parameters are presented in this chapter.

4.1 Basic approaches

In this section we will discuss approaches to forecasting population since a certain choice of an approach determines the kind of method that should be applied to forecasting a population. According to T. Kucera there could be distinguished tree ways of approaching population forecasting depending on how population development process (subject of population forecasting) and/or population (object) and/or the process of population forecasting itself are considered.

4.1.1 Approaching the subject: Alternative views to population development

One could find several ways of approaching population development process. One way of approaching might be in general terms, when population development is treated either as an unstructured process when simple time series extrapolation could be applied or as a structured process with the use of the cohort-component method. In the first case the extrapolation methods are used to usually project total population size and if population structures is needed then so-called distributional methods have to be applied. Treating population development as an internally structured process leads to the cohort-component method.

The first approach is being less applied nowadays since its applications provides significantly less plausible results than the structural approach does in general. Nevertheless, extrapolation techniques are not absolutely ineffective. They can be and frequently used in forecasting cohort-component projection model parameters.

Basically, almost all forecasting methods have mathematical nature. Some use purely mathematical functions and others in addition to that, necessitate application of judgmental and analytical skills, however. The first ones are usually require relatively little time to apply and simpler conceptually and known as mathematical methods (Shryock et al., 1980).

Application of mathematical methods suggests that on the basis of available empirical data a particular function, curve or a model may be found which fits historical observations and then it can be extrapolated into the future, usually, a short-term future. Also, such extrapolation technique is mainly applied for the forecasting of small area populations (e.g. regions of the country, districts or cities), with often no reliable and detailed demographic data and deals only with aggregate trends from the past without attempting to account for the underlying demographic and economic processes that caused the trends, because, such data are easier to obtain and their analyses can conserve time and cost less

The extrapolation technique, however, should not be used to blindly assume that past trends of growth or decline will continue into the future. Past trends are observed, not because they will always continue, but because they generally provide the best available information about the future. Before applying this method the past trends must be carefully analysed whether they expected to continue or if continuation seems unlikely, alternatives must be considered.

There are numbers of exponential forms that could be used to forecast population, usually, a total population alone. And now we will briefly discuss the basic features of some most commonly used extrapolation curves.

The Linear Curve ($Y = a + bX$). Fits a straight line to population data, the growth rate is assumed to be constant, with non-compounding incremental growth. Calculated exactly the same as using linear regression (least-squares criterion), useful for slow or non-growth areas but rarely appropriate to demographic data. Curve increases without limit if the b value > 0. Curve is flat if the b value = 0. Curve decreases without limit if the b value < 0 (see Figure 4).

Figure 4 - Linear curve types

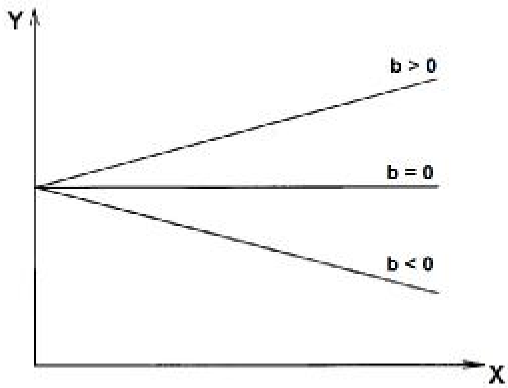
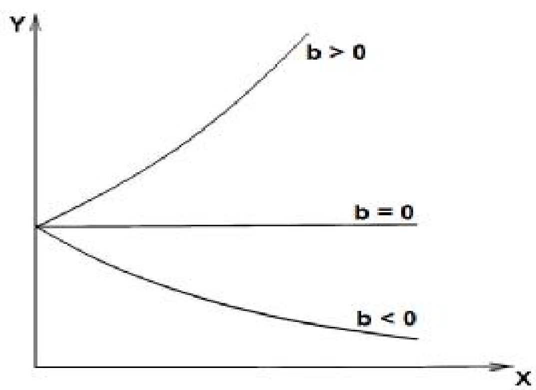


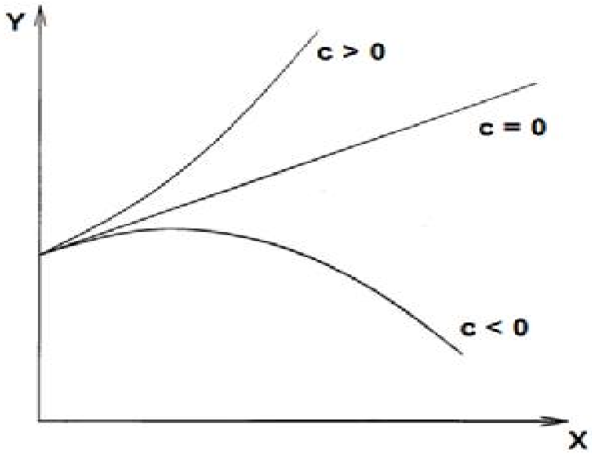
Figure 5 - Geometric curve types



The Geometric Curve ($Y = ab^x$). In this curve, a growth rate is assumed to be compounded at set intervals using a constant growth rate. It assumes a constant rate of growth but does not take into account a growth limit. *The Geometric Curve is* good for short term fast-growing areas. However, over the long-run, this curve usually generates unrealistically high numbers (see Figure 5)

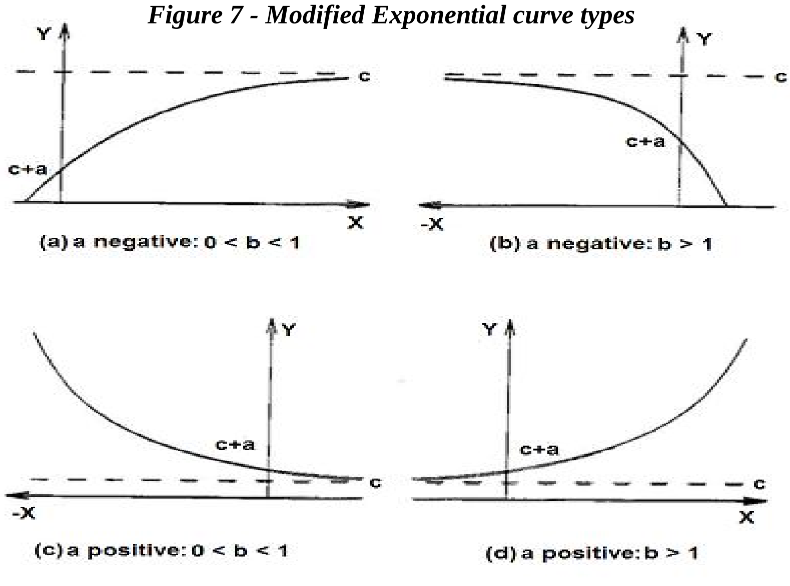
The Parabolic Curve ($Y = a + bX + cX^2$). Generally the curve has a constantly changing slope and one bend. This curve is very similar to the Linear Curve except for the additional parameter (c). Using the Parabolic Curve one may model fast growing areas but it has no growth limits and cannot be applied for long-term forecasts. Growing very quickly when $c > 0$, declining quickly when $c < 0$ (see Figure 6)

Figure 6 - Parabolic curve types



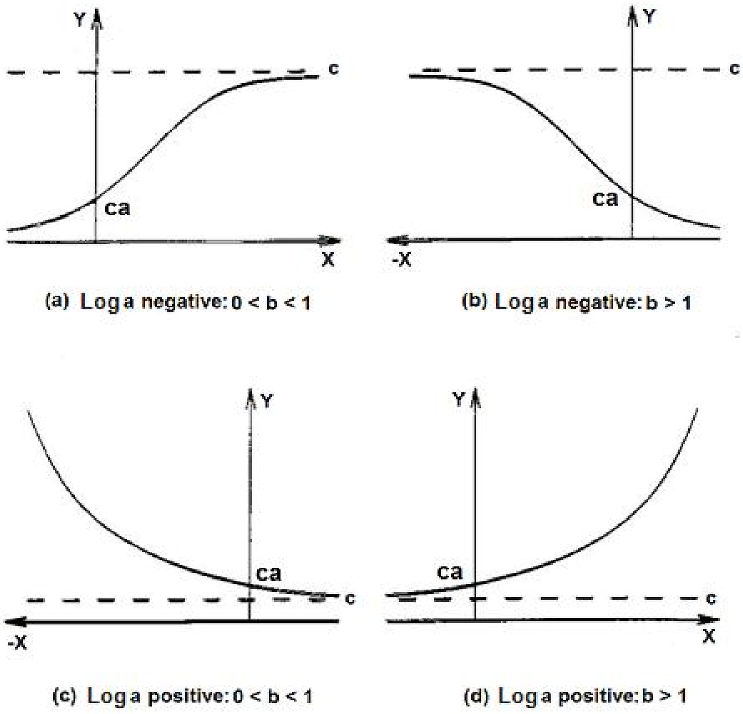
Modified Exponential Curve ($Y = c + ab^X$). This curve is the first of the Asymptotic Curves which takes into account an upper or lower limit when computing forecasted values. The asymptote can be derived from local analysis or supplied by the model itself. This curve largely depends upon the growth limit. If the limit is reasonable, then the curve can be a good one, however the growth limit can be misleading (see Figure 7).

Figure 7 - Modified Exponential curve types



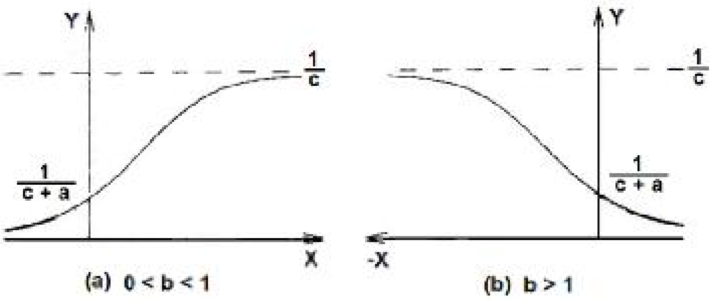
The Gompertz Curve ($\log Y = \log c + \log a(b^x)$) *The curve* **d**escribes a growth pattern that is initially quite slow, increases for a period and then tapers off. Like the Modified Exponential curve, the upper limit can be assumed or derived by the model. *The Gompertz Curve is very* useful and can be fitted to all kinds of growth patterns. However, as with the previous curve, using an assumed growth limit can be problematic unless it is reasonable and makes sense for the case at hand (see Figure 8).

Figure 8 - Gompertz curve types



The Logistic Curve ($Y = (c + ab^X)^{-1}$ *).* This curve is very similar to the Modified Exponential and the Gompertz curves, except that we are taking the reciprocals of the observed values. The Logistic Curve is considered to be the "best" of the extrapolation curves. It represents a trend of growth with increasing annual increments until a point is reached where growth is at a maximum; beyond that point, growth diminishes until it becomes negligible. It is more stable than the Gompertz curve and it does not have a misleading growth limit (see Figure 9).

Figure 9 - Logistic curve types



In order to select an appropriate extrapolation curve one should test results using measures of dispersion that are:

- CRV (Coefficient of relative variation)
- ME (Mean Error)
- MAPE (Mean Absolute Percentage Error)

In general, curve with the lowest CRV, ME and MAPE should be considered the best fit for the observation data. One of the basic principles when using the extrapolation technique effectively is the choice of the base period which can have a significant impact upon the results of the forecast

However, use of such mathematical methods has several disadvantages. Firstly, they allow forecasting mostly total population size and often do not take into account age and sex composition of the population which affects the evolution of its size, and also may miss impending changes in the growth rate signaled in advance by changes in fertility or mortality (Lee et al 1995). Secondly, the mathematical approach assumes that the socioeconomic factors that have determined the dynamics of the population in the past will remain unchanged in the future. But there is absolutely no guarantee that the past will have a strong bearing on the future. The analyst assumes that past conditions will help to predict the future. There is simply no assurance that past trends will continue into the future.

Other limitations of such methods are apparent from the fact that the very low data requirements that are so attractive are also an inherent limitation to the forecasts. Total population figures for past years are being used to forecast future conditions; there is no inclusion of housing trends, economic changes, growth management, or any other external pressures on population in this technique (Klosterman, 1990). Any factors other than past population totals are external to the methods. Therefore, extrapolation techniques should be used carefully and with a full understanding of their limitations.

Structural approach to the subject of population forecasting results in application of "component" methods of population forecasting. Cohort-component method is their dominant representative. In its general concept, the cohort-component method is based on separate forecasts of fertility, mortality and migration and their application on the initial sex and age structure of the forecasted population. Separate forecasts for each of several ethnic or linguistic groups, of urban and rural populations, or any other segments into which the population can be divided, might also be regarded as "component" forecasts (UN Manual III, 1966). The distinction of these components in producing forecasts is useful to account separately for causes of population change, since each component usually responds differently to alterations and modifications in cultural, social, political, economic, environmental and other factors that affect population change over time and geographical area. The assumptions for components of population change are often done in the form of age and sex specific probabilities and that allows obtaining future probable composition of the population with various scenarios of development.

National population forecasts are usually done with the application of the cohort-component model in which, the components of population change (fertility, mortality, and migration) are forecasted separately for each birth cohort (persons born in a given year) (Klosterman, et al, 1993). The popularity of this method might be explained by the fact that it provides a vigorous and flexible approach to population forecasts, allowing incorporation of a variety of theoretical models at any levels from cities and small territories to whole nations and enables forecasting of total population, age and sex composition, and individual components of growth. In its simplest statement, the cohort-component method is mathematically can be expressed by the following equation:

$$\mathbf{P_{(t+n)} = P_{(t)} + B_t^{t+n} - D_t^{t+n} + IM_t^{t+n} - OM_t^{t+n}} \quad (1)$$

where:

$P_{(t+n)}$ = Population at the end of the period (at time t+n)

$P_{(t)}$ = population at the beginning of the period (at time t)

B_t^{t+n} = births during the period (time t to t+n)

D_t^{t+n} = deaths during the period (time t to t+n)

IM_t^{t+n} = in-migration during the period (time t to t+n)

OM_t^{t+n} = out-migration during the period (time t to t+n)

To generate population forecast with this model, the separate data sets for each of these components should have to be created. The base population is being divided into cohorts, as regard to age cohorts, they are usually defined as one or five-year age groups with 85+ or 100+ as the eldest cohorts and then the population can be subdivided by regions, ethnicity and urban/rural places of residence, which typically leads to more data requirements and calculations, but the procedure remains the same.

The forecasting begins with calculation of the age and sex-specific rate of transformation for the initial population, which is done in order to obtain the number of persons who survive to the end of the forecast interval. The transformation rates defined as S_x are usually derived from life tables using L_x - numbers of person-years lived between exact age x and x+n.

$$\mathbf{S_x = L_{x+1}/L_x} \quad (2)$$

The following steps relate to the calculations of migration rates based either on migration data, trend extrapolation, structural models or model schedules, and then B^{k+1} - the number of births is forecasted applying to $P_x^{k,f}$ - the female population in each age cohort f_x - the age-specific births rates as described by formula (3) and applying ϕ - the index of femininity numbers of girls and boys are then separately calculated.

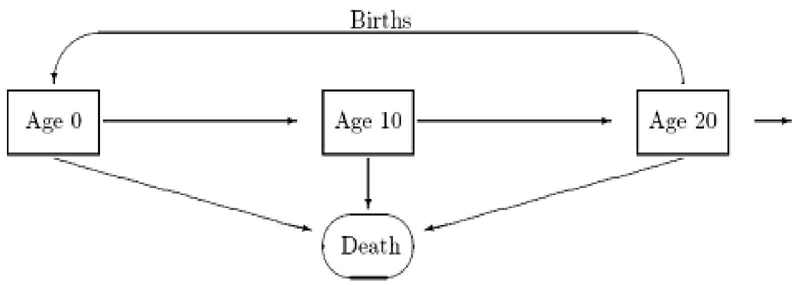
$$\mathbf{B^{k+1} = ½ \sum_{x=14}^{49} P_x^{k,f} * (f_x + S_x^{\ f} * f_{x+1})} \quad (3)$$

Obtained births are added to the rest of the population, as a result one gets a forecasted total population by age and sex. Resulting population serves as the base for forecasts of the next interval. The process is repeated until the final target year in the forecast horizon has been reached.

The cohort-component method is now the most widely used of the analytical methods for preparing national and sub-national population forecasts. Development of this method was the major innovation in the evolution of forecasting methodology (O'Neill, 2001).

The cohort component method is viewed as one the most reliable forecasting techniques which provides very necessary for planning and decision making processes detailed information. However, the very advantage of this method is also the serious drawback of it; the method is extremely data demanding. Thus, it is often difficult to apply this method especially for developing areas with not yet properly established data collecting system. Also, in case of application of the cohort-component method the purely demographic factors of change are considered and all other non-demographic aspects are usually neglected.

Figure 10 – Single region population system

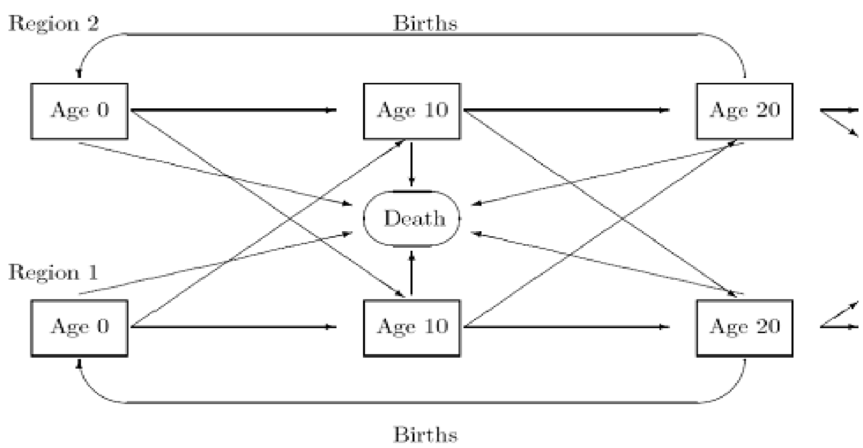


Source: Gullickson, 2001

On the basis of the cohort-component model the multi-state technique was developed, which might also be called another type of the "component" methods.

The major sources of heterogeneity in population behaviour are age and sex and usually, users of population forecasts are mainly interested in them, but sometimes, other characteristics can also be of interested such as education level, marital status, household type or place of residence which, in turn may too lead to in-homogeneities in vital rates. Thus, the method that takes additional characteristics, or "states," of a population into account is known as multi-state method and the population forecasts that consider place of residence or regions of origin are called multi-regional forecasts. The model was first suggested and developed by Andrei Rogers in late 60's and early 70's (Rogers, 1966, 1975). He extended the cohort component model by adding migration variable in demographic analyses and as a result a multiregional life table was introduced. The method focuses on analysing interregional mobility with migration flows by direction instead of net migration values; also, it links regional dependent fertility and mortality (Rogers, 1995). The multiregional forecasting is illustrated in Figures 10 and 11.

Figure 11 – Multiple region population system



Source: Gullickson, 2001

In Figure 10 the single region system is depicted, when a person have only two options - either move up in age or die. Whereas, in the multiregional system depicted in Figure 11 there are more options for a person. He can move up in age in the same region, he can move up in age in a different region, or he can die in either region (Gullickson, 2001).

Organised in 1970s at the IIASA the Migration and Settlement Study popularised the application of the multi-state method at that time, but currently not many organizations use it especially for long-term forecasts (O'Neill et al., 2001). The main disadvantage is again in large data demand and also in the assumption that the population system under question as a whole is relatively closed regarding to migration. The additional characteristics or "states" require more detailed data. Besides the mortality rates at each age, the forecaster now needs to know e.g. outmigration rates from one region to another and vice versa. Thus, specific sets of assumptions need to be applied to population by place of residence linked with fertility, mortality and migration patterns.

4.1.2 Approaching the object: Forecasting in a hierarchical regional systems

Population is usually delimited territorially. It is mainly because official population statistics are also organized territorially at state, regional and local levels. As it is stated in the second edition of the English version of the Multilingual Demographic Dictionary: "In demographic usage, the term population refers to all of the inhabitants of a given area, though on occasion it may be used for part of the inhabitants only… Such groups are properly called sub-populations." (United Nations, 1982). Thus, bearing this in mind one can treat any population as a part of a hierarchical regional system with several levels of units which forecasters usually divide by size of population and approach them accordingly starting from the lowest level or vice versa.

According to Willekens there are at least four such approaches that have been distinguished and could be relate to the object of population forecasting (Willekens, 1983). The first approach is called *"top-down"* and can be characterized by the use of an allocation procedure decomposing a population forecast for higher regional unit into forecasts of regional sub-populations. For instance, in practice we can meet situation when a national population is forecasted in the first place and then the results are disaggregated according to assumed shares of total population of the region (Salahudin, 2002). The main advantage of this approach is that there is no difficulty with consistency of national and regional forecasts because according to the top-down approach whatever happens in the regions it is closely related to what is going on at the national level. However, the regional specificities as well as role of demographic processes are neglected in application of this approach. Therefore is rather difficult to obtain reliable estimate of future population structures through application of this approach.

The second approach to forecasting population by region is the *"bottom-up"* approach, which fully considers regional peculiarities, but does not take into account interregional migration, thus needs corrections of migration's net affect. The sum of regional populations which are produced independently from the state population gives the value of a national variable and there is no guarantee that it will equal to the national control total figures, therefore, it may lead to the high level of inconsistency.

The approach, which is derived by combination of advantages of the *"top-down"* and the *"bottom-up"* approaches, is called *"hybrid approach"*. This approach allows having regard for regional specificities and also taking into account interregional migration, by applying to each region region-specific out-migration rate. Besides, in-migrants are calculated considering the fact that out-migrants from one region are usually in-migrants to another region. To ensure consistency, the concept of migration pool is introduced, and the national total of out-migrants obtained by summation, from the migration pool (Salahudin, 2002). Application of the hybrid approach makes it easier to adjust consistency between the predetermined national total population and the sum of regional values.

There is also *"multi-regional"* approach which is viewed as an extension of above described approach with migration pool. While in the hybrid approach a single distribution function is used for all out-migrants irrespective of region of origin, in the multiregional approach the distribution function depends on the region of origin (Salahudin, 2002). The main advantage of this approach is that it allows simultaneously forecast population of all regions and at the same time considers interregional migration and differences of regional mortality and fertility schedules. However, in order to apply this approach the detailed data on vital events are necessary at the regional level as well as national one.

Of all approaches the *"bottom-up"* approach suits best for our aim since it is widely recognized that population development in Kazakhstan is significantly differentiated regionally and by the type of residence. Following principles of this approach, we will analyze recent developments of mortality, fertility, immigration and emigration and generate forecasting assumptions primarily on regional level by the type of residence when the national level shall represent only the reference framework. The national forecast will be compiled by summing up the final results of the forecasts of particular sub-populations. Thus, the approach allows separate forecasting of each component at the regional and residential levels taking into account all main specificities and differences of population development in the country.

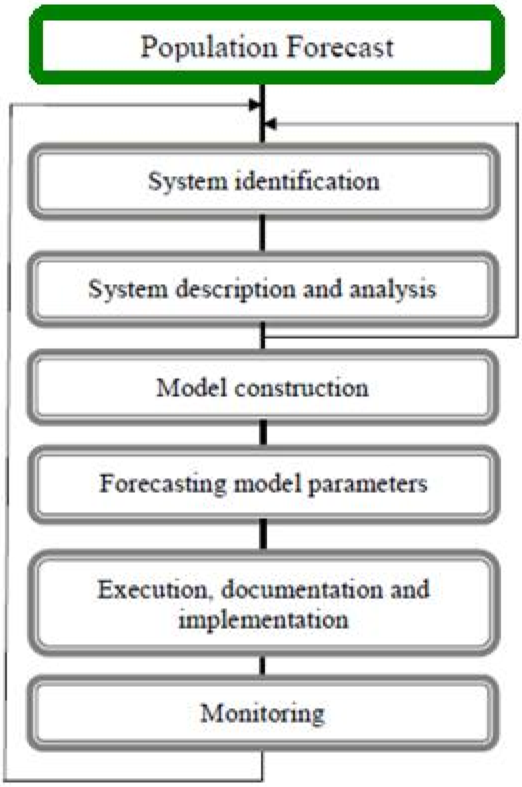
4.1.3 Approaching the process: The scope and phasing of forecasting

Forecast production procedure is a complex process involving a set of follow-up and interrelated exercises leading to the ultimate forecast itself. In the case of regional population forecasts the process becomes even more complex. The main tool in dealing with complexity of a real system is application of the principle of abstraction, i.e. to ignore all insignificancies and by that simplify a given segment of reality (Kučera, 1998). In other words, to obtain a forecast one needs a model that is a simplified abstraction of a real world and which is relevant to the system under study, thus in order to create such a model we need to identify the system which is usually considered as a first stage of a six stage process of population forecasting (Keilman, 1990) (see Figure 12).

System identification is the first step of population forecasting which follows the forecast assignment. This assignment is sometimes called the zeroth stage of forecasting since forecasters are sometimes participating on its formulation or formulate it themselves, especially when producing the forecasts on a regular basis without particular external impulse. The system identification mainly means to specification of the principal elements – population categories, and relations among them. The population categories concern not only the sex and age groups but, for instance, also breaking down the population on regional, ethnic or other subpopulations. The leading forces are the purpose of the forecast expressed in the assignment, availability of data and sufficient size (numerousness) of elementary categories which allows tracing developmental regularities.

During the second stage the identified system is described and past developments of the elementary reproduction processes within relevant population categories are analyzed. The ultimate goal of forecast oriented demographic analysis performed within this stage is to discover developmental regularities, i.e. trends which could be extrapolated to the future. If this behavior is insufficiently understood due to incorrect system specification, a revision of the identification step may follow (Keilman 1990). Main methodological tools used for description and analysis are the methods of demographic and statistical analysis, first of all principal concepts of demographic measurement, methods of curve fitting and analysis of time series. If generally available data appears to be insufficient, the forecasters can approach supplementary data collection (e.g. through a sample survey) in this stage.

Figure 12 - Stages of population forecasting



Source: Own scheme based on Keilman(1990) and Kučera (1998)

The third stage is reserved for model construction when a suitable model is selected and adopted to correspond with the identified population system. The forecasters are standardly choosing between classical cohort component model and its multiregional/multistate modification. The classical projection model applications can differ according to the way how migration is incorporated into the model. Migration can be observed as an elementary process and incorporated through net migration or as an aggregate consisting of two components, in- and out-migration.

Key stage of population forecasting process is the fourth one when forecasts of the model parameters are produced. The assumption on future development of population system and its significant environment, i.e. the venue influencing population system development, are formulated in this step. Pittinger (1977) proposed and Keilman (1990) has illustratively discussed important systematization of the assumption-making process. They have distinguished three basic levels on which assumption are formulated and Kučera within his lectures on population forecasting at Charles University in Prague (2009) has labeled and specified them as it follows: (a) elementary level – the level of parameters of projection models or demographic characteristics from which the parameters can be directly derived (e.g. sex and age specific indicators); (b) aggregate level – the level of indicators summarizing values of elementary ones (e.g. total fertility rate, life expectancy at particular age or net migration); (c) general level – mostly level of qualitative assumption in the form of statements on future development of social, economic, cultural, political and legal conditions (venue) of the given population system development. Keilman (op.cit.) is also proposing a basic strategy for moving among these three levels when forecasting the projection model parameters. He suggests starting on a general level and moving down through aggregate level to elementary one. Generating quantitative assumptions formal extrapolation or interpolation techniques can be employed either separately or in mutual combination. Interpolation methods are usually applied when target values are set.

When the batteries of the projection model parameters are completed the forecast process is going on with application of the projection model and obtained results management and presentation. In this fifth stage of forecasting the parameters of population development are applied in repeating steps on the given real population structured into population categories, i.e. groups of persons according to sex, age and other selected characteristics. The results of calculations are ordered, archived and further processed in special tables, graphs and other graphical outputs. For the presentation purposes the number and graphics are accompanied by text, usually a brief and widely understandable description of the given forecast making process, used approaches, methods and techniques, analyzed and forecasted population system, main results of the analysis of its developments, adopted projection model, basic assumptions on future developments of the system and its components, major results of final forecast and principal conclusions concerning the future development of the system and its potential consequences.

Each forecasting cycle is completed by evaluation of the forecast within the last, seventh step of population forecast making process. Qualitative evaluation based on the assessment of forecasting process realization mainly through observation of generally adopted principles and rules, quality of applied data and methods as well as other conditions can be realized immediately after presentation the final results. Quantitative evaluation of the forecast quality referring to the concept of accuracy has usually to wait for realization of the forecast, i.e. passing at least several years from the forecast period. Lessons learned close forecasting cycle becoming an input into the following one.

4.2 Cohort-component projection model

In the study the cohort-component method is used as it considers disaggregated population, which enables to learn about the underlying demographic processes. The cohort-component technique uses the components of demographic change to forecast population growth. The technique projects the population by age groups, sex, in addition to other demographic attributes such as regions and urban/rural place of residence. This projection method is based on the components of demographic change including births, deaths, and migration. The basic processes or stages of the projection tool are given above, thus in the present section we will mostly concentrate on the description of matrix model based on the work of T. Kucera (Kucera, 1998).

The cohort-component projection model in its basic form describes transformation of one sex and age structure of population to another during a particular period of time. This transformation can be labeled as a step. The step is a procedural element of the projection model application during the forecast making process. Situation on the beginning of any step is characterized by the initial age structure and in its end analogically by the final age structure. These structures can be described by two similar vectors. Any population age structure is a result of previous transformations. Therefore the initial structure can be labeled as the population after the kth step of transformation and the final one as the population after the k+1st step of transformation. Then the corresponding vectors have the following form:

$$\{P^k\} = \begin{Bmatrix} P_0^k \\ P_1^k \\ . \\ . \\ P_{98+}^k \end{Bmatrix} \quad (4) \quad \text{and} \quad \{P^{k+1}\} = \begin{Bmatrix} P_0^{k+1} \\ P_1^{k+1} \\ . \\ . \\ P_{98+}^{k+1} \end{Bmatrix} \quad (5).$$

Since any transformation has two phases – the shift of existing age groups and surviving of newly born – it is advantageous to imagine the resulting vector as a sum of two different vectors marked by letters a and b, respectively. Then the vector describing a complete age structure of males or females after a given (k+1st) step of transformation can be written as:

$$\{P^{k+1}\} = \{P^{k+1,a}\} + \{P^{k+1,b}\} \quad (6),$$

where the partial resultant vectors have the following structure:

$$\{P^{k+1,a}\} = \begin{Bmatrix} 0 \\ P_1^{k+1} \\ . \\ . \\ P_{98+}^{k+1} \end{Bmatrix} \quad (7) \quad \text{and} \quad \{P^{k+1,b}\} = \begin{Bmatrix} P_0^{k+1} \\ . \\ . \\ 0 \\ 0 \end{Bmatrix} \quad (8).$$

The first part of the initial age structure transformation can be described by the equation

$$\{P^{k+1,a}\} = S * \{P^k\} \qquad (9),$$

where **S** symbolizes a square matrix. On its first sub-diagonal there are allocated age (and sex) specific probabilities of surviving between two exact dates, the beginning and the end of the projection step defined in the sub-chapter 4.1.1.

$$S = \begin{Vmatrix} 0 & 0 & 0 & . & . & . & 0 & 0 \\ s_0 & 0 & 0 & . & . & . & 0 & 0 \\ 0 & s_1 & 0 & 0 & . & . & . & 0 \\ . & . & . & . & . & . & . & . \\ . & . & . & . & . & . & . & . \\ . & . & . & . & . & . & . & . \\ 0 & 0 & 0 & . & . & . & s_{98+} & 0 \end{Vmatrix} \qquad (10).$$

The second part of the initial age structure transformation can be described by the equation

$$\{P^{k+1,b}\} = U * \{P^k\} \qquad (11),$$

where **U** also logically symbolizes a square matrix with non-zero elements in the first row, on positions related to reproductive age of females during the given transformation step, i.e. between the 15th and 50th positions . These non-zero elements are represented by aggregates based on age specific fertility rates f_x and survival probabilities s_x in the same mutual relation as described in the formula for calculation the number of live births during a transformation step as specified in the sub-chapter 4.1.1 and completed by two other parameters. The first one is a operator distributing newly born children by sex (index of feminity) and the second parameter describe intensity of the newly born surviving between birth and the end of projection step, a tilt of the set of newly born on the set of persons in the completed age 0 years at the end of the transformation step.

$$U = \begin{Vmatrix} 0 & \dots & 0 & u_{14} & u_{15} & \dots & u_{49} & 0 & \dots & 0 \\ 0 & \dots & 0 & 0 & 0 & \dots & 0 & 0 & \dots & 0 \\ 0 & \dots & 0 & 0 & 0 & \dots & 0 & 0 & \dots & 0 \\ . & . & . & . & . & \dots & . & . & \dots & . \\ . & . & . & . & . & \dots & . & . & \dots & . \\ . & . & . & . & . & \dots & . & . & \dots & . \\ 0 & \dots & 0 & 0 & 0 & \dots & 0 & 0 & \dots & 0 \end{Vmatrix} \qquad (12).$$

Having defined both transformation matrices, the description of the entire cohort component model can be finalized. Since we have not distinguished properly males and females in our descriptions till now, we have to define compounds vector describing the population in its sex and age structure at the beginning and at the end of the particular transformation step as:

$\begin{Bmatrix} P^{k,f} \\ P^{k,m} \end{Bmatrix}$ (13) and $\begin{Bmatrix} P^{k+1,f} \\ P^{k+1,m} \end{Bmatrix}$ (14) respectively.

All partial vectors P have the same structure as the analogous vectors describing completed age structure presented above. In the similar way as in the previous case the structure of a complete transformation matrix has to be extended taking into account different reproductive roles of males and females as well as their different mortality patterns. Then the basic form of the cohort component projection model can be expressed by the equation:

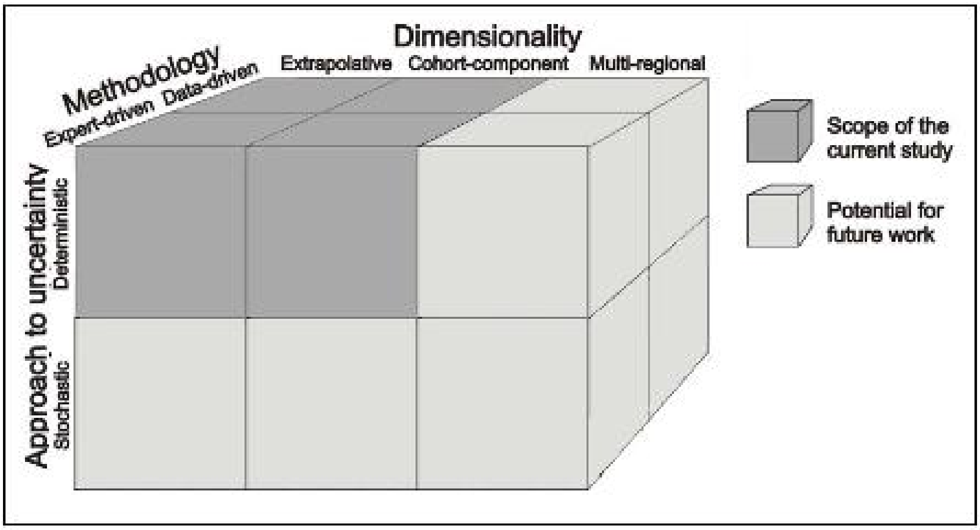
$$\begin{Bmatrix} P^{k+1,f} \\ P^{k+1,m} \end{Bmatrix} = \begin{vmatrix} S^f + U^f & 0 \\ U^m & S^m \end{vmatrix} * \begin{Bmatrix} P^{k,f} \\ P^{k,m} \end{Bmatrix} \qquad (4)$$

representing the matrix notion of an extensive system of linear equations completely describing relations among elements of standard defined population system in the process of population reproduction.

4.3 Forecasting components of population development

There can be found various classifications of population forecasting methods in literature which are usually obtained by applying some kind of criteria. According to Bijak et al. (2006) typology of forecasting methods can be done by dimensionality of the problem under study (simple extrapolations of population size or growth rates, single region cohort-component models and multiregional models), by approach to uncertainty (deterministic versus stochastic) and by methodology (data-driven versus expert-driven) (see Figure 13).

Figure 13 – Population forecasting methods



Source: modified from Bijak et al. (2006)

Every method has specific characteristics such as data requirement, time consumption, cost of application; level of forecaster's modeling skills, user friendliness, and usefulness and so on. Usually, before choosing a certain method one should consider all these specificities and apply the method which best suites to a particular project. Therefore, our aim in this section is to provide the overview of commonly used forecasting methods and to analyse their strengths and weaknesses.

4.3.1 Fertility forecasting methods

Fertility forecasting is important and difficult because it is the most essential demographic factor influencing population growth and the age structure and historically had been one of the most volatile components. Also, fertility largely contributes to the reliability and accuracy of national and sub-national population forecasts due to the fact that mortality and migration have less impact on the quality of the forecasts. Since everybody dies, in mortality forecasting we are mainly interested in the age when people die, while, even though, migration is heavily influenced by political and socioeconomic situations the number of people involved in (in- and out-) migration is small compared to the population already present in the country.

Forecasting the future course of fertility has always been a challenging endeavour for the demographers and it gets even more challenging at the sub-national level. These challenges include the requirements of consistency, not only between forecasted sub-national and national populations but, for cohort-component forecasts, between assumed fertility, mortality, and migration at regional and national levels (McDevitt, 2008).

Much attention has been given to fertility forecasting in the past and also many recent studies were devoted to the topic, mainly reasoned by surprisingly rapid falling and rising trends of fertility rates in developed as well as in developing countries in the second half of the XXth century. Various methods have been developed to forecast future numbers of births, however, most of them are more or less sophisticated form of time series model (Keilman, Cruijsen, 1992).

In order to take advantage of the known age structure, in the framework of the cohort-component method, sometimes five years, often single years of age-specific fertility rates are used in forecasting fertility. Generally, forecasters, often of official statistical agencies to forecasting issues involve the application of time series model. The time series model involves on the basis of the available data, selecting of a model to fit and forecasting the fitted model forward as if it were a "true model". One of the fundamental questions in application of the time series method is how much data there should have to be used. The more data we have (the longer the time series) the more likely it is that we will select a model that can approximate the structure of the data well, and the better our parameter estimates will be (Bell, 1988). Another important issue when analysing the fertility time series is whether these analyses should better have period basis or cohort. We are more inclined to use period data due to the fact that cohort age-specific data is massively incomplete and the cohort fertility rates usually do not follow as period rates the smooth patterns across age. Also, related to time series model dimensionality and consistency problems should have to be born in mind.

In this dissertation after preparing age-specific fertility rates the annual numbers of births are derived by applying these forecasted rates to the forecasted female population of corresponding child-bearing ages. Values of regional parameters for future years will be obtained separately for each region. Before that, a careful study of the patterns of inter-regional variations in the time series of fertility measures is made. Only on the basis of this analysis, the assumptions will be made what fertility trends should be expected in the regions.

Many countries, in order to improve fertility extrapolation use the information about child-bearing intentions expressed by women in the child-bearing ages. However, some researchers have shown that child-bearing intentions often reflect current norms rather than intended future behaviour and also when there is an unstable development of fertility in the country women may easily overestimate or underestimate their future births to a considerable degree, thus, such information cannot be straightforwardly used in fertility forecasting (Hoorn and Keilman, 1997). On the other hand, the use of surveys on child-bearing intentions can help to understand close future but not long-term fertility development which requires more statistical data and analyses of socioeconomic, cultural situations.

4.3.2 Method of mortality forecasting

The choice of the method for forecasting mortality rates depends generally on whether the approach is deterministic or probabilistic. In this dissertation we are more interested in deterministic population forecast, thus all the mortality indicators in the future are interpreted as deterministic variables. In other words, we are mainly interested in the expected level of mortality, not in its prediction interval (Keilman, 2003).

Methods of forecasting mortality is a widely studied topic. Many works were devoted to the issue by Girosi and King (2006), Booth (2006), Keilman (2005), Tabeau et al (2001), Murphy (1990), Willekens (1990), Pollard (1987). These authors suggest a number of ways of mortality forecasting methods' classification, however, in the present study we will only distinguish several important models such as the extrapolation model, causal model, expert opinion and cause of death approaches and briefly discuss them.

It is not easy to find a universally accepted method, however, the trend extrapolation model is one of the widely used methods of mortality forecasting, which allows to express an age-specific measures of mortality as a period function and to develop a model for forecasting future values of these mortality measures (Wong-Fupuy and Haberman, 2004).

The extrapolation technique may include models based on the traditional and simple forecasting of age-specific mortality rates as well as new and sophisticated models such as the Lee-Carter or the ARIMA. Also, in extrapolative forecasting can be used models based on two-factor age-period or age-cohort and tree-factor models age-period-cohort (APC). According to extrapolative methods it is assumed that past trends will continue into the future, but sometimes irregularities may occur such as increasing death rates due to new epidemics, stagnation in Czech mortality in 70's and 80's or fluctuation in Kazakh mortality after the collapse of the Soviet Union.

Extrapolation method is usually applied for short-term forecasts, however the method can perform fairly accurately in continuation e.g. of life expectancy trends (White, 2002). Using data for past years a parameterised curve might be fitted and these parameters forecasted into the future but, usually most of such curves are not flexible enough to describe present situation and also it is not easy to fit the data and derive values for the necessary parameters. Also, there is a targeting method, involving interpolation between present mortality rates and subjective and qualitative statements that are made about mortality levels for a certain future date. The target values are usually determined for example, as a set of age-specific mortality rates, specified rates of mortality improvement, or as an "optimal", "best life table" found on the basis of international comparisons in countries with lower mortality. The advantage of targeting is that, the chosen targets can take into account the possible effects of advances in medical practice, changes in the prevalence of disease or the recent emergence of new diseases. However, the main drawback of these methods is that, relationship between rates of different age groups are neglected because the rates at different ages are forecasted independently which may result in rather implausible outcomes.

There are also exist non-demographic models such as causal methods which use information on behavioural and environmental changes and tries to model mortality from bio-medical perspective. Variables employed in causal models include various indicators that reflect health, the environment, life style, access to health care, social support, income, socioeconomic class and others. These models are not yet fully developed and are rarely used in official forecasts because of imperfectly understood relationships between risk factors and mortality. Thus, it is less than reliable to apply such methods in forecasting and main use of existing causal models is in the simulation of the effect on morbidity and mortality of policy changes affecting the risk factors, rather than in forecasting per se (Booth and Tickle, 2008).

Often, official forecasts, based on deterministic scenarios rely heavily on expert opinion. Indeed, expert judgement is of importance in the practice of population forecasting, since the question whether the trends observed will continue in the long term or not cannot be based only on purely statistical criteria. The advantage of expert opinion is the incorporation of demographic, epidemiological and other relevant knowledge, at least in a qualitative way and the disadvantage is its subjectivity and potential for bias (Booth and Tickle, 2008). It was observed that forecasts of mortality improvement, life expectancy or rate of mortality decline based on expert opinion tend to be underestimated. (Alho and Spencer, 1990; Lee & Miller, 2001; Waldron, 2005: Shaw, 1994; Murphy, 1995)

The above mentioned methods can be used to forecast mortality from different causes of death, separately or grouped. The use of cause of death in forecasting is advocated from a theoretical perspective as a means of gaining accuracy in overall mortality forecasting (Crimmins, 1981; Caselli, 1996). Due to, sometimes, insufficient data and for the sake of clarity forecasting death by cause usually involves grouping of these causes into limited number of groups, e.g. ten main groups and mortality rates for each cause are forecasted forward, then the resulting mortality rates are combined to produce aggregate mortality rates. Causes of death normally relate to specific ranges of age, but sometimes, when actual average values are estimated, these range of ages is divided into 19 groups, each containing a range of five years and for ultimate values, the range of ages is divided into only four groups (Wong-Fupuy and Haberman, 2004).

The main benefit from forecasting mortality rates separately by cause of death is that it provides an insight into the way that mortality is changing. Remarkable results were gained by Pollard who applied this method for Australian data which allowed for some demographers, including Pollard himself, assume that cause-of-death forecasting may offer greater accuracy and improvements in the financial and demographic forecasts for sectors such as health and personal social services, however, subsequent experience has often proved otherwise.

In practice, limited value can generally be gained from decomposition by cause of death because deaths from specific causes are not always independent, the age patterns for the main causes are often similar and usually, it is difficult to properly determine the final cause of death. Death may be due to a number of reasons and the one that is recorded as the main cause of death may not be the only or even the actual underlying cause. Furthermore, misclassification and unreliability of cause-of-death reporting at older ages where most deaths occur can also be a problem (Alho, 1991; Stoto and Durch, 1993; Murphy, 1995).

Although it is not always recommended that mortality forecasting should have to be done by cause of death, however, some analysis of the past trends in causes of deaths should be carried out to help to make judgmental decisions about future rates of mortality improvement. In general, the methodology that will be used in Kazakh population forecast can be considered as a mixture of many of above mentioned models – trend extrapolation of age-specific death rates and expert judgement. In fact, judgment is required at almost every stage (Alders & De Beer, 2005). Furthermore, numerous experiences have shown that more complex data or more sophisticated methods are not themselves a guarantee for better results and in many cases simple methods can sufficiently outperform them.

4.3.3 Forecasting migration

Forecasting migration is an important yet very difficult research task, because migration, especially international is a complex and multi-dimensional phenomenon characterised by a large dose of uncertainty and high errors in forecasting, also by inherent randomness of the processes under study, lack of comprehensive migration theories (Willekens, 1995), and poor data quality (Kupiszewski, 2002) which should have to be properly addressed and quantified.

The existing methods of migration forecasting include various approaches originating from demography, economics, sociology, geography, political science etc (Bijak, 2005). In the current section, a survey of some of these methods is offered. The presented overview relates only to deterministic methods due to our interested, as was mentioned above, mainly in deterministic population forecasting so far.

In order to select a forecasting model and to describe future trends of any population component, including migration, expert opinion is used, which involves qualitative and quantitative argumentation of what is considered to be the plausible development of the variables in question. Expert judgement is widely used by many official agencies and forecasters for national as well as subnational population forecasts of population movement. Often, expert opinion is concealed among the assumptions applied and does not explicitly stated in the forecast, in any case, the incorporation of expert judgement in population forecasting is always present and crucial.

Expert judgement used in setting the scenarios can be either made by the authors of forecasts themselves, or derived from a survey carried out among a larger group of specialist from various countries and fields of expertise (Bijak, 2006). The latter method is called Delphi, which allows obtaining migration scenarios by anonymous and interactive communication process among experts in the field. This method is based on structural surveys conducted in two or more rounds and in the second and later rounds of the survey the results of the previous round are given as feedback, so that participants under the influence of their colleagues' opinions may alter the original assessments if they want to - or stick to their previous opinion (Cuhls, 2003). Thus, the Delphi method is a "relatively strongly structured group communication process", which delivers qualitative as well as quantitative results and makes unsure and incomplete knowledge applicable after it is analysed and judged by experts (Häder, 1995).

Other survey-based studies which are used to evaluate the future course of migration are sociological survey studies of 'migration potential' (Fassmann and Hintermann, 1997). In such surveys usually questionnaires are filled in by a representative random sample of respondents, who are asked questions whether they consider undertaking migration, when, from what reasons, for how long, etc. Usually, the authors of such studies do not refer to their outcomes as forecasts per se and the results of the surveys are generally presented in a way that does not deal with the issue of uncertainty (Bijak, 2006). This method is not without drawbacks, which include problems with vagueness of definitions used in such surveys, strong dependence of the results on the way how questionnaires are organised and questions are asked and difficulties with transformation of respondents statements to actual migration behaviour (Kupiszewski, 2002).

Another group of methods for forecasting migration relates to mathematical models which make use of multi-dimensional linear algebra, calculus and the applications of the methodology of Markov chains. The most widely used model among them is the cohort-component which evolved to include migration component since 70's. The cohort-component model is usually involves forecasting of population size and age structure on the basis of scenarios of change in dynamics of fertility, mortality and migration components related to the country under study. This traditionally-used cohort-component model for demographic forecasts underwent a major advance with the development of multi-regional models by Rogers (1966, 1975), Rees and Wilson (1975, 1977), Willekens and Drewe (1984) and others.

The multi-regional model allows to model place to place migration flows and these flows are calculated as a function of population which responds to changes in structure and distribution of this population. In case of application of the multi-regional model one can meet serious problems with data collection, with the cost of purchasing the full origin by destination by age by sex migration matrix and also it gets extremely difficult to manage so many variables (Wilson and Bell, 2004). However, there are several ways of reduction of input data requirements of the model: aggregation and partitioning (Rogers 1976; Rees 1997). Aggregation involves merging categories in any of the four principal dimensions of the multi-regional model: origins, destinations, age and sex and partitioning is achieved by breaking up the model into a small number of semi-independent subsystems with limited direct connections (Wilson and Bell, 2004).

There are also other ways of migration treatment in the framework of regional population forecasting. Toth, Cao and Hizsnyik for Chinese regional population forecast have developed a simple model to estimate the provincial share of the national inter-provincial migration based on the historical data between 1990 and 2000. The model takes the population of the given province in 1990 and the natural growth rates between 1990 and 1999 for each year. The difference between the calculated population (based on natural growth rates) and the actual population (based on the census data) in 2000 is taken to be the population won or lost due to inter-provincial migration. In this way the total numbers of inter-provincial migrants as well as the share of each province in the flow of inter-provincial migration are obtained. Then the flows of inter-provincial migration are harmonized with the urbanization rates in the underlying demographic scenarios (Toth, Cao and Hizsnyik, 2003).

Apart from purely demographic models, several authors made efforts to create models with additional explanatory variables which can combine social and economic aspects of population development. Such additional variables can be, for example, GDP per capita, unemployed rate, labour supply, productivity, income levels, employment rates and so on. These so-called demo-economic models are often applied to internal migration forecasts, especially in cases when analysis is focused on a single country, however on the macro level the application of the models is also wide spread. The examples of population dynamics combination with an economic input-output analysis can be found in the studies of Franzmeyer and Brücker (1997), Sinn et al. (2001), Venanzoni and Fachin (2002), Alvarez-Plata et al. (2003) and others.

In our case we intend to apply judgmental method of obtaining future migration numbers in combination with time series extrapolation and we plan to treat each migration viz international and interregional separately for each forecast unit and sum them with projected population.

Chapter 5

Identification of the population system

Identification of the system is the first and at the same time one of the most crucial stages of population forecasting (Keilman, 1990). *"Considered from the accuracy point of view, the three most crucial phases are: those of system identification, system description and parameters extrapolation. Subjectivity plays a major role in these three phases … Subjective decisions have to be made during the stage of system identification, when the forecaster is confronted with the choice whether or not to include demographic characteristics such as region of residence marital status, nationality etc."* (*op.cit.*, p. 48).

Our principal task to be solved in this stage is to define (delimit and specify) such a population system that would be most suitable for forecasting population development in Kazakhstan till 2030. Bearing in mind the above mentioned high subjectivity of the system identification we will try to find ways that will allow us to minimize or at least substantially reduce the role of subjectivity in making decisions about the scope and structure of the population system.

Referring to the importance of the system identification we will analyse the current demographic situation in Kazakhstan, and based on available information we will attempt to define a population system which could become an object of our forecasting efforts and then it would be necessary to assess suitability of this system for the purpose of the study. To assure required level of objectivity the method of cluster analysis will be applied as a basic instrument of identifying the system and for the assessment purposes the principles of SWOT analysis will be employed

5.1 Recent population dynamics

Kazakhstan is the second largest country after Russia among the CIS countries, has a territory of over 2,7 million square kilometers (9th place in the world). It borders Russia to the north and west, the Central Asian republics of Uzbekistan, Kyrgyzstan, and Turkmenistan to the south, and China to the east. The fact of having such a vast territory already gives basis for developing a heterogeneous socio–economic and demographic situation in the country such as uneven distribution of population, water, soil suitable for agriculture, natural resources and so on.

Kazakhstan is divided into 5 economical regions, 14 administrative regions (oblasts) and 2 municipal cities (see Map 1) which are further broken down into 175 smaller administrative areas called raions. The country has a population of 16.5 million (KAS, 2011). With 6 persons per square kilometer, Kazakhstan has one of the lowest population densities in the world. The population is comprised of more than 100 nationalities and ethnic groups. Sixty-three per cent of the population is Kazakh, twenty five percent Russian, other significant subpopulations are Germans, Ukrainians, Uzbeks, Tatars, Uigurs, and Koreans.

Map 1 – Regions of Kazakhstan

Source: own drawing

Demographic indicators of Kazakhstan have shown considerable fluctuations in the last two decades. Since gaining Independence as a consequence of transition from central command planning to a market economy the overall economic system of country seriously deteriorated which affected socio-demographic situation in the country. The economic crisis of the first decade of Independence led to massive emigration of mostly non-Kazakh population, also during the transition period TFR fell below replacement level and increase of mortality as well divorce rates occurred. Life expectancy at birth dramatically declined during this period compared to pre-Independence years especially for male population. However, with improvement of economic situation during the second decade of Independence the socio-demographic indicators are getter better with increasing birth rates and life expectancy at birth.

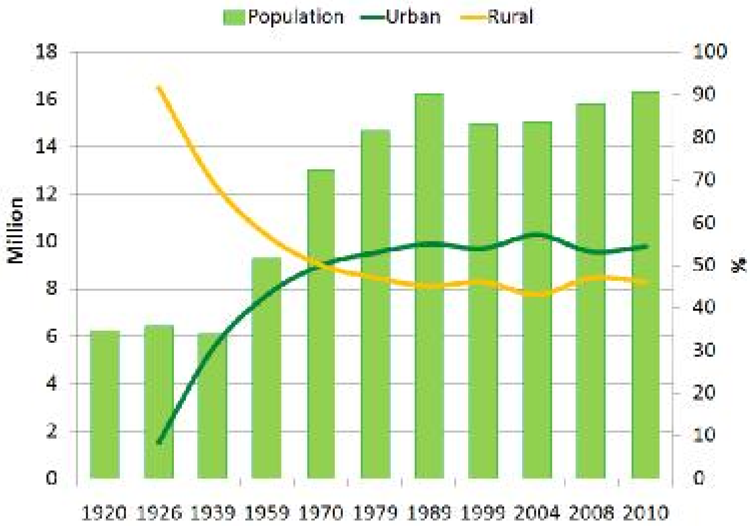
5.1.1 Population size and structure

This section focuses on population features of Kazakhstan with the main aim of capturing and understanding the demographic picture of the country and analyzing and determining its regional heterogeneity.

With regard to the regional dimension, the oblast level is taken as the basic unit of analysis. In Kazakhstan, the oblast is the highest unit of regional administration. Prior to December 1997 Kazakhstan consisted of 19 oblasts, then with the 1997 territorialadministrative reform East-Kazakhstan oblast was attached to Semei oblast, Jezkazgan oblast was incorporated into the Karaganda oblast, Kokshetau was incorporated into North-Kazakhstan oblast, Torgai was attached to Akmola and Kostanai oblasts, and Taldykorgan was united with Almaty oblast.

Despite these geographical changes in Kazakhstan, the present chapter considers 14 oblasts and 2 municipal cities throughout the whole independence period and data available on demographic trends have also been provided and adjusted for these 16 main administrative units.

Figure 14 – Population of Kazakhstan, 1920-2010

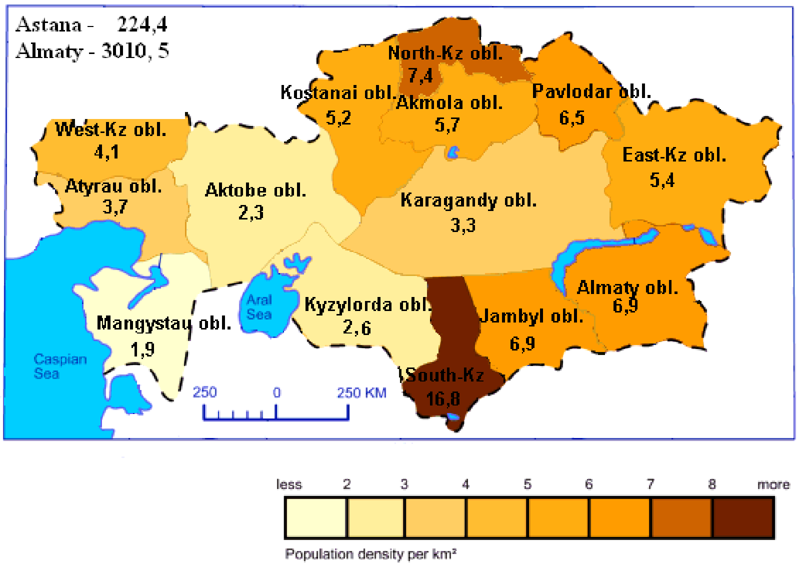


Source: stat.kz

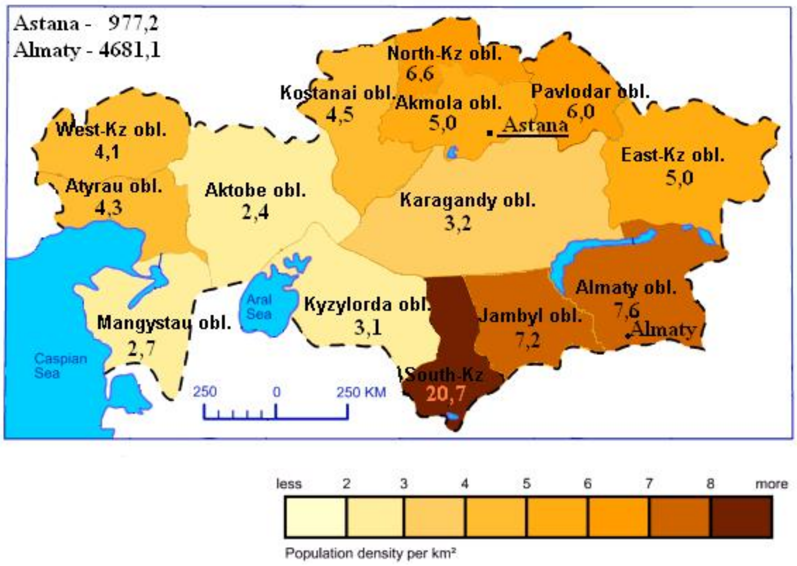
When forecasting population, analyses of historical trends are necessary. In case of Kazakhstan last 40 years are the most important because only after 1970s the country's population reached relative stability at around 14 million. According to Figure 14 until 1940s population in the country despite comparatively high fertility (around 40 births per thousand people) fluctuated around 6 million. The population increase was only 2.6% or 0.22% per year between censuses of 1926 and 1939, which can relate to several factors such as famine in early 1930s and migration. Famine on the one hand resulted in the sharp decline of population while immigration on the other – alleviated the decreasing effect of famine. Migration at that period was mainly to labour camps and new industrial towns of Kazakhstan which influenced apart from ethnic also residential composition of the population by diminishing proportion of rural residents for 1.3, and increasing the city dwellers for 3.7 times in the mid 1920s. According to the 1926 Census the proportion of urban population was 8.5% and it increased to 30.4% in 1939 (see Figure 14). Not only migration contributed to that, many Kazakh people majority of whom (97.9%) lived in rural areas in the mid 1920s moved to towns in search of employment which led to the decline of their proportion among rural residents by 1.8 times.

The most rapid increase of urban population took place during the first half of the 20^{th} century as a result of industrialisation reforms and migration. The proportion of urban population equalised rural in the 1970s and during last 40 years keeps at the level of 50% experiencing slight fluctuations from time to time.

Map 2 – Population density in Kazakhstan, 1999



Map 3 – Population density in Kazakhstan, 2010



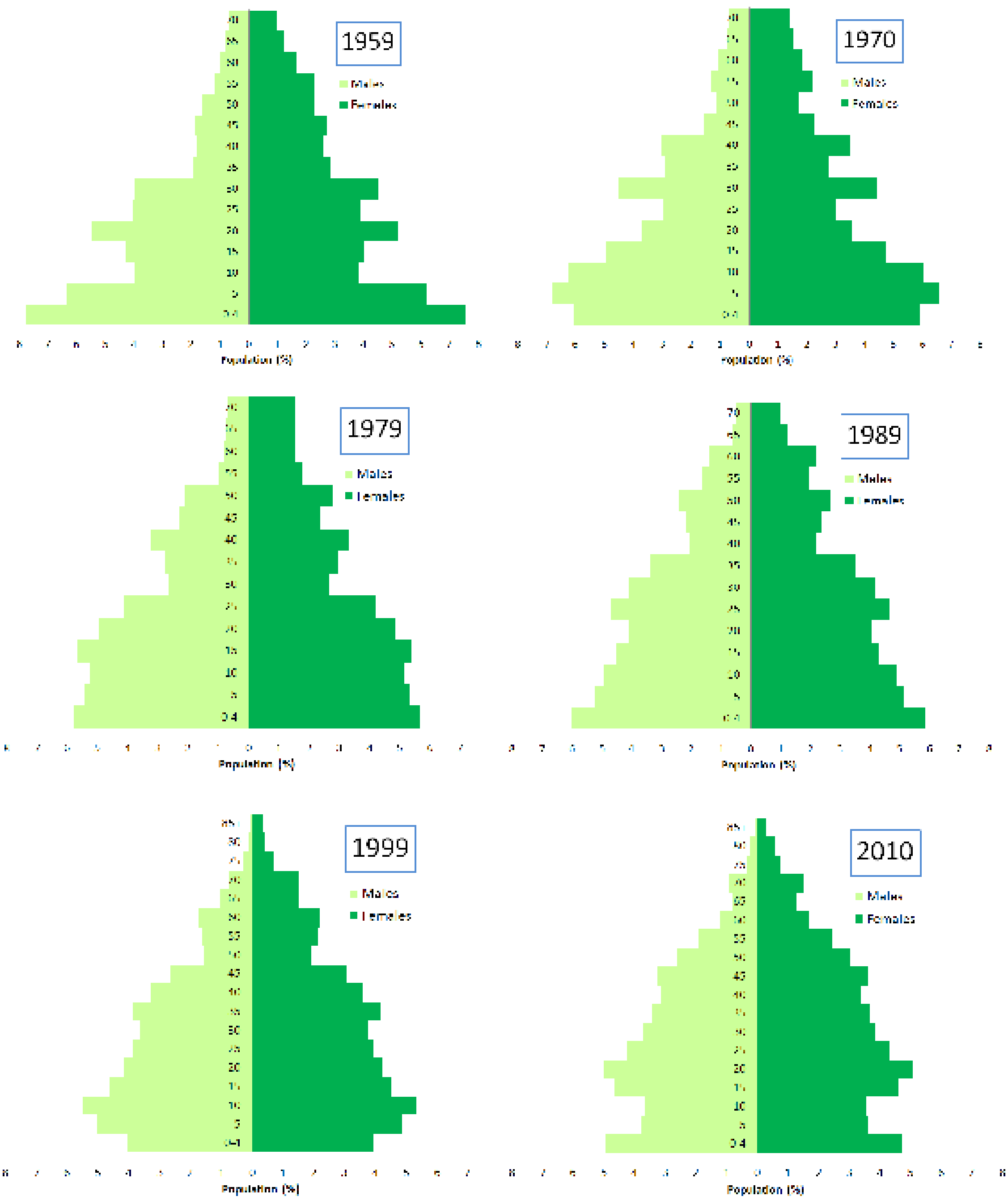
Source: www.state.gov and own drawing

The standards of living between urban and rural settlements in the country were quite significant and the difference is not diminishing with the laps of time. Many attempts are being made and programmes have been launched since Independence (Aul development programme 2003-2005) to improve position of auls and although, the overall situation have taken a turn for better, but a huge success in the field is still far from country's reach.

The large proportion of the country's population living in rural places tend to have more intensive demographic rates, especially in case of marital fertility which contributes to stable increase of population numbers in agricultural oblasts mostly located in the South, South-West and some in the North parts of Kazakhstan.

Changes in population density per square kilometer for the last 10 years in the country are shown in Maps 2 and 3. Map 3 illustrates that most of Kazakhstan's population is concentrated in southern and northern regions and in the municipal cities, while central and western Kazakhstan regions are populated sparsely. During the last 10 years the overall density picture of the country changed slightly with South gaining in population, whereas North keeps losing (see Map 2).

Figure 15 – Kazakhstan's population pyramids, 1959-2010

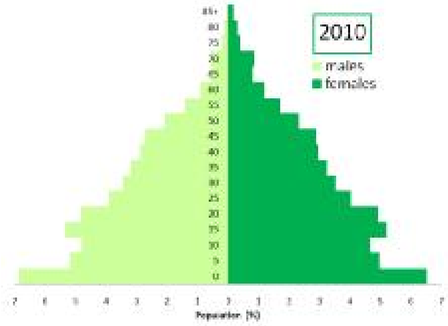


Source: stat.kz

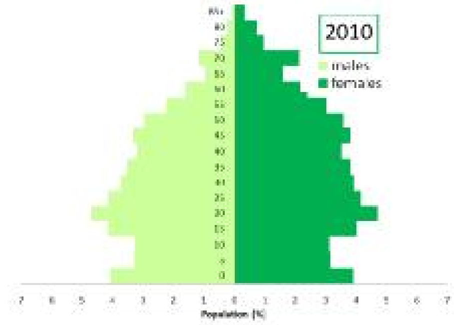
In population forecasting disaggregation of population by age and sex is one of basic issues. The best way to analyse age and sex structure is through population pyramids. Kazakhstan's population pyramid, which reflects the structure and composition of population, has changed from flat and wide towards a bell shape. Generally, the pyramid of developing countries in the early stages of the demographic transition is broad at the bottom and narrows at the top. Indeed, in 1959 and 1970 the younger cohorts are large, which relates to boom of fertility at that time.

The pyramid starts to narrow since 1979, probably as a result of declining fertility rates and of family size. However, there was another boom of births in the second half of the 1980s, which resulted in a broad bottom of the 1989's pyramid (see Figure 15).

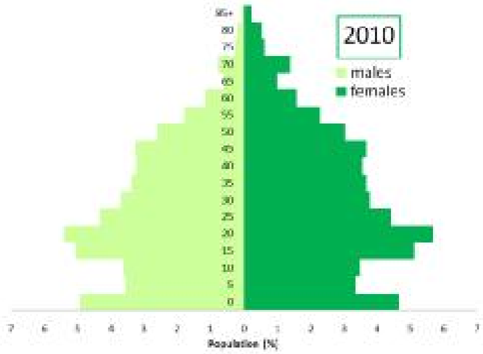
Figure 16a-g – Kazakhstan's regional population distribution by age and sex, 2010



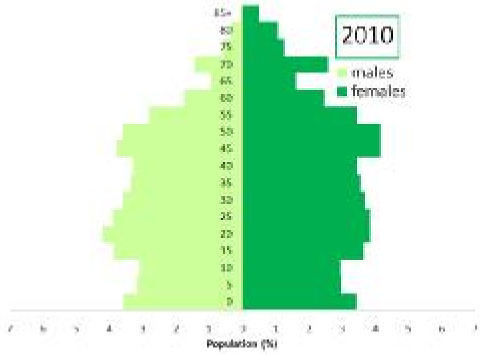
16a - South-Kazakhstan oblast



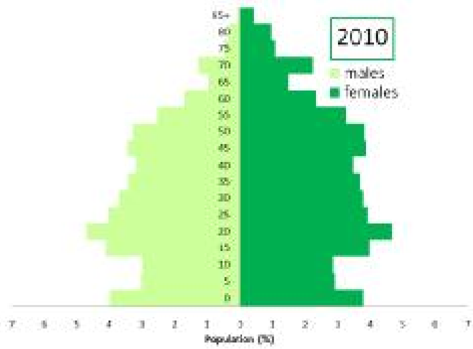
16b - Karaganda oblast (Central Kazakhstan)



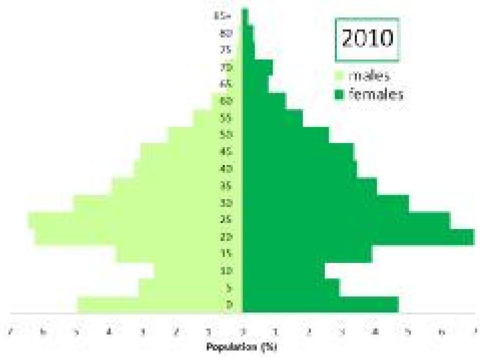
16c - Aktobe oblast (West Kazakhstan)



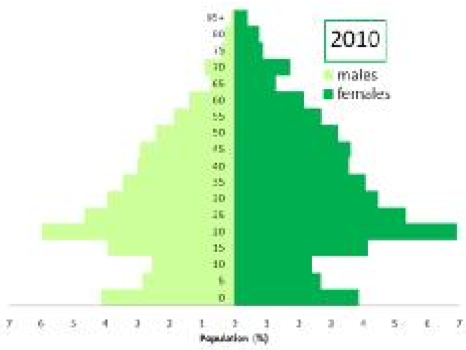
16d - North-Kazakhstan oblast



16e - East-Kazakhstan oblast



16f - Astana city



16g - Almaty city

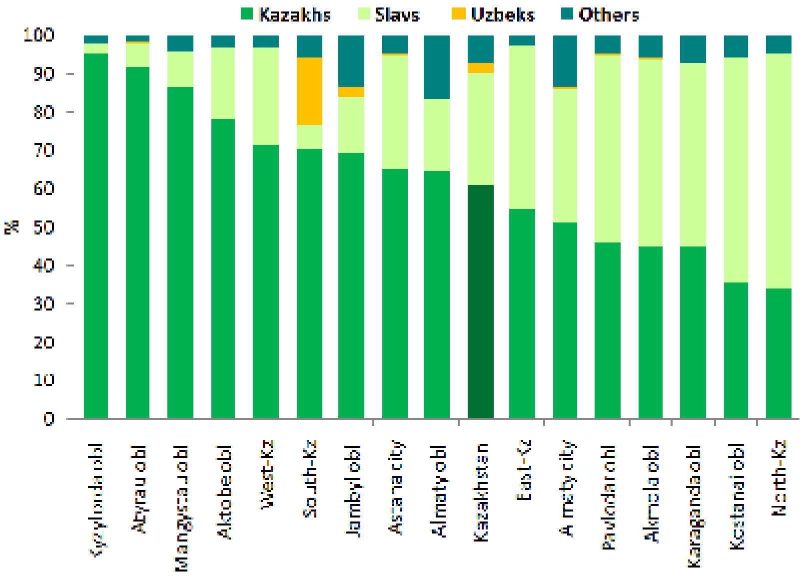
During the next decade Kazakhstan went through a deep political and socioeconomic crisis with rather negative effects on healthcare system and demographic indicators. However, in the second decade of Independence the economic situation in the country started to improve positively affecting fertility i.e. people began to feel financially safer with development of economy and many women decided to have postponed in 1990s children. Besides, people born during the fertility boom of 1980s reached their reproductive age (see Figure 15). However, it is very much uncertain how long will last this "positive" fertility trend in the country.

At the sub-national level, the age distribution shows significant variations. In Figure 16a-g given selected most divergent regional pyramids in 2010. From Figure 16a it is clear that southern oblasts, represented by the South-Kazakhstan oblast have a considerably large proportion of young age groups, while people in the reproductive age groups became narrow exceptionally rapidly at ages above 20. It is not surprising since these southern oblasts are well known as main donor provinces for the internal migration within the county, particularly for the male population. Meanwhile, an early stage of aging has appeared in the oblasts of northern, central and eastern Kazakhstan, where the size of older population is larger than in the other oblasts. The larger proportion of population aged 15 to 25 in this province may be explained by migration.

The age and sex structure of cities Astana and Almaty are mostly made up by migrants between ages 25-35 and their children at very young ages and low proportion of elderly and school age children. Indeed, these two cities are country's major migrant recipients apart from oil and gas mining regions (see Figure 16f-g).

Despite seemingly young age structure of Kazakhstan's population, the country may already be well on the way of facing population ageing problems, because northern regions constituting almost 40% from total population are experiencing steady increase of share of people at advanced ages.

Figure 17 – Kazakhstan's regional population by ethnic composition, 2010



Source: stat.kz

The main reason for such diverse age and sex structure of regional population could be related to ethnic composition of the population. Since gaining Independence in 1991 the ethnic portrait of the country gradually changed for the benefit of natives i.e. the share of Kazakhs in total population reached 63% in 2010 which owes on the one hand to the massive emigration of non-Kazakhs in the mid 1990s and to the repatriation programmes started at the same period by the government and on the other to high birth rates among the rural population represented mainly by Asian population residing mostly in western oblasts and in the agrarian South. Also, from Figure 17 it becomes clear that Asian ethnicities still prefer to reside in southern part of the country while almost half of the North part of Kazakhstan which include central, eastern regions are inhabited by Slavs and other nonnative nationalities.

According to the above analyses of population structure and size it is evident that population in Kazakhstan is distributed rather unevenly between regions related to geographical, historical and economic factors. Besides, a large proportion of the country's population still lives in rural areas and there was not much change in its share during the last 40 years. In the next sections we will discuss fertility, mortality as well as migration indicators in order to understand and to be able to justify our choice of categories which are necessary in our opinion to achieve the most possibly accurate estimates of Kazakhstan's future population numbers.

5.1.2 Fertility

This section attempts to assess the trends of fertility in Kazakhstan at national and regional levels. Fertility is a component which can greatly influence population forecast results. Our aim is in this section to try to understand current fertility patterns in the county in order to more accurately prognosticate its future development.

According to Table 1 there was an increase in values of TFR for the country as a whole as well as in all oblasts during the second decade of Independence. For Kazakhstan more significant growth of TFR happened in urban areas from 1.55 in 1999 to 2.47 in 2010 rather than in rural - from 2.18 to 2.78 in the same years. Although, all oblasts have experienced rise of numbers of children per women, however, there is a substantial variation of the TFR among Kazakhstani regions. The highest TFRs in urban as well as rural areas are in southern oblasts Kyzylorda, Jambyl, South-Kazakhstan and Almaty with average values rising from 2.05 in 1999 to 3.22 in 2010 in cities and from 2.61 to 3.34 in rural places for the same period. In western oblasts were registered the second highest TFR values, experiencing growth of regional average in cities from 1.80 in 1999 to 2.77 in 2010 and from 2.43 to 2.86 for respective year in auls. With lowest shares of native population the rest of the country have on average 1.95 in urban areas and 2.04 in rural places in 2010 and growth of TFR which took place during the last ten years was lowest in these regions also in cities Astana and Almaty.

At the regional level, during the period 1999-2010 changes at mean age at childbirth combined with TFR values are remarkable. In 1999 oblasts were making a one big "cloud" consisting of northern oblasts with lowest TFR on average 1.5 children per women located around mean ages 25-26 at childbirth, while the other end of the "cloud" made of two southern regions and two western oblasts Mangystau and Atyrau with the highest TFR above replacement level but with mean ages 27 and 27,5 at childbirth, and with Jambyl, West-Kazakhstan, Aktobe and Almaty oblasts positioned in the middle of the "cloud". The two municipal cities were also somewhere in the centre, but with very low level of TFR.

Table 1 – TFR by regions and urban/rural places of residence, Kazakhstan 1999 and 2010

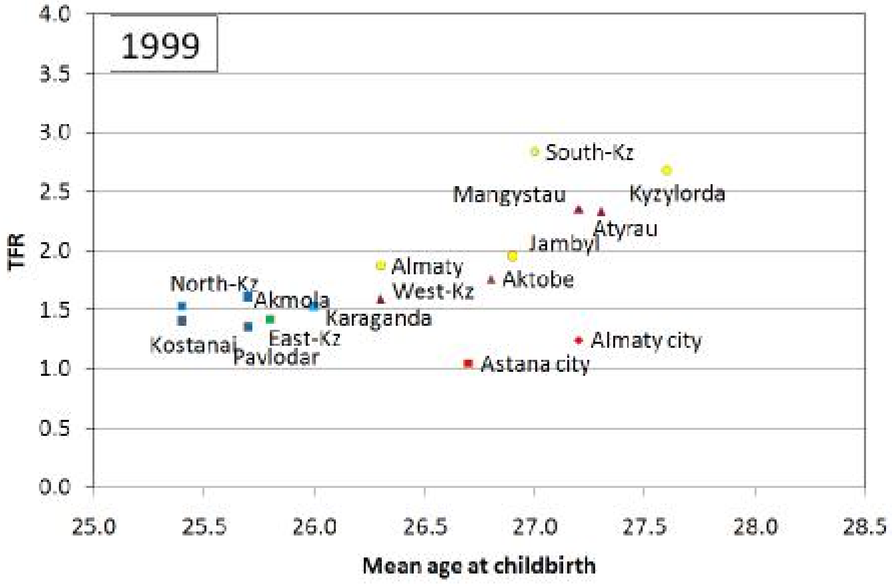
Oblast	*Total fertility rates*			
	Urban		*Rural*	
	1999	*2010*	*1999*	*2010*
Kazakhstan	1.55	2.47	2.18	2.78
North				
North-Kazakhstan	1.20	1.78	1.75	2.18
Pavlodar oblast	1.26	1.81	1.55	2.26
Kostanai oblast	1.17	1.67	1.71	1.78
Akmola oblast	1.45	2.35	1.75	2.04
West				
West-Kazakhstan	1.23	2.42	1.89	2.32
Mangystau oblast	2.16	2.97	3.24	3.46
Atyrau oblast	2.26	3.37	2.47	3.16
Aktobe oblast	1.55	2.32	2.10	2.75
South				
South-Kazakhstan	2.35	3.37	3.20	4.04
Kyzylorda oblast	2.50	3.66	2.99	3.62
Almaty oblast	1.81	3.01	1.91	2.79
Jambyl oblast	1.55	3.00	2.35	3.59
East				
East-Kazakhstan	1.24	1.80	1.73	2.53
Central				
Karaganda oblast	1.55	1.98	1.47	2.39
Astana city	1.05	2.26		
Almaty city	1.25	1.81		

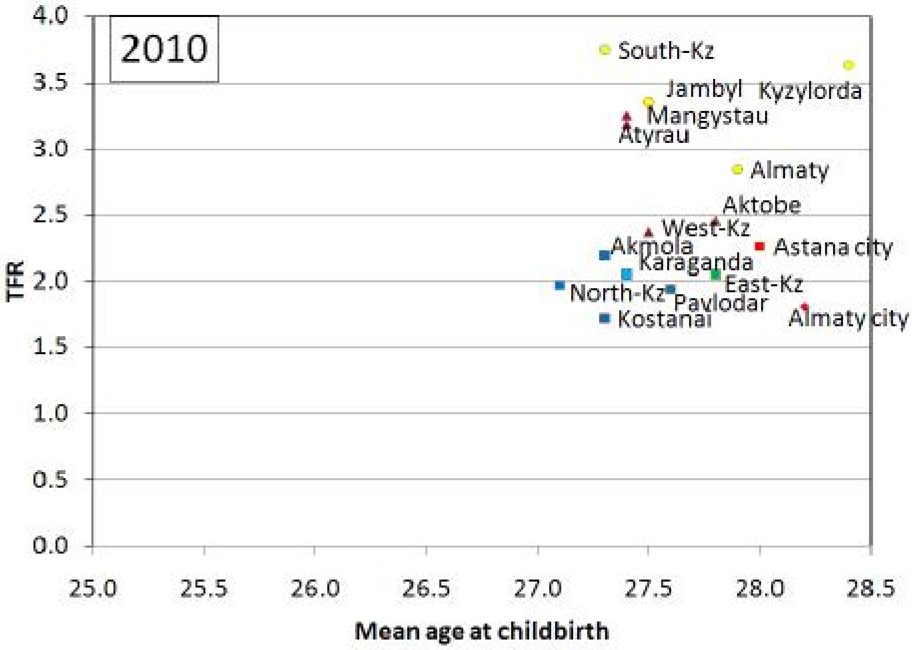
Source: stat.kz

The situation is rather different ten years later with two distinct groups: Asian South-West with average TFR well above 3 children per women and Slavic rest of the country with TFR around replacement level. However, despite differenced in TFR levels the mean age at childbirth converged at around 27 and 28 with only several northern oblasts lagging behind (see Figure 18). During 1990s women living in northern part of the county used to have fewer children at younger ages whereas nowadays these women still have few children but mean age at childbirth rose for almost two years.

An inevitable outcome of declining fertility rates and increasing age at birth in most of the countries in the world leads to a reduction in family size. The reduction in average annual rate of population growth, which is a global phenomenon, primarily occurred due to reductions in fertility levels, which means that when present temporary fertility boom will be over the average annual growth rate of population in Kazakhstan can start to decline.

Figure 18 – TFR and Mean age at childbirth by oblasts of Kazakhstan, 1999 and 2010

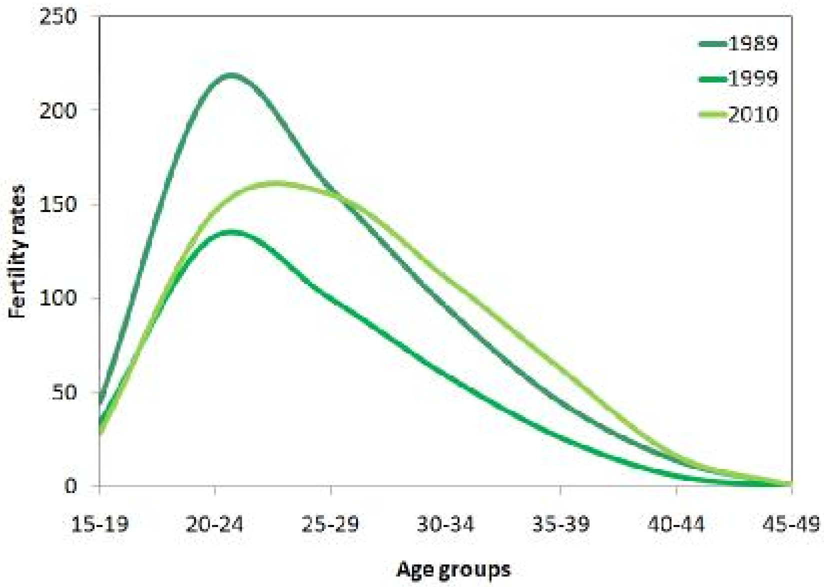




Source: stat.kz

The changes during the last twenty years in age-specific fertility rates can be seen in Figure 19. Fertility rates substantially decreased in Kazakhstan between the 1989 and 1999 among all age groups related to the political and economic crisis. During 1990s most births occurred at ages 20-25 and their numbers decline considerably after ages 25-29, and births among women aged above 35 were quite rare.

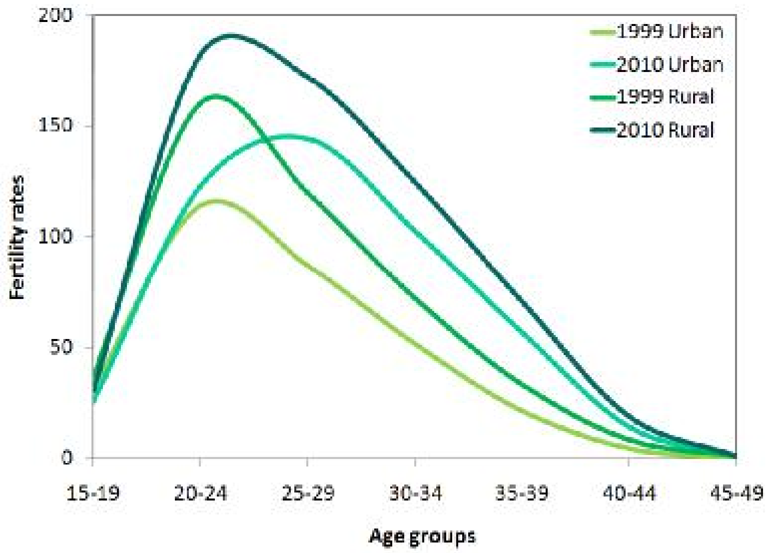
Figure 19 – ASFR by five-year age groups (per 1000 females), Kazakhstan 1989-2010



Source: stat.kz

Since economic improvements in 2000s the ASFR values have increased, however, rise in birth rates occurred mostly among women aged 25-29 and 35-39. Despite a slight shift to older ages, young women aged 20-25 still have high fertility, but important thing is that current fertility boom is mostly due to rise of later, postponed births (see Figure 19).

Figure 20 – ASFR by five-year age groups and urban/rural places of residence (per 1000 females), Kazakhstan 1999 and 2010

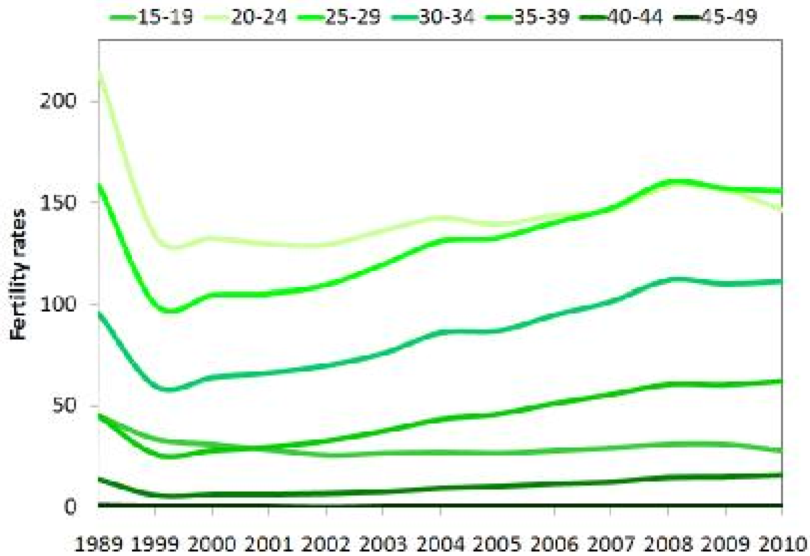


Source: stat.kz

Above mentioned shift of peak age of age-specific fertility rates shown in Figure 20 in urban/rural dimension. Increase of birth rates is obvious as well as flattening trend of the fertility curves, denoting substantial increase in fertility rates of women aged 25 to 35 years. Also, unlike first post-soviet years in present days fertility at late thirties has risen too. Besides, during 1990s there was a significant difference between urban and rural fertility rates, which have considerably diminished at present days, though women living in rural areas have slightly higher fertility.

How age structure of fertility changed during the last twenty years is shown in Figure 21. There is a clear trend of shifting fertility to older ages, especially during the last five years. This shift could be related to changing attitudes of women towards later marriages or postponement of childbirth. An increase in the level of female education and participation at work may have also contributed to this recent phenomenon.

Figure 21 – ASFR by five-year age groups (per 1000 females), Kazakhstan 1989 and 1999-2010



Source: stat.kz

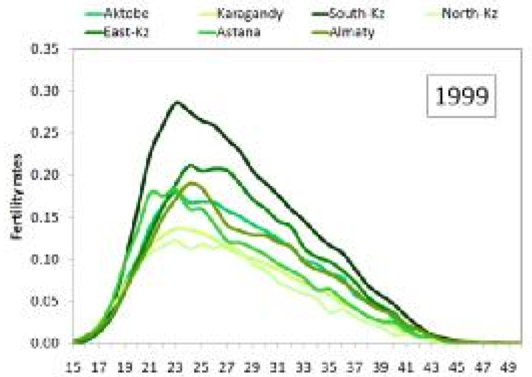
The regional variation in ASFR is very high and it changed over time. In order to see the variations of these fertility rates among oblasts, data for fertility rates from 7 selected oblasts were used as illustrations. These are one oblast with higher TFR (South-Kazakhstan oblast), two provinces with lower TFR (Karaganda and North-Kazakhstan), two province with TFR somewhere in the middle (Aktobe and East-Kazakhstan oblasts) and two major cities Astana and Almaty. These provinces exhibit variations in the trends of fertility patterns at regional levels. Particularly, from Figures 22a and 22b it is clearly seen that southern oblasts have substantially higher fertility rates than the rest of the country with age group 20-25 years dominating the high proportion of fertility rates.

In the period 1999-2009 the ASFRs have fallen for all regions especially low in eastern and central Kazakhstan though births became more concentrated at younger ages in northern and western oblasts. Women have fewer than the rest of the country children in cities Astana and Almaty, even though they have the highest proportion of people at childbearing ages. Majority of population of these cities are migrants who came mainly in search of opportunities, employment or education and since women spend more time for self-development and self-fulfillment fertility rates of the cities dropping with the lapse of time.

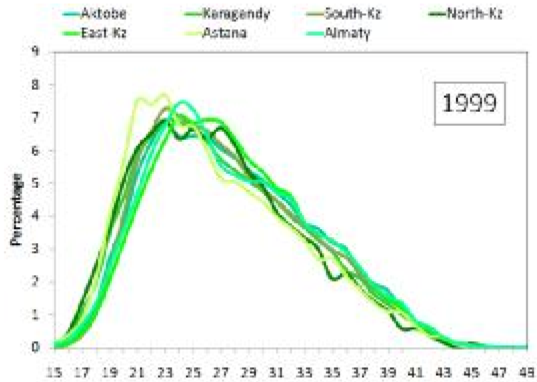
The percentage distributions of ASFR, which is calculated by dividing the ASFR with the sum of fertility rates and multiplying the results by 100, for selected regions of Kazakhstan are provided in Figure 22c and 22d. Based on KAS data, 50% of fertility rates were attributed to the fertility rates of women at ages 19 to 28 having about 6% each single age almost for all regions except for the capital city Astana which has higher fertility among younger age groups. In ten years, although the shape of fertility rates' curves has changed over time, the percentage distributions of fertility rates by age group have changed very slightly with births nowadays concentrated more among young women, particularly for women in age group 19-25 years. Over time, the regional differences in percentage distribution of fertility rates increased especially for women aged 25-34 years accounting for about 40 percent of the total fertility rates while the percentage of fertility for age groups 35-49 decreased from 15% in 1999 to 10% in 2010 on average for the country.

Figure 22 – ASFR and percentage distribution of fertility rates in selected oblasts, Kazakhstan 1999 and 2010

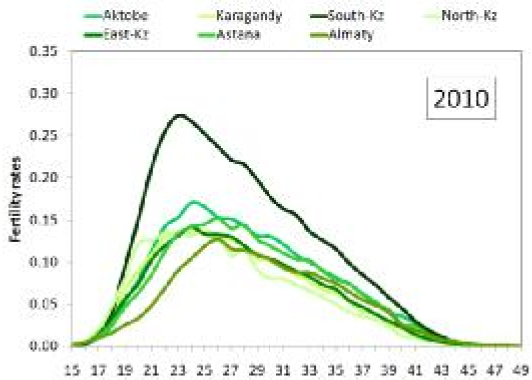
22a - Age-specific fertility rates



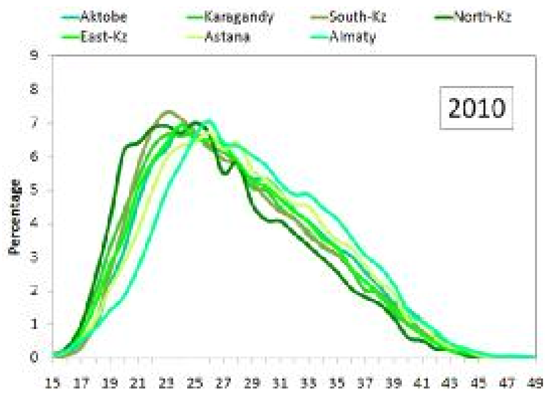
22c – Percentage distribution of fertility rates



22b - Age-specific fertility rates



22d – Percentage distribution of fertility rates



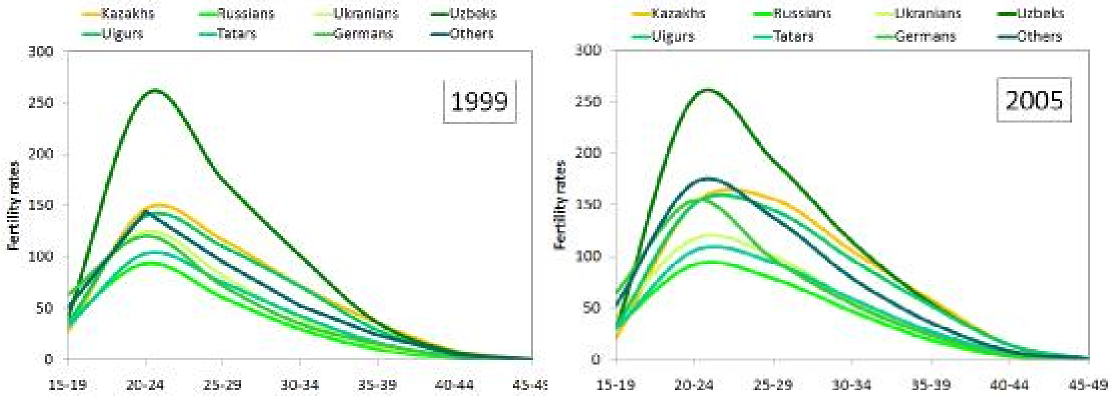
Source: yearbooks

Fertility rates are also diverse for ethnic groups in Kazakhstan. Unfortunately, data for calculation of the ASFRs by ethnicities were available only till 2005, but still these 6 years were enough for changes to occur in fertility patterns at the ethnicity level. The highest ASFRs as could be guessed among the Asian ethnicities with most salient rates among Uzbeks. Majority of Uzbeks as we know from the previous section live in southern provinces, particularly in the South-Kazakhstan oblast which leads to higher rates of fertility in age groups from 19 to 30 in this oblast in comparison to other regions. Fertility of Uzbek women aged above 30 is getting equal to fertility levels of other Asian ethnicities (see Figure 23).

Fertility rates between Kazakh and Uzbek females differentiate greatly especially in age groups 20-24 and 25-29, for example, in 1999 ASFR for Kazakh women aged 20-24 and 25-29 were 147 and 116 births per 1000 females, whereas Uzbek women for the same period and the same age groups had more than 258 and 174 births per 1000 women respectively and in 2005 among Kazakh women the same rates increased to 151 and 155 respectively, while for Uzbek women among the studied age groups ASFR remained highest at the 255 and 192 births per

1000 females level. It means Kazakhs have peak fertility rate at ages 22-26 which is shifting towards older ages as a result ASFR for age groups 35-39 increased during six years for more than 60% and for age groups 40-44 also for 57%, only the oldest reproductive age groups are experiencing decline for more than 17% during the same period.

Figure 23 – ASFR by ethnicities (per 1000 females), Kazakhstan 1999 and 2005



Source: stat.kz

In general terms, fertility of the rest Asian ethnic groups is typical of Kazakhs with very slight differences among age groups as well as over time. Russians, Tatars and Ukrainians exhibit lowest ASFRs which are further falling with the lapse of time. Very different are fertility patterns of German females who have much younger peak age of fertility at 20-24 which is more or less stable and moreover number of births among this age group have increased for almost 30% during the period 1999-2005. At older ages all Slavic nationalities have more or less similar values of ASFR which are much lower than ASFR of Asian ethnicities.

As was mentioned before, the level of fertility has the greatest effect on population growth as a consequence on results of population forecasts as well, because it has a multiplier effect, which means that additional children born today will have additional children in the future. From our analyses of fertility we may assume that despite currently increasing birth rates, shifting peak age of fertility, rising mean age at childbirth and changing attitudes of women indicate that eventually fertility in Kazakhstan will start to decline affecting population growth.

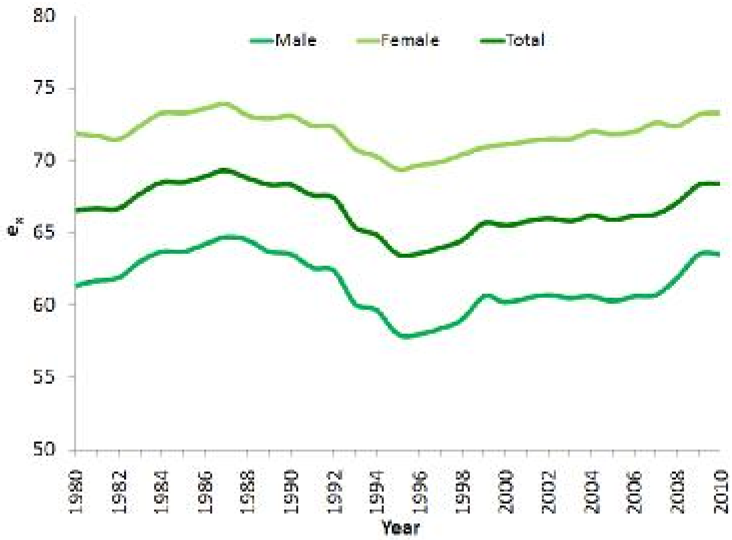
Therefore, it is necessary to bear in mind all those probable changes of fertility patterns and be able to distinguish temporary occurrences from long-lasting and try to accurately predict pace of fertility decline and the assumed eventual fertility level, which are important to determining trends in population size and age structure. The two factors also interact: the lower the assumed eventual fertility level, the more important the pace of fertility decline becomes to forecasted population size (O'Neill et al 2001).

5.1.3 Mortality

Since early 1990s, as a result of political and economic crisis mortality rates in Kazakhstan have fluctuated dramatically. The country experienced a disastrous increase in mortality from independence through the mid-1990s. Substantial recovery then occurred after 1997, with present data showing a clear reversal of the earlier rise. Although rapid improvement has not continued but still the situation is gradually getting better and it appears that in many regions of the country and in some segments of society a genuine recovery is underway. Broadly speaking, the recovery is strongest among women and in cities and it was nearly as dramatic as the earlier increase, although gains are likely to be slowing. In areas with slower economic development, mortality recovery appears to have stalled, though there are other signs of demographic improvement—notably, rising marriage and fertility rates. Perhaps most strikingly, some kinds of mortality (from certain communicable diseases) continue to show marked improvement, while for other causes (accidents, heart disease, and diseases of the digestive system) the recovery situation remains slow and in case of diseases of the digestive system number of deaths is even rising.

The economic collapse in Kazakhstan was stunning, and its recovery also seemed very impressive, however as we see now the rapid economic improvement of early 2000s was short-lived and the current World Financial Crisis is again stagnating and complicating the economic situation in the country which will certainly have subsequent effects on demographic trends. Furthermore, the era of economic crisis was mirrored by deteriorating mortality indicators including life expectancy, while a comparably symmetric improvement in mortality (in life expectancy) has not accompanied economic recovery, instead, for example, the improvement in life expectancy at birth is very slow and it is only now reaching levels of Soviet era life expectancy at birth.

Figure 24 – Life expectancy at birth by sex, Kazakhstan 1980-2010



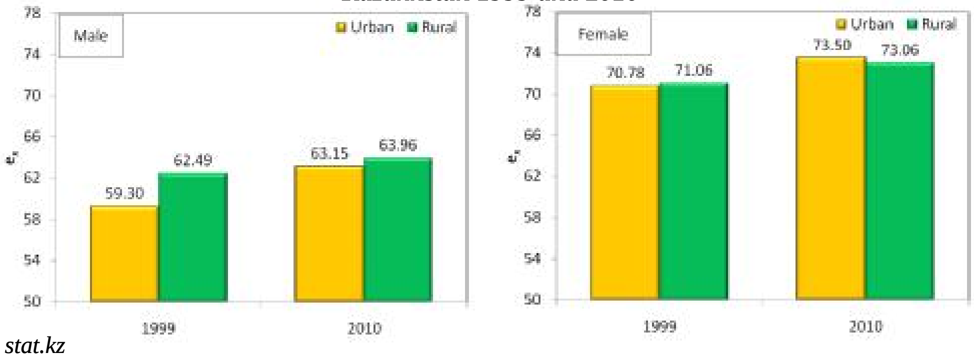
Source: World Bank, stat.kz

From the early 1960s till the early 1990s life expectancy at birth in Kazakhstan had with some fluctuations an upward trend for men as well as women (see Figure 24). Life expectancy peaked in 1987, and then declined slightly. With the collapse of the USSR and the ensuing economic crisis, mortality levels exploded, especially for working age groups. Birth rates collapsed, as did the incidence of marriage. Population growth rates slowed and in some regions became negative as fertility declined below replacement levels, and substantial out-migration of non-Kazakh ethnicities occurred in the country (Becker et.al, 2004).

From the late Soviet period through the initial post-Independence crisis, life expectancy in Kazakhstan declined dramatically for both men and women. The 6.5 - year decline in life expectancy for males and 5.6 - year decline for females during the period 1990–1995 is exceptional – almost unique for peace time societies not facing an extraordinary epidemic

(Becker et.al, 2004). However, comparable declines did occur in other former Soviet states (Shkolnikov et al., 1998). Life expectancy began to recover in 1996, but at a very slow pace. The recovery actually strengthened in 1999 and then it was stagnated at 60-61 years for males and 71-72 years for females till 2008 and only in recent several years it fastened its pace of recovery and reached 64 for males and 73 for females in 2010 (see Figure 24).

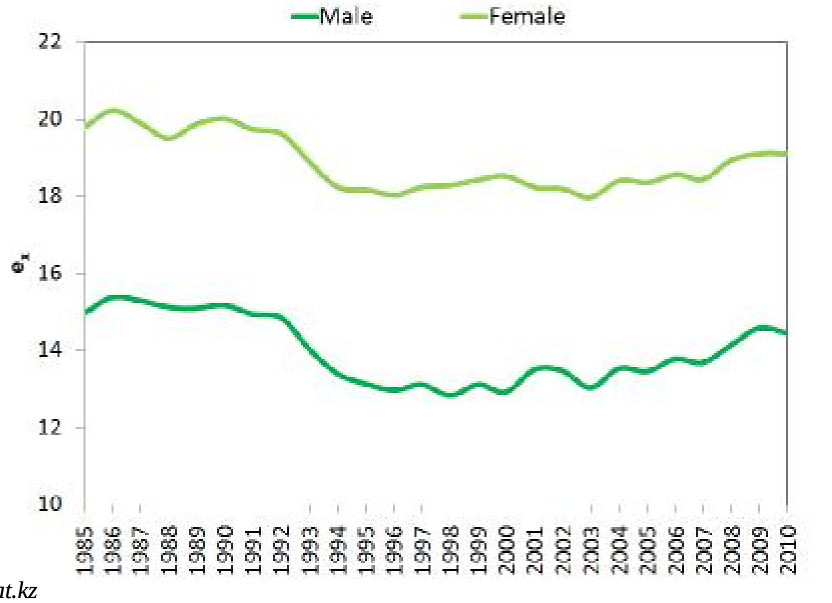
Figure 25 – Life expectancy at birth by sex and urban/rural place of residence, Kazakhstan 1999 and 2010



Source: stat.kz

Although, during the last ten years there was not a really substantial improvement in life expectancy at birth for people living in urban areas as well as in rural places, however the difference between them slightly diminished as did the difference between male and female life expectancies. In cities both male and female population during the period 1999-2010 gained in life expectancy at birth only slightly more than 2 years which is even less in rural areas - 2 and 1 year for males and females respectively (see Figure 25).

Figure 26 - Trends of life expectancies at age 60 in Kazakhstan, 1985-2010

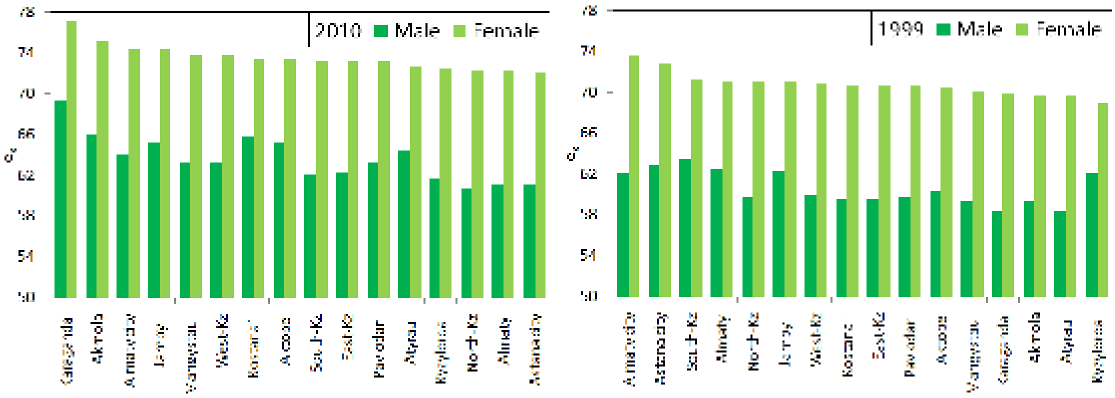


Source: WHO, stat.kz

Trends of life expectancy at old age, which are shown in Figure 26, indicate that before the collapse of the Soviet Union in Kazakhstan people at exact age 60 used to live more than 15 years on average. However, the political crisis of the 1990s was followed not only with economic but also with demographic difficulties as well, which resulted in drop of life expectancies to such levels that after twenty years of Independence the country is still far from prior-independence levels.

The difference between male and female life expectancies at birth is higher in cities than in rural places which is 10 and 8 years in 2010 respectively. However, it is still more advantageous to live in urban places rather than in rural, especially in cities Astana and Almaty – two cities with the highest levels of life expectancy in the country. Ten years ago people lived longer in Almaty than in Astana while nowadays the cities have swapped their places (see Figure 27).

Figure 27 – Life expectancy at birth by sex and regions of Kazakhstan 1999 and 2010



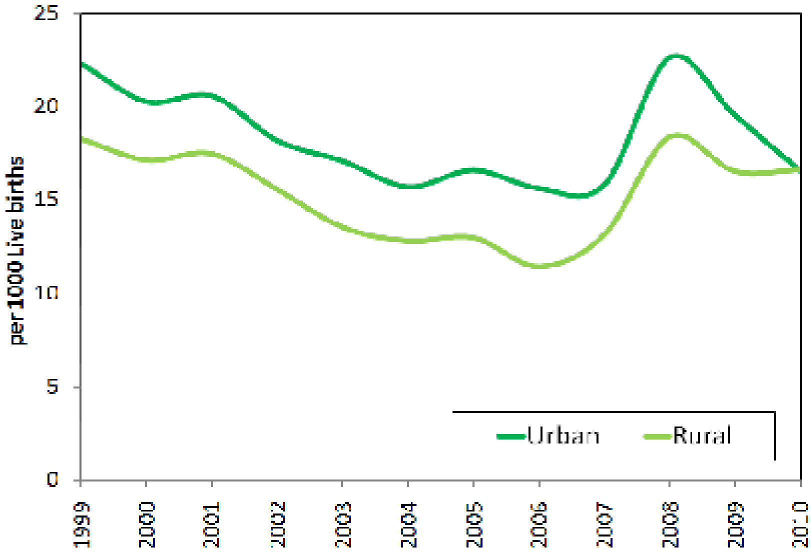
Source: stat.kz

At the regional level there is not a big divergence of life expectancy levels and the difference between the region with the highest life expectancy at birth (South-Kazakhstan oblast in 1999 with 63,4 years for males and 71,4 for females and Aktobe in 2010 with 63,7 and 74,1 respectively) and the region with the lowest (Kyzylorda in 1999 with 62 years for males and 69 for females and Akmola in 2010 with 61.1 and 71,1 years for respective sexes) is only about 3 years. In comparison with female life expectancies at birth male life expectancies vary more between regions with higher values in southern regions with higher share of Asian ethnicities, while the lowest value exhibit northern regions which are more populated by the Slavic nationalities.

The collapse of economic output with gaining Independence has had negative effects on population health indicators such as rising infant mortality. According to the KAS data, following a decline in infant mortality rates from 30 per 1000 live births in 1980 to 26 per 1,000 live births in 1990, infant mortality rates then rose to 28 per 1000 live births in 1993. In general, infant mortality rates throughout the Central Asian countries, including Kazakhstan, have risen from Soviet-era levels, but since 1994 it was gradually falling in Kazakhstan and in 2007 it declined to 15 deaths per 1000 live births. However, it peaked again to more than 20 per 1000 live births in 2008 (see Figure 28) which can be related to the transition of the country to the WHO definition of live births.

A proper definition of 'live birth' is a crucial determinant of the infant mortality rate, since if an infant is not considered to be born alive, then he or she cannot be considered to have died. The World Health Organization developed the following definition of a 'live birth' in 1950: "The complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of the pregnancy, which, after such separation, breathes or shows any other evidence of life, such as beating of heart, pulsation of the umbilical cord, or definite movement of voluntary muscles, whether or not the umbilical cord has been cut or the placenta is attached." (WHO, 1950, definition 3.1)

Figure 28 – Infant mortality by urban/rural place of residence, Kazakhstan 1983-2010



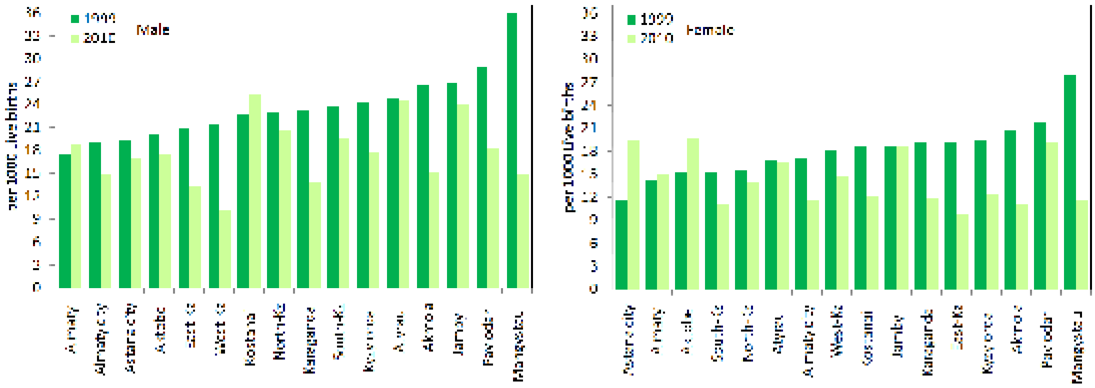
***Source**: World Bank, stat.kz*

In other words, any birth with any signs of life, however insignificant, and which is then followed by death, however quickly, should be defined as a live birth and infant death. This definition is officially recognised in most countries of the Former Soviet Union, for example Belarus and Georgia since 1993, Armenia in 1994 and Kyrgyzstan in 2002. Kazakhstan till 2008 used the Soviet less rigorous definition of live birth, according to which a sign of life is counted only breathing and it was presumed that infants who are born before the end of 28 weeks of gestation, or who weigh less than 1000 grams at birth are not live births until they have survived a full seven days (or 168 hours). If they survive for less than this time, they are considered as miscarriages or not counted at all.

The nationwide registration of newborns according to the WHO criteria has started in January 2008. The application of these criteria enabled Kazakhstan to compare its statistics with other countries and, in turn, will probably help to improve medical interventions to reduce infant mortality. The Government of Kazakhstan was trying to introduce the WHO criteria since 2002. With USAID support, a pilot model was developed and implemented in ten maternity houses in Almaty City and Oblast. All newborns weighing 500 grams and with 22 weeks of gestation (instead of the 1000 grams and 28 weeks that was required under the former system) were registered as births. Due to the initiative, the official statistic for infant mortality in pilot facilities has increased at least twice. Almost the same happed in the whole country since 2008, but during the last several years there are already some sings of infant mortality improvement, in 2010 it fell to 18 per 1000 live births.

Even in Soviet times, there was a high degree of regional variation in infant and adult mortality rates, as a result of different economic opportunities and access to services. This situation was still persisting during the first decade of Independence, however during the last ten years the regional variation is gradually diminishing, though the difference of infant mortality values between boys and girls is substantial for all regions, it was around 6 deaths on average in 1999 which only fell to around 4 deaths per 1000 live births in 2010. Ten years ago Mangystau had the highest value of infant mortality both for boys and girls 36 and 28 per 1000 live births respectively and it is still among the five regions with high rates of infant deaths such as Kyzylorda, Atyrau, South-Kazakhstan and East-Kazakhstan oblasts (see Figure 29).

Figure 29 – Infant mortality by regions of Kazakhstan 1999 and 2010



Source: *stat.kz*

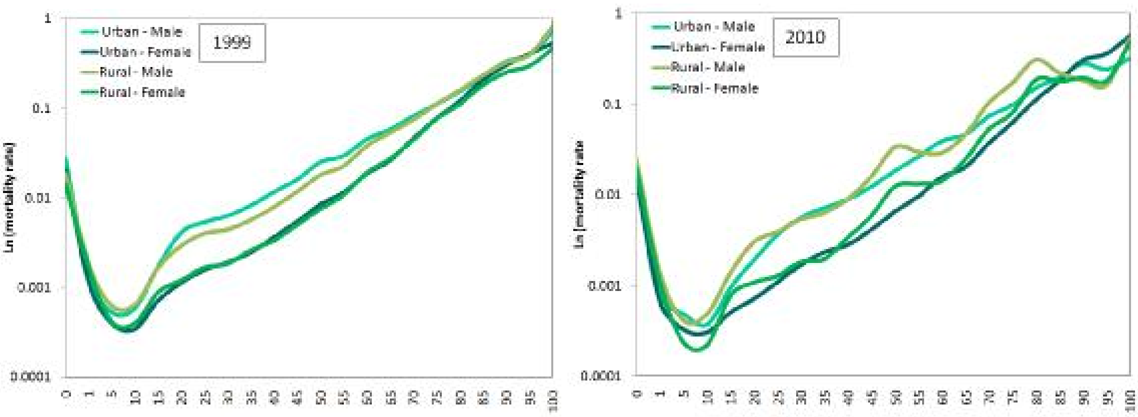
All these four oblasts and plus the capital city Astana have experienced increase in infant mortality rates during the period 1999-2010. This geographic variation could probably be related to an urban-rural divide i.e. regions with majority of population living in rural areas characterized with poorer health facilities, lack of trained medical personnel, and a general pattern of lower investment in public infrastructure (including hospitals, clinics, and roads) have higher proportion of infant deaths, while regions with more urbanized population with cities where more concentration of educational and economic opportunities exhibit lower levels of infant mortality.

As was stated earlier, during the first ten years of post-soviet era the mortality situation in Kazakhstan rapidly deteriorated. The rise in mortality has been concentrated in a selected number of major causes. Neoplasms (cancer), respiratory illnesses, and digestive illnesses were relatively unimportant. However, the incidence of infectious disease mortality has doubled, but from a low level. As in most other former Soviet republics, rising mortality in Kazakhstan can overwhelmingly be attributed to circulatory system disease and to a large rise in accidents, injuries, poisoning and traumas, which is particularly high among men. Mortality from neoplasms and respiratory and infectious and parasitic diseases has a declining trend, corresponding to the concentration of the mortality increase in middle-age groups.

Mortality in working age groups is far more likely to be from circulatory system diseases, which is still very high for both sexes, or accidents and violent deaths than from degenerative diseases more heavily associated with old age. Therefore, the surge in circulatory system and external cause mortality was responsible for most of the mortality increase during the first decade of independence, and these causes started to show a downward trend only recently.

The most important factors influencing population health in Kazakhstan are closely related to insufficient physical activity, poor diet, smoking, alcohol consumption, unhealthy lifestyle, intolerance to stress, and delaying visits to specialists. Worsening environmental conditions in fast developing country continue to have an impact on the health of young generations and generally have more negative impact on male population rather than female.

Figure 30– Age-specific probabilities of dying per 1000 persons, Kazakhstan, 1999 and 2010



***Source**: stat.kz*

According to Figure 30 there is a significant difference between male and female mortality rates. The difference increases from age 20 to ages 40-44 and the gap narrows in advanced age groups. Among males there is higher dissimilarity of mortality between urban and rural areas which results from a more pronounced change in mortality age structure during the last ten years.

Summarizing the analyses of mortality trends in Kazakhstan we can say that the general trend is positively oriented even though with rather weak improvements. Since the present study is long-term intended then it is necessary to bear in mind that in case of further economic development in the country which in turn will have positive effect on health care system, the overall mortality improvements might hasten up and intensify in following several decades. Besides, it is well known that in developing countries with relatively high levels of mortality there is possibility of achieving more pronounced improvement in mortality indicators during shorter time than in countries with already low mortality levels.

5.1.4 Migration

Migration is a demographic variable that might greatly influences population size and structure. The entire demographic history of Kazakhstan is a perfect evidence of that fact.

Migration is a form of geographical mobility or spatial mobility of people between one geographical unit and another, involving a change of usual place of residence to the place of destination. In this section we distinguish between international and internal migration. The difference between these two types of migration is in the dimension of space. Internal migration is a permanent, temporary or seasonal movement of individuals between regions and within a defined region within the territory of the Republic of Kazakhstan, which includes interregional migration - a permanent, temporary or seasonal movement of individuals between 14 administrative regions and 2 cities – Almaty and Astana and intraregional migration - a permanent, temporary or seasonal movement of individuals within a defined region within the territory of Kazakhstan.

International migration is a movement of people between different countries. International migration is often influenced by government control, regulations and policies (i.e. immigration policies) both at origin and destination regions.

Historically, migration had a profound effect on size, structure and ethnic composition of the population in Kazakhstan. It can be said with certainty that the current demographic situation in the country is a direct result of migration processes which took place throughout the 20th century. To understand recent and being able to estimate future migration and partially also other components of population change one must turn back to deeper migration history and study historical implications of major migration flows, in particular on ethnic composition of population.

From the time of establishment of the Soviet system on the territory of Kazakhstan there have been several massive waves of multinational forced migration from other parts of the Soviet Union which led to vital changes in the structure and composition of the country's population. The first such flow of Russians moved to Kazakhstan in connection with industrial modernization reforms of 1930s which resulted in the growth of the urban population in both absolute and relative terms.

However, not only Slavs contributed to this increase. Thousands of Kazakhs moved to the towns to seek employment in the newly created industries. By 1939 16% of Kazakhs were urban dwellers, an eightfold increase since 1926. A whole new class of Kazakh industrial workers emerged in those years, reaching 246,900 by 1939, a 3.7–fold increase since 1927. By the late 1930s 50% of all industrial workers in Kazakhstan were Kazakhs, though the numbers of highly skilled workers among them were still low (Kiikbaev, 1968)

But the general effect of the 1930s on the ethnic balance in the Republic was disastrous for the Kazakhs. The collectivization of the early 1930s and subsequent famine led to a significant fall in Kazakh numbers due to deaths and migration out of the USSR. In combination with the inflow of new migrants this created a situation in which the Slavic and Kazakh populations were virtually equal in numbers, and the general trend was then working against the Kazakhs. In the late 1930s the beginning of mass deportations of "unreliable" ethnic groups from the border areas deep into the center of Eurasia, by way of preparation for World War Two, further contributed to this trend.

With the war raging deportations acquired bigger dimensions. The first really massive deportation was undertaken in August – September 1941, when the Autonomous Republic of the Volga Germans was abolished and its residents resettled in Kazakhstan and Siberia. Although, of all German deportees only 36.6% have been sent to Kazakhstan, nevertheless they made a large absolute number. According to the 1959 census, Germans amounted to 7.1% of the Republic's population (Census 1959, 1962), hence an important consequence of the war period for Kazakhstan was a large German community. Subsequently in the course of the war other minority groups such as Chechens, Ingush, Polish, Karachai and Balkar were deported to the county for alleged cooperation with the Nazis and for participation in brigandage on a large scale.

The last act of migration to Kazakhstan was played out in the 1950s. In 1954 the Virgin Lands campaign initiated by Khrushchev started and brought to the country hundreds and thousands of new inhabitants. During the period 1954–1962 about 1.7 million people came to Kazakhstan from the European part of the USSR (Tereschenko, 2002).

Table 2– Ethnic composition of population in Kazakhstan (%), 1897–2010

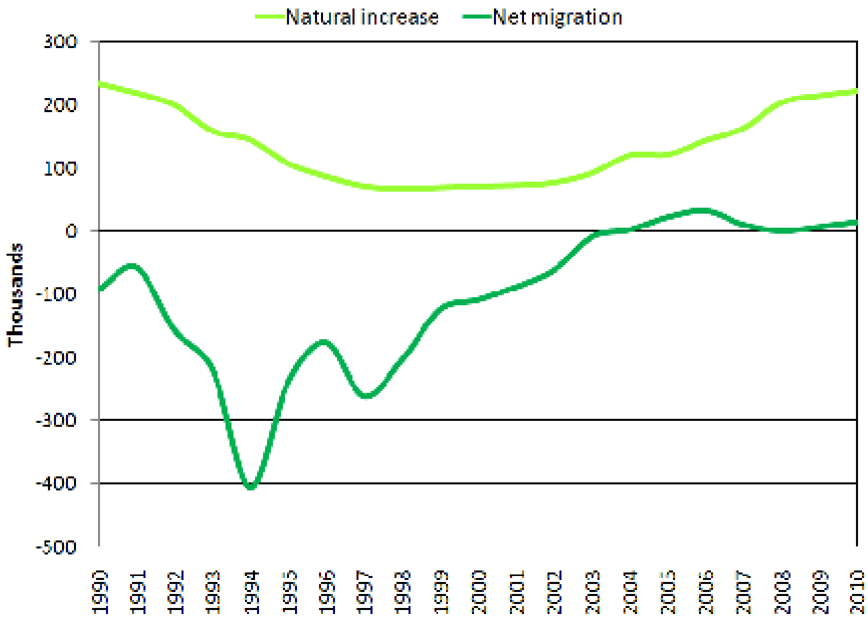
	1897	1911	1926	1939	1959	1970	1979	1989	1999	2010
Kazakh	73.9	60.8	59.5	38	30	32.6	36	39.7	53.4	63.1
Russian	12.8	27	18	40.2	42.7	42.4	40.8	37.4	29.9	23.7
Ukrainian	-	-	12.4	10.8	8.2	7.2	6.1	5.4	3.7	2.1
German	-	-	0.7	1.5	7.1	6.6	6.1	5.8	2.4	1.1
Tatar	1.1	1.1	0.7	1.6	1.5	2.2	2.1	2	1.7	1.3
Uzbek	1.3	1.1	3.2	1.7	1.1	1.7	1.8	2	2.5	2.8
Belarusian	-	-	-	0.5	1.2	1.5	1.2	1.1	0.8	-
Uyghur	-	-	-	-	0.6	0.9	1	1.1	1.4	1.4
Korean	-	-	-	-	0.8	0.6	0.6	0.6	0.7	

***Source:** demoscope.ru, stat.kz*

Ethnic balance in Kazakhstan was adversely affected (see Table 2), with Kazakhs becoming a minority in their own republic. By 1959 they amounted to only 30% of the total population. Not surprisingly, the impact of the Virgin Lands campaign on the Kazakh consciousness remains extremely negative. This campaign, conducted exclusively on the basis of economic considerations, is still perceived in Kazakhstan as forcible justification. It was not until 1989 that Kazakhs managed to reverse the ethnic balance in their favour. Nevertheless the ultimate result of migration to Kazakhstan remains unchanged even now. The non–Kazakh population of the republic is still very substantial.

Kazakhstan is a country with a vast territory and the population here is distributed rather unevenly between regions. Since the demise of the Soviet Union in early 1990s, as a result of political independence, economic and social conditions in Kazakhstan have drastically changed and fluctuated. The Independence for the country meant, first of all, breaking down and losing all ties with former Soviet economic partners and secondly, transition from centrally-planned to a market economy which resulted in deep economic and social crisis which lasted almost a decade. As a consequence Kazakhstan experienced massive out–migration of non-Kazakh ethnicities represented mostly by well-educated and high-skilled population, especially from the North, East and Central regions. The loss of population amounted –58 thousand persons in 1991 and in 1993 this number was already fourfold and reached –219 thousand but the peak of net emigration fell to 1994 when the country left more than 400 thousand people. Kazakhstan continued to lose population till 2004 when net international migration was less than 3 000 people. With economic improvement number of net-migrants consequently increased to 33 041 in 2006, but dropped again to 1 117 in 2008 (see Figure 31). Moreover, the transition period was accompanied by dramatic and largely asymmetric economic developments which led to increasing regional disparities and widening of the gaps between prosperous and depressed regions of the country. Overall number of emigrants during the transition decade got close to 3 million and in order to “cure” the existing situation the repatriation programmes have been suggested and launched. Repatriates or oralmans are ethnic Kazakh people - descendents of refugees who fled the country during collectivization, dispossession of the kulaks and political repressions in 1920s and 1930s and then returned to Kazakhstan after gaining Independence. In the international practice, countries usually start to solve ethnicity questions when they build strong economic background to support invited repatriates such as in the case of Germany, Israel, however, Kazakhstan started to assign quotas right in the “bottom” of the economic crisis i.e. in mid 1990s and consequences were respective.

Figure 31 – Natural increase and net-migration, Kazakhstan, 1990–2010

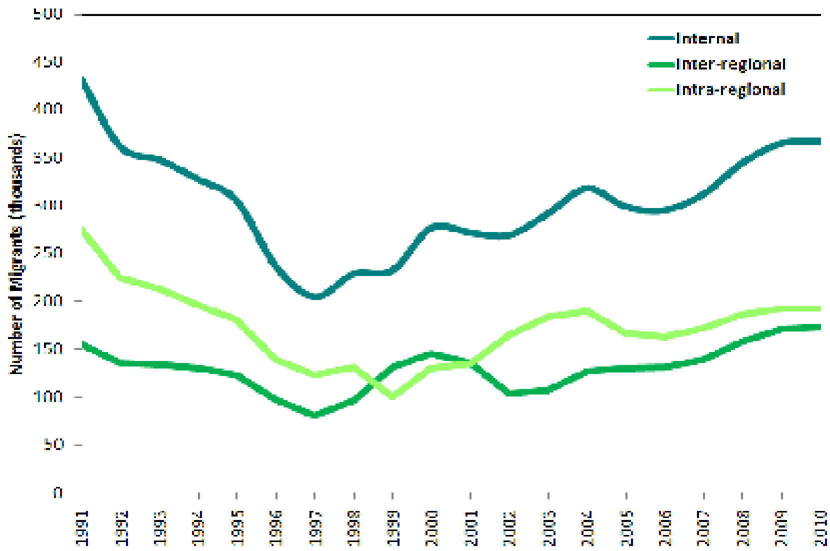


Source: *www.stat.kz*

Apart from fled refugees, as oralmans can be called people, for example, Kazakhs in Uzbekistan, who simply found themselves outside the Kazakh SSR as a result of Moscow’s occasional shifting of Central Asian borders during the Soviet era. Most oralmans came from across Asia – mainly from former Soviet republics, but also from countries such as Afghanistan, China and Mongolia. Each year Astana sets a quota for the number of Kazakhs eligible to return (in 2011 quota will be granted for 20 thousand families). Those who immigrate under the quota are promised to be provided with housing, a grant of roughly $120 per family, and assistance in acquiring a residence permit and Kazakh passport and other help. However, in reality the case is somewhat different, usually oralmans have great problems of getting residence permit and identification cards, with housing and finding employment and etc. The main reasons of such state of matters are legislation related to repatriation and migration, attitude of local people, quality of oralmans themselves i.e. majority of them have no education, no qualification, and also they have language problems, social and climatic behavioural habit differences and so on. As a result, many oralmans have adaptation difficulties to places of their assignment, allocation and prefer to move to regions with close to their accustomed conditions. Since almost 80% of repatriates came from Uzbekistan then major part of them usually concentrate in southern regions of Kazakhstan with already high population density such as South-Kazakhstan, Kyzylorda, Almaty oblasts, some also go to the west regions predominantly Mangystau.

Although, the number of arrivals used to far exceed the quota during the first decade of repatriation programme, last several years number of people interested in getting quotas falling short with each year. In 20 years of Independence the total gained number of oralmans accounts for slightly less than a million of low-skilled, not well-educated people with many children compared to lost 3 million European working-age qualified population.

Figure 32 – Internal migration in Kazakhstan (thousands), 1991–2010



Source: www.stat.kz

The economic boom in mid 2000s coincided with immigration boom with 23-33 thousand legally registered arrivals in 2005-2006 respectively. Nowadays number of immigrants fluctuates around 10 thousand people per year, a peak of immigration already gone there remains little hope of another immigration boom in the near future. However, inflow from close-bordering countries (Uzbekistan, Kyrgyzstan, and Turkmenistan) will always exist, but often in illegal, uncontrolled form and with only faint effect on overall situation in the country.

Like many other countries that have undergone economic and social development, Kazakhstan has experienced an increase in the movement of people both within and between its regions over the past 10 years (see Figure 32).

There is growing recognition that these processes – development and migration - go hand in hand. Migration drives, as well as results from, a country's social and economic development. In Kazakhstan, the socio-economic improvement resulting from the development of the overall economy, especially of the oil and gas industry, has certainly catalyzed increasing internal migration by making it possible for people to move away from their area of origin, and by providing the motivation to do so as a result of growing regional disparities.

Despite the complexity of the interrelationship between migration and development, one point is clear: migration should not be seen as an impediment to development. However, neither is it a panacea for poverty or income inequality. The movement of people is a natural and irrefutable part of human history. In recognizing this it is easier to appreciate that fact that migration offers both opportunities for development as well as challenges. Internal migration can contribute to economic growth, both on a national scale as well as at the household level, and can foster links between destination areas and areas of origin, decreasing regional disparities. Supporting migration involves supporting individuals' and households' decisions about their livelihoods, which contributes to migrants' economic and social empowerment.

Table 3 – Pearson's correlation coefficient between economic indicators of regions, 1999–2007

Oblast	In-migration		Out-migration
	GRP per capita (thou.) tenge	Average wage, tenge	Unemployment rate
Akmola oblast	0.568	0.718(*)	0.733(*)
Aktobe oblast	0.679(*)	0.753(*)	-0.495
Almaty oblast	0.608	0.674(*)	–0.781(*)
Atyrau oblast	0.867(*)	0.879(*)	0.491
West-Kazakhstan oblast	0.489	0.649	-0.259
Jambyl oblast	0.840(*)	0.862(*)	–0.729(*)
Karaganda oblast	0.806(*)	0.865(*)	0.890(*)
Kostanai oblast	0.659	0.746(*)	0.695(*)
Kyzylorda oblast	0.914(*)	0.884(*)	-0.526
Mangystau oblast	0.769(*)	0.777(*)	0.679(*)
South-Kazakhstan oblast	-0.199	-0.238	-0.332
Pavlodar oblast	0.187	0.206	0.589
North-Kazakhstan oblast	0.409	0.479	-0.294
East-Kazakhstan oblast	-0.349	-0.241	-0.437
Astana city	-0.559	-0.616	-0.626
Almaty city	0.647	0.723(*)	0.591

* Correlation is significant at the 0.05 level (2–tailed)

Source: F. Tolesh, 2009

There are three main magnet-centres of interregional migration in Kazakhstan: Almaty city, oil and gas mining oblasts and Astana. The reasons of internal movements of population in the country are classical: employment, education and marriage, the peculiar are pushing factors: poverty, shortage of job opportunities and perspectives, undeveloped infrastructure etc.

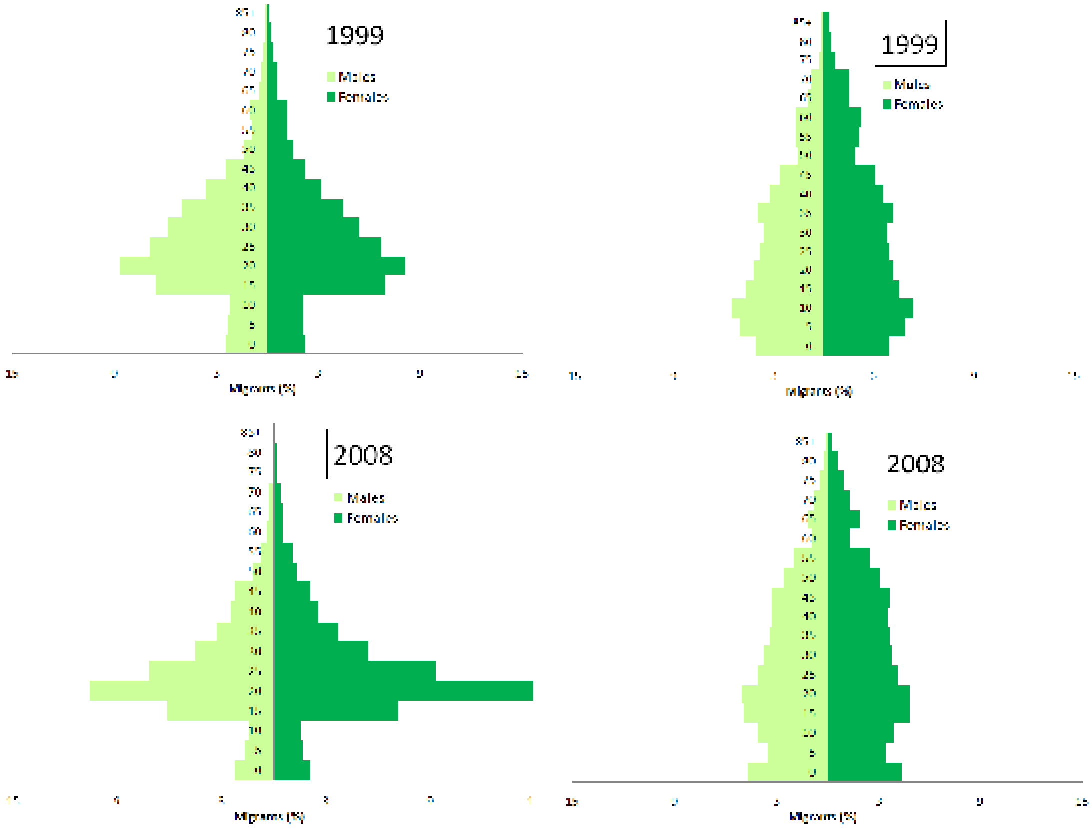
Since unemployment rates are more or less equal throughout the country only in few regions there is a positive correlation between out-migration and unemployment (see Table 3) despite the fact that a new job opportunities among top main reasons of migration. More significant correlation can be seen between GRP (Gross Regional Product) and average wage level with in-migration rates.

As for the sex and age structure of interregional migrants noticeable changes have occurred during the last decade. Till the start of the economic recovery in Kazakhstan male migrants have prevailed women, however since the 2000s female migrants became predominant than males for 10-15% (see Figure 33). A rising number of female migrants might be related to several factors, firstly, the share of women is higher in total population (52%) compared to men, also women often move as 'tied movers' following their husbands making career. Futhermore, we should take into consideration that the postponed marriages and higher level of education of women as well as increasing level of women's labour force participation and emancipation processes may as well add to women's higher mobility.

The sex distribution of migrants in the regional context has been changing during the last decade. In 1999 oblasts like Akmola, Karaganda, Jambyl, Kostanai, East–Kazakhstan and Kyzylorda were losing migrants of both sexes while South–Kazakhstan oblast in the same year left more men than women in contrast to Almaty oblast which lost more women than men. Consequently Almaty city as the closest and the most desirable destination for people from Almaty oblast received more female migrants than male. Only Astana city as a new capital gained the most from the interregional migration around 30 thousands of male population and slightly more than 26 thousands of females (KAS, 2010).

Figure 33 – Proportions of migrants and non-migrants, by age and sex, Kazakhstan (1999, 2008)

Migrants ***Non-migrant population***



Source: *www.stat.kz*

During the recovery period the age structure of internal migrants have also altered with increasing share of youth and declining proportion of children and young adults (see Figure 32). Such change can probably indicate that the role of some reasons have also altered, for example, young people aged 20-24 can be migrating mainly due to education motives who can with increasing well-being afford to choose bigger cities with more popular universities and with better qualified teaching stuff and so on.

In the year 2008 South–Kazakhstan oblast replaced Akmola oblast as a region with highest out–migration of both sexes. From the Figures 34 and 35 one can see that the regions with the highest losses are represented by agricultural oblasts like Jambyl, North and South–Kazakhstan oblasts also by East–Kazakhstan with Kyzylorda and Kostanai where the main push factor is a serious ecological situation and in the first three agrarian oblasts high unemployment forces people to move to more environmental safe regions and to oblasts with higher wage and better job opportunities.

Moreover, the economic growth is closely connected to the development of the oil industry and that made oil–extracting oblasts quite attractive for labour migrants and as a result Atyrau and Mangystau oblasts started to have a positive net migration. The two municipal cities Astana and Almaty are still the most desirable places for interregional migrants to go, however the net migration gains in 2008 are less for both cities than in 1999 which means people start to be interested in moving to other regions.

Indeed, with the course of time internal migration trajectories are gradually changing, ten years ago people were often out-migrating from cities to cities, but nowadays, the share of migration with such direction have declined giving some room for rising urban to rural and rural to urban in-migration (see Figures 34 and 35).

Ethnic composition of interregional migrants is quite predictable, since the share of Kazakhs have been rising during the last decade respectively about 70-80% of migrants account for Kazakhs with declining share of Russians among them from around 20% in 1999 to approximately 10% in current days. In fact, owing to falling number of all non-Kazakh ethnicities in the country, their total share in movement within Kazakhstan is also falling.

In comparison with the migrants of the previous decades the educational level of interregional migrants has been increasing during the period 1999–2008. In Kazakhstan the majority of people moving between regions have a secondary education 30-40%, although gradually proportion of migrants with high and not-completed high education is also growing, from time to time even outnumbering migrants with secondary education (last 4-5 years). The least mobile group of migrants aged 16 + are people with no education at all and not completed secondary education, also share of people with not completed higher and secondary educations is not significant among interregional migrants. A proportion of migrants with vocational education is rather stable with very slight fluctuation from 25% to 20%.

It is well-known that education is a capital of a person and educated people is the capital of a country and despite the fact that there are many reasons for population mobility within the country or between regions of it, the main moving factor always is employment. Generally there are two types of job seekers or labour migrants: low-skilled and high-skilled. Nowadays, in Kazakhstan as a consequence of the massive emigration of highly skilled population during the transition period there is a shortage of qualified workers especially in the high-tech field, science, construction sector, gas and oil-extracting industry etc. Although, during recovery decade the situation have slightly improved, however around 70% of interregional migrants still are not white-collar workers and this is only the official statistics, companies in order to solve the problem often invite foreign specialists and professionals. And many people in the country view migration as an escape from disadvantageous and unfavourable socio-economic situation in places of their residence, they just decide to migrate without really considering all the consequence.

Migration is an integral part of human behaviour and it will always be present differing in dynamics, timing, volume in the country irrespective of county’s socio-economic development level and political situation. By most measures, internal migration in Kazakhstan is very low, according to the official statistics only approximately 2% of the population is mobile. But still internal migration is an important part of population development in Kazakhstan because firstly, a vastness of the territory makes all the bases for rather significant differences of regional geophysical, mineralogical and demographic backgrounds which make country’s regions economically and socially disparate and secondly, sparsity of population and its uneven distribution. In case of sagacious approach to understanding, controlling and regulation of internal movements many socio-economic benefits can be derived from it.

Figure 34 - Directions of internal migration in Kazakhstan by regions, 1999

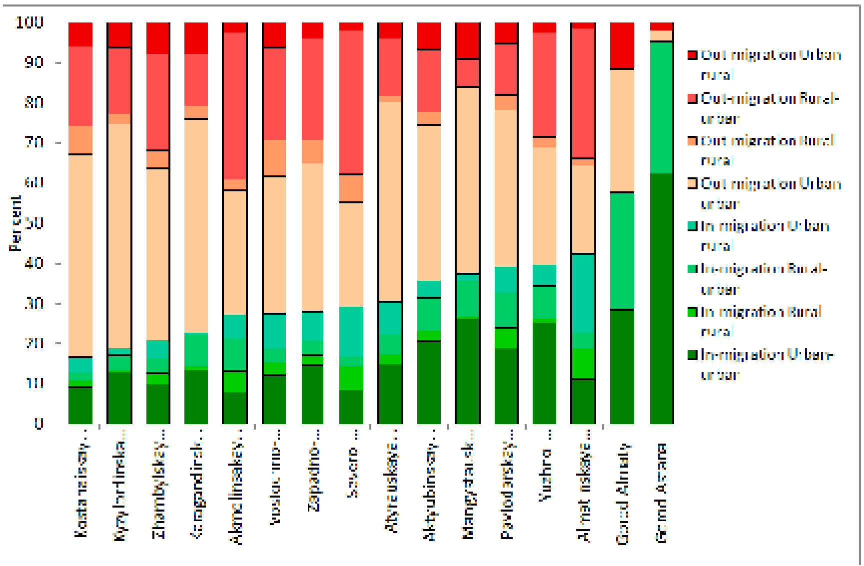
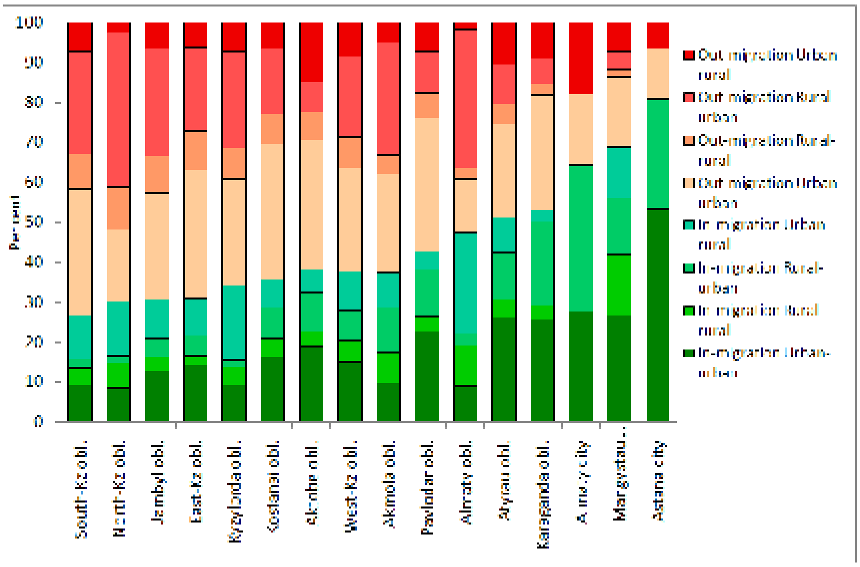


Figure 35 - Directions of internal migration in Kazakhstan by regions, 2008



Source: www.stat.kz

In the meantime, the migration analyses show that internal movements in the country are increasing in volume while international migration intensity became very insignificant. Migration is the most difficult to predict and most volatile component of population change and there are many non-demographic factors which may have an influence on its course such as socioeconomic and political situation, migration legislation and so on.

5.2 The system delimitation and specification

The present study's main aim is to make population forecasts for Kazakhstan till 2030 and since there are no official forecasts we took as our objective to produce several population forecasts and compare them and try to find out what are the principle determinants of population development in the country and whether they will persist to play the determining role also in the future. By several forecasts we mean three: first one is for Kazakhstan on a country level disaggregated only by age and sex, for the second set of forecasts we will further disaggregate population by urban/rural place of residence on the state level again. Kazakhstan being an agrarian country has almost half of its population living in rural areas and it is well known that urban and rural population tend to differ in their demographic behaviour which is also relevant for Kazakhstan's case too. Bearing this fact in mind we plan to learn by comparing first two types of forecasts if present demographic differences between urban and rural population's behaviour will continue in the future and whether consideration of these dissimilarities makes any difference in forecast results on the country level.

The third set of forecasts will be carried out by disaggregating population for 16 main administrative units by urban/rural place of residence and age-sex. Such detailed consideration of the population may arise the problem of small numbers, thus to avoid probable random fluctuation we suggest to join regions with common fertility, mortality and migration schedules separately for each sex and urban/rural place of residence. In this section the results of cluster analyses will be given for each component. Moreover, a SWOT analysis is going to be performed, which is known as one of the effective tools to evaluate a situation. In our case we need SWOT to understand pros and cons of population forecasting by regions and urban/rural places of residence.

In this chapter our main task is also relates to outlining of a model that will be build corresponding with our population system which was previously identified and described. After analyses of population dynamics presented in the preceding chapter we came to the conclusion that our suggestion of making forecasts by urban and rural places of residence and also by regions seems to be necessary and justified.

Cluster analysis or clustering is the task of assigning a set of objects into groups (called clusters) so that the objects in the same cluster are more similar (in some sense or another) to each other than to those in other clusters. Such division of data into groups is usually meaningful and useful. Clustering is a main task of explorative data mining, and a common technique for statistical data analysis used in many fields, including geography and demography.

Our cluster analysis was carried out in SPSS and using hierarchical classification. Hierarchical clustering is obtained by making clusters to have subclusters, in other words hierarchical clustering is a set of nested clusters that are organized as a tree. Each node (cluster) in the tree (except for the leaf nodes) is the union of its children (subclusters), and the root of the tree is the cluster containing all the objects. Often, but not always, the leaves of the tree are singleton clusters of individual data objects.

Hierarchical cluster analysis attempts to identify relatively homogeneous groups of cases (or variables) based on selected characteristics, using an algorithm that starts with each case (or variable) in a separate cluster and combines clusters until only one is left. One can analyze raw variables or can choose from a variety of standardizing transformations.

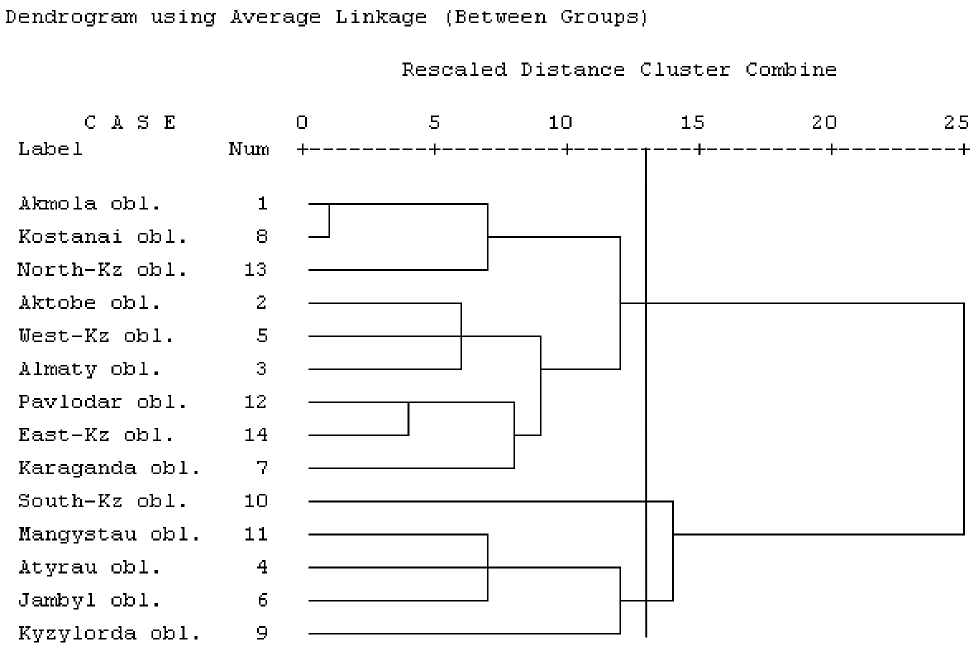
Our choice of variables for clustering fertility and mortality was based on availability and quality of data. We considered such demographic indicators that allow us to cover as much heterogeneity as possible for a given population component. The table of variables and results obtained are presented below.

Table 4 - List of variables used in the cluster analysis

Fertility	Mortality
Urban/Rural	Urban/Rural, Male/Female
Total fertility rate (1999-2010)	Life expectancy at birth (1999-2010)
Age-specific fertility rates by five year age groups (1999, 2010)	Infant mortality rate (1999, 2010)
Mean age at child birth (1999, 2010)	Probability of dying by ten year age groups (1999, 2010)

In case of rural fertility 14 administrative units, (because two cities were excluded), are classified into two big groups (see Dendrogram 1) – all northern oblasts are joined with east, central and two north-west oblasts, which is well justified by the fact that these oblasts have low proportion of rural inhabitants as well as considerable share of non-Kazakh population with different fertility behaviour. The second group consist of all southern oblasts and plus two south-west regions. In this group Kyzylorda, Jambyl, Atyrau and Mangystau are joined as one unit with additional South-Kazakhstan branch which we suggest to consider separately since it is the only oblast with high share of Uzbek population with traditional fertility habits which significantly influences overall oblast's fertility indicators and might keep doing so for many years to come.

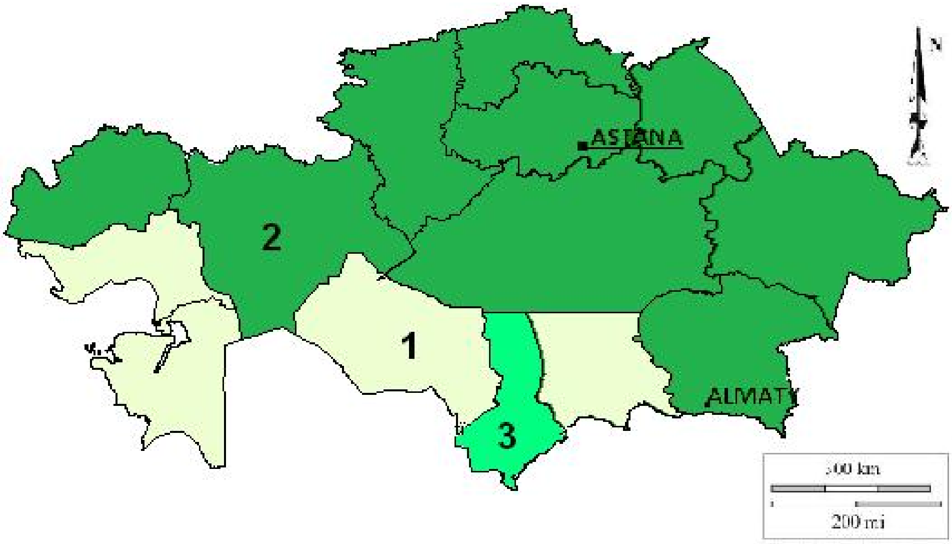
Dendrogram 1 – Fertility rural clustering



Note: Euclidean distance, Average Linkage between groups method, entry data transformed into Z score
Source: Author's own calculations based on data from stat.kz

For illustration of rural fertility forecast regions see Map 4. Number 1 with the pale green colour relates to South-West group (S-W) including oblasts Jambyl, Kyzylorda, Atyrau and Mangystau, number 2 - the dark green covers North group (North) which includes Almaty oblast, East-Kazakhstan, Karagandy, Pavlodar, Akmola, North-Kazakhstan, Kostanai, Aktobe and West-Kazakhstan and finally number 3 – the bright green depicts South-Kazakhstan oblast.

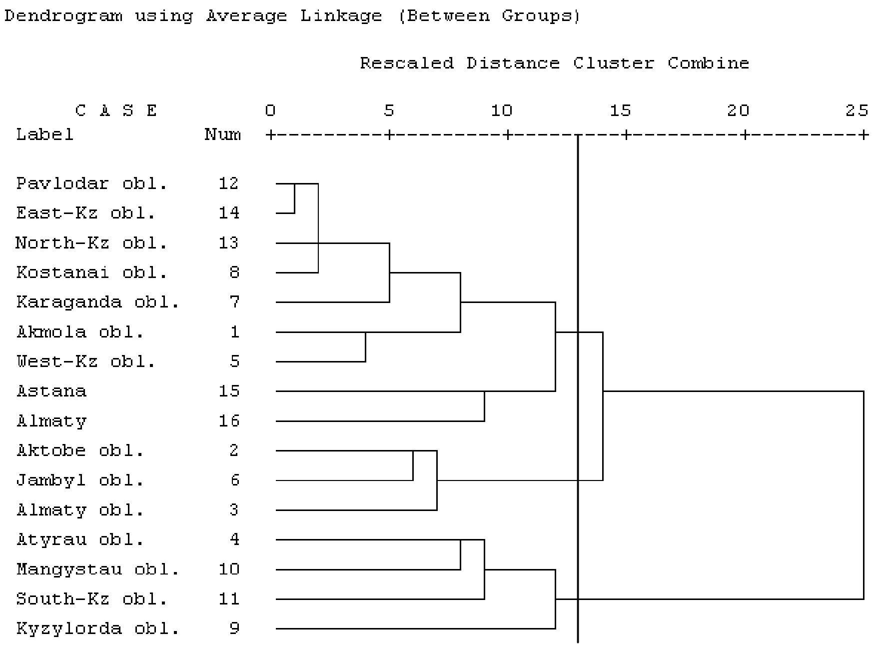
Map 4 – Rural fertility forecast regions, Kazakhstan



Source: Author's own drawings

In case of urban fertility 16 administrative units are classified into three groups (see Dendrogram 2), the first one the North group consists of 9 oblasts and includes all northern oblasts, east and central Kazakhstan as well as West-Kazakhstan oblast which has the same logic of unification as in case of rural fertility and it is illustrated under number 3 with the dark green on Map 5.

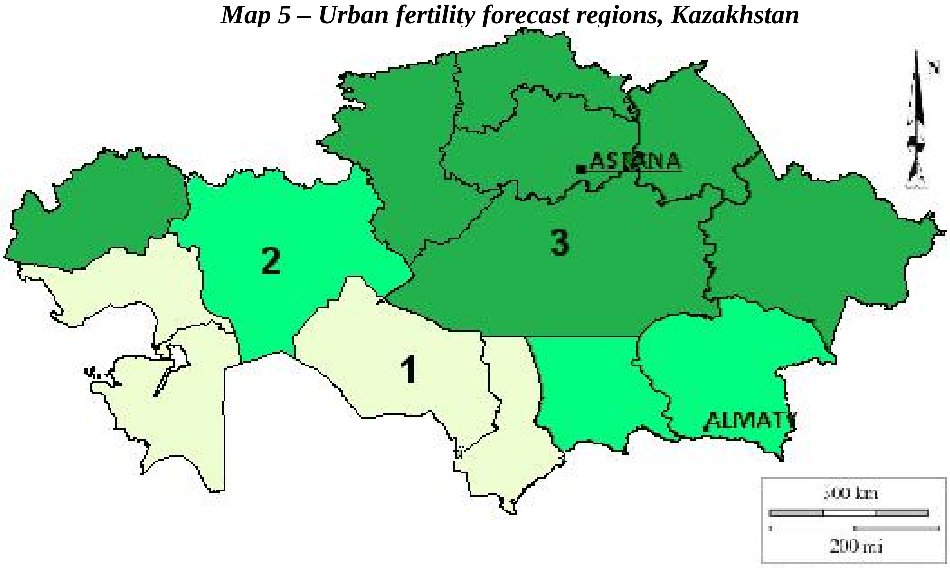
Dendrogram 2 - Fertility urban clustering



Note: Euclidean distance, Average Linkage between groups method, entry data transformed into Z score
Source: Author's own calculations based on data from stat.kz

The second South-East-West (S-E-W) group consists of 3 oblasts – Aktobe, Jambyl and Almaty which have higher share of native population and exhibit relatively higher fertility patterns compared to the North group and it is under number 2 – the bright green regions while with the pale green colour under number 1 shown the South-West (S-W) group consisting of 4 oblasts with the highest share of Asians and as a result the highest fertility regimes in the country.

Map 5 – Urban fertility forecast regions, Kazakhstan

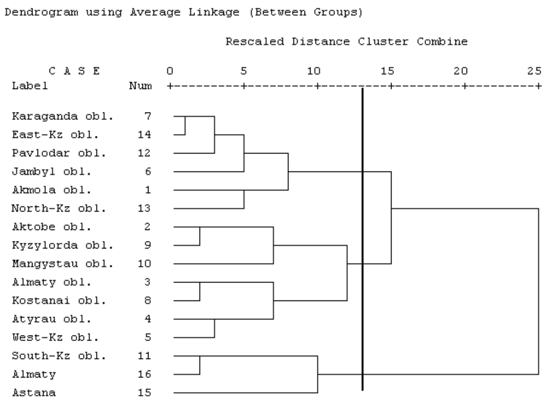


Source: Author's own drawings

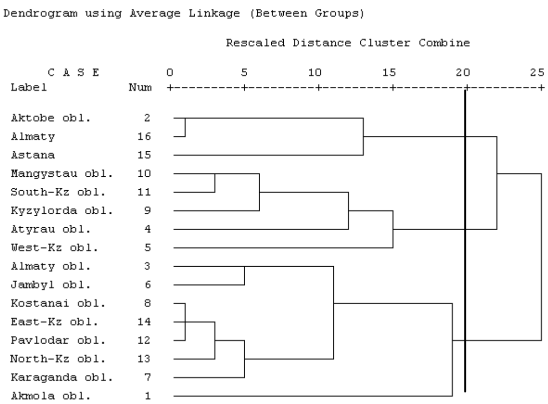
The situation with mortality is somewhat simpler since death rates of urban/rural areas differ insignificantly from each other for both sexes and there is a trend that in rural places people in Kazakhstan are under less probability of dying than in urban, though very less, however the difference between sexes is distinguished. Despite more or less mortality homogeneity throughout the oblasts we obtained 5 mortality forecast units for males (3 units for urban and 2 units for rural mortality) and 6 units for females (3 urban and 3 rural mortality units) (see Dendrogram 3).

Dendrogram 3 - Mortality clustering

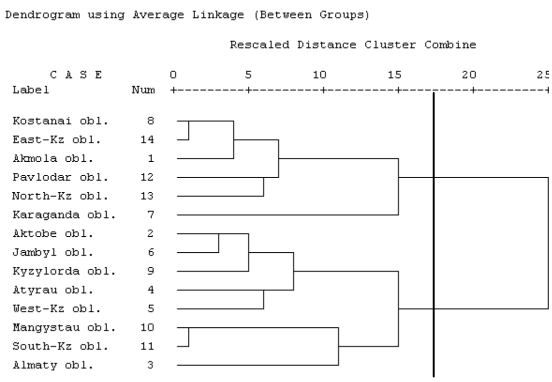
3a – Male, urban



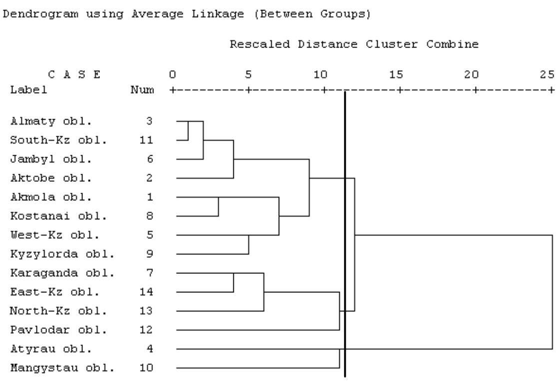
3b – Female, urban



3c – Male, rural



3d – Female, rural



Note: Squared Euclidean distance, Average Linkage between groups method, entry data transformed into Z scores

The only common feature of all our results is that cities Almaty and Astana should rather be treated separately from the rest of the regions while analysing mortality, therefore there are going to be two mortality forecast units – Cities group and The rest group in case of male/female and urban regimes and one mortality unit for the rural case.

We have not carried out migration classification due its high volatile nature and unstable patterns, we rather plan to consider each type of migration for each oblast separately and if there are some similarities in age schedules we intend to find them out during forecast oriented analysis of migration in the following chapter.

Having aggregated regions with common fertility and/or mortality features and thus justifying our regional forecasting to better assess and consider heterogeneity we now turn to analysis of overall advantages and disadvantages of detailed population forecasts using the S.W.O.T analysis (see Table 5) .

Table 5 – SWOT analysis

Strengths	**Weaknesses**
ü allow to take into account regional and residential differences of demographic indicators ü to evaluate the population in the different regions and urban/rural places of residence ü to estimate the likely future proportions of the different ethnic, regional populations in the overall population and to determine the monitoring targets likely to be required in the future, ü these forecasts may play useful role in informing current and future policy issues	ü more irregularities in demographic trends due to small data sets, ü lower quality of data for rural area population indicators, ü difficulties with more detailed data
Opportunities	**Threats**
ü measure equality of residential and regional opportunities, ü can be used for policy and planning purposes and research on different fields.	ü difficulties with consistency of regional and residential forecasts results with control total figure

The S.W.O.T. analysis is a strategic planning method used to evaluate the Strengths, Weaknesses/Limitations, Opportunities and Threats involved in a project. As can be seen, the S.W.O.T. consists of four factors each clearly having its own identity and purpose and these factors are commonly classified as External and Internal. For the External factors, it consists of the Opportunities and Threats, whereas the Internal Factors are Strengths and Weaknesses. S.W.O.T. Analysis can be performed in a variety of application or situation. It can be used as a situation analysis as an input into a strategic planning process. It can also be applied to evaluate the situation in terms of its capabilities. We use S.W.O.T. as a situation analysis tool.

With the help of S.W.O.T. Analysis we attempt to assess all the advantageous and disadvantageous of producing population forecasts disaggregated by place of residence, and regions (see Table 5).

Summarizing the present section it is necessary to say that both cluster as well as SWOT analyses have justified the reasonableness of our choice of categories in order to achieve the most plausible and reliable forecasts of population in case of Kazakhstan.

Chapter 6

Construction of the model

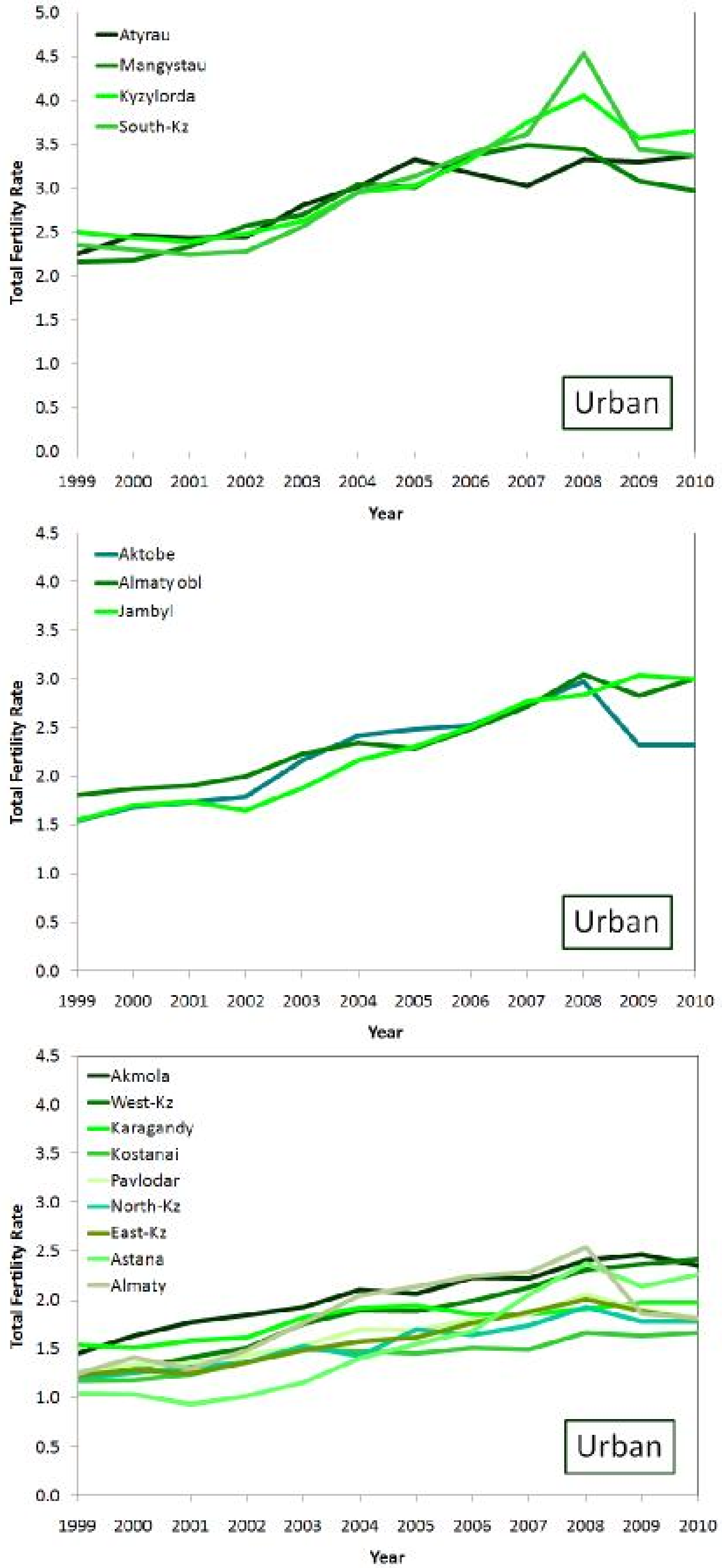
Model construction is the third stage in the process of population forecasting which involves forecast oriented analysis of the previously identified and described system and building a simpler but corresponding with the population system model. By forecast oriented analysis of the population components we mean finding out specific for the system schedules and regimes of fertility, mortality and migration. In case of the first two types of forecasts there are no difficulties with small numbers and high fluctuations since they consider the entire population of the country and its urban/rural disaggregation. However things get more complicated at the regional urban/rural and male/female levels and thus to ovoid them we will build with the use of above described cluster analyses the common schedules for above defined aggregations of regions.

6.1 Fertility

Fertility is the most important component in determining future population structure, especially in the case of Kazakhstan, since health care system do not seem to promise great improvements in coming decades and any changes in lifestyle and system of values require years and decades which are two main factors influencing mortality levels, mortality seem to have very slow and gradual pace of change. As for international migration, with termination of repatriation programme due to its inefficiency and present global economic crisis net gain of the country during the last several years became very insignificant and there might be very little impact on overall population composition from future emigration.

According to the cluster analysis both urban and rural fertility forecast regions were united into three units with slightly different organization of regions. Aggregation of urban/rural fertility regions by Total fertility rates are illustrated in Figures 36 and 37. TFR Trends of urban fertility regions seem to be more unified compared to rural ones, some serious changes have started to occur since 2008 when after rapid increase of TFR values many regions experienced their decline. Despite some fluctuations the overall trend of TFR is upward for almost all regions, but there are some signs though very little that the country has already gone over the peak of TFR increase and it could be possible that in future 5-10 it will return to its decade earlier level.

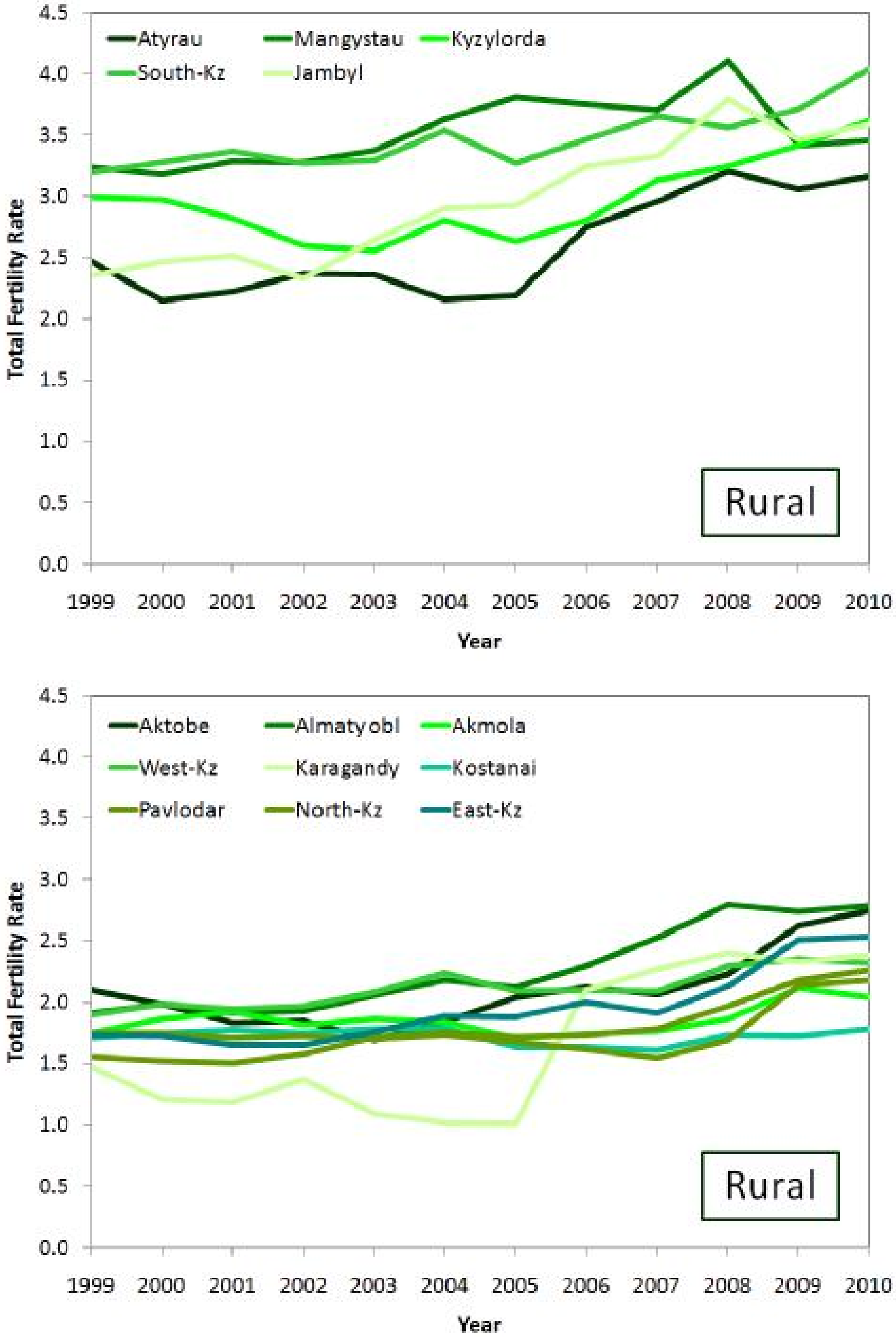
Figure 36 – Aggregation of urban fertility regions, TFR, Kazakhstan, 1999-2010



Source: stat.kz

As it was stated above rural forecast regions were also organized into three units, but since only South-Kazakhstan oblast was separated as one unit we decided to put together with other high fertility oblasts for the sake of comparison. As could be seen from Figure 37 South-Kazakhstan oblast nowadays exhibits the highest level of TFR, however several years prior Mangystau was on its position. I believe more clear understanding of South-Kazakhstan oblasts being singled out could be achieved through analysis of age-specific rates.

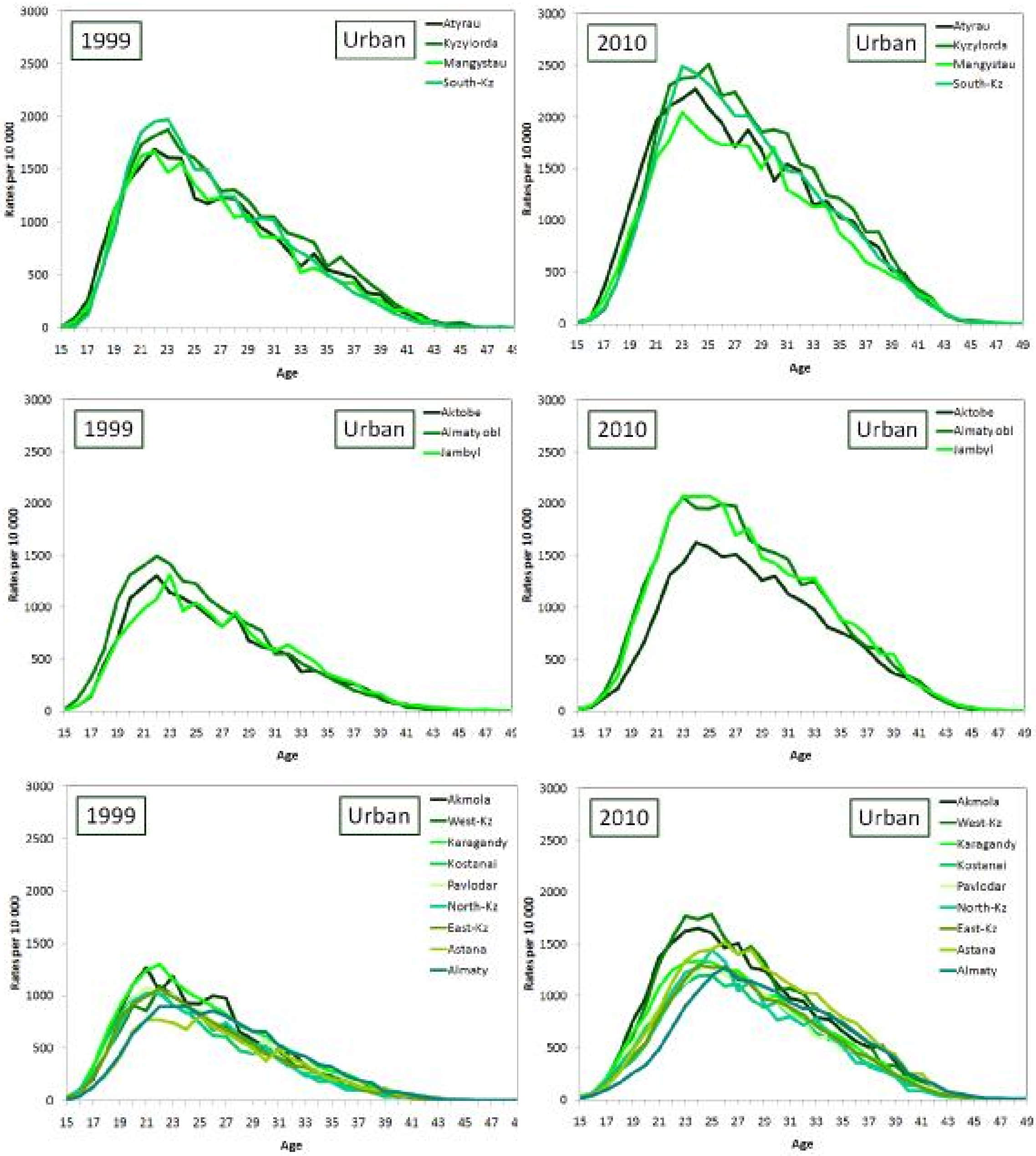
Figure 37 – Aggregation of rural fertility forecast regions, TFR, Kazakhstan, 1999-2010



Source: stat.kz

Aggregation of urban/rural fertility regions by age-specific fertility rates are demonstrated in Figures 38 and 39 for the years 1999 and 2010. Why we chose 2010 is clear – it is the last year with detailed data available and 1999 is the first year with such data, besides we also wanted to see how much changes have occurred in age structure of regional fertility rates.

Figure 38 – Aggregation of urban fertility forecast regions, ASFR, Kazakhstan, 1999 and 2010

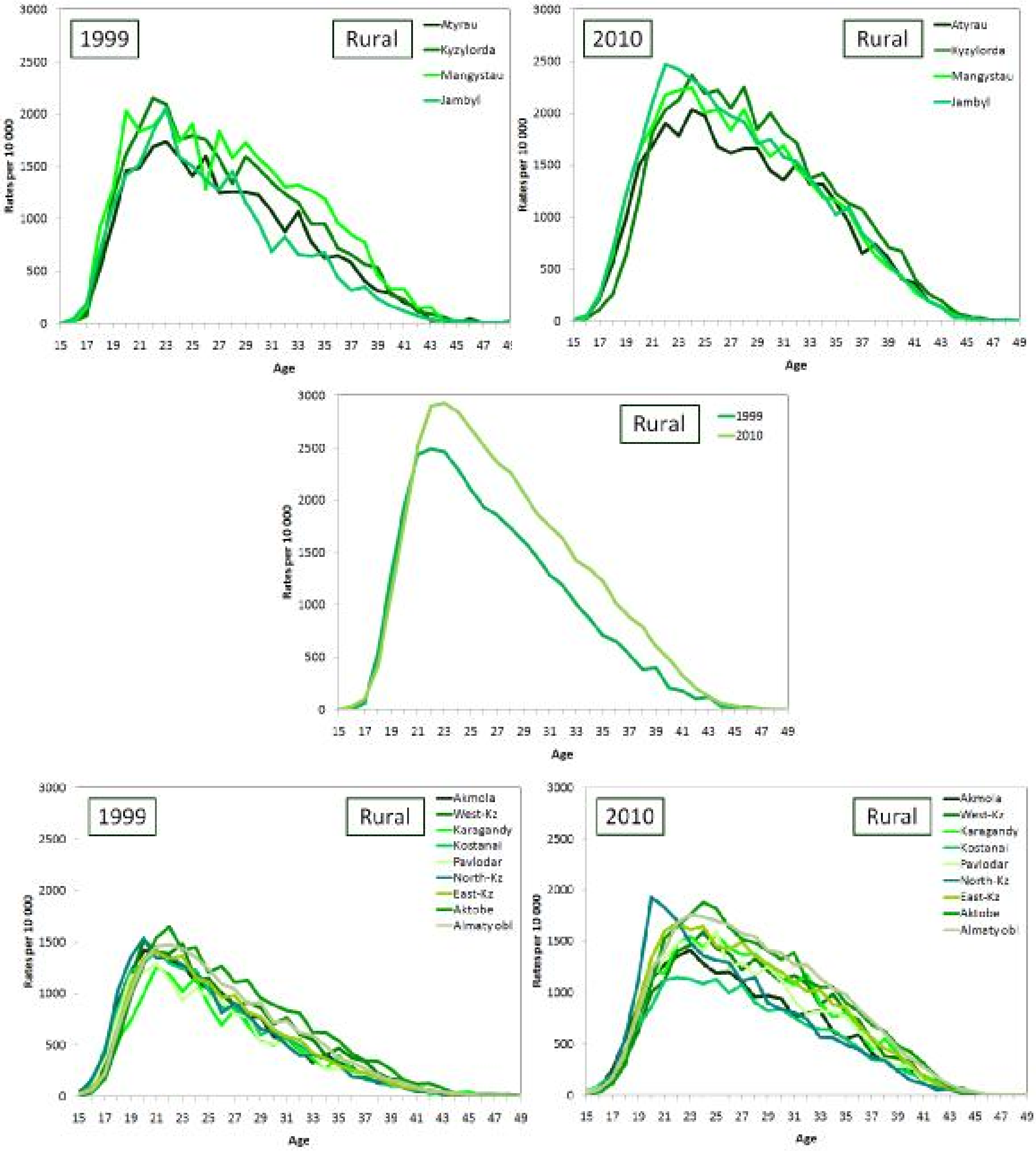


Source: stat.kz

Aggregated urban fertility regions were organized as follows: South-West (S-W) unit with highest levels of ASFR includes Atyrau, Mangystau, Kyzylorda and South-Kazakhstan oblast; South-East-West (S-E-W) unit with average level of ASFR includes Aktobe, Almaty oblast and Jambyl and North unit with the lowest age-specific fertility regimes include the rest 9 oblasts and two capital cities. In contrast rural fertility regions were aggregated a trifle differently, particularly, in case of South-West (S-W) unit Jambyl was joined with Atyrau, Mangystau and Kyzylorda and South-Kazakhstan oblast was taken as a separate unit due to its much younger structure of fertility and its higher intensity compared to the rest of oblasts with high fertility rates. The other remaining two Aktobe and Almaty oblasts of urban South-East-West (S-E-W) unit were put to the group of North low fertility unit.

The current fertility boom has slightly different effect on different regions, a decade ago ASFR were more consolidated when birth rates were substantially lower and like with TFR rural ASFR are more diverse compared to urban.

Figure 39 – Aggregation of rural fertility forecast regions, ASFR, Kazakhstan, 1999 and 2010

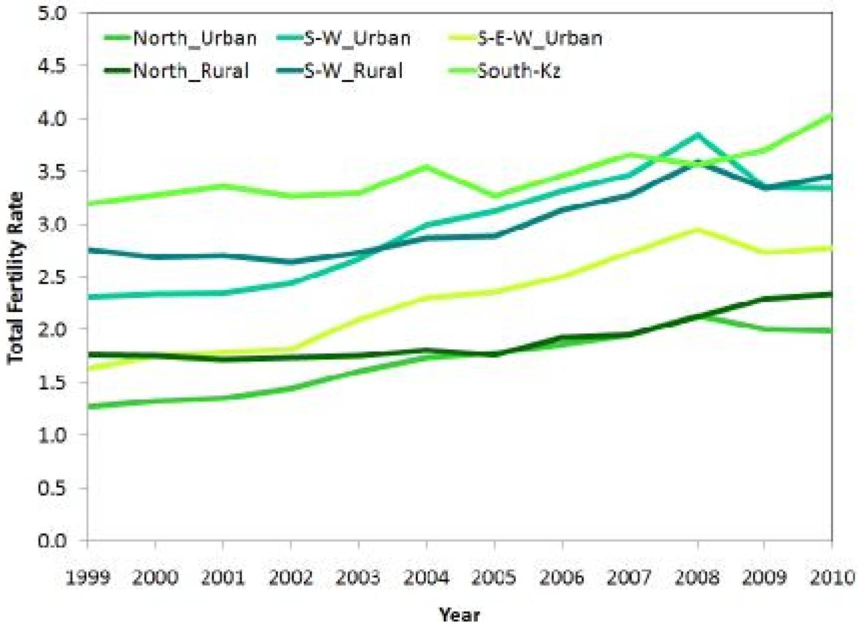


Source: stat.kz

In general there are going to be six different age-specific schedules of fertility: three – North, South-West, South-East-West for urban with TFR 1,7, 2,5 and 3 for respective units and North, South and South-West for rural with TFR 2, 4, and 3,2 accordingly. Except for rural South regions all the rest of fertility forecast units have more or less downward trends (see

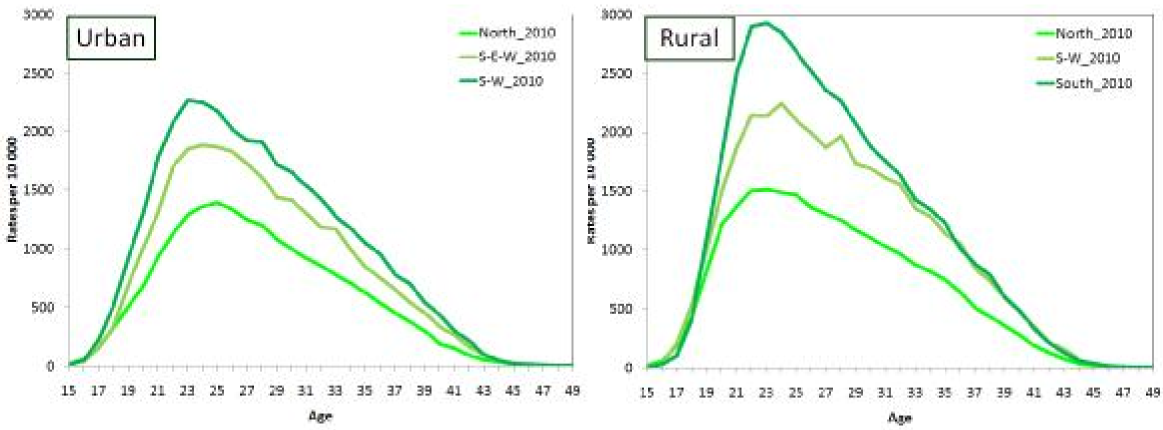
Figure 40). In case of ASFR (see Figure 41) the main difference between urban and rural fertility regimes apart from the intensity of it is that peak age of fertility is seems to be for several years younger in rural places than in urban, which could also mean that in rural places girls enter matrimony a bit earlier than city girls who spend more time getting educated.

Figure 40 - TFR for urban/rural main aggregated fertility forecast regions, Kazakhstan 1999-2010



Source: stat.kz

Figure 41 - ASFR for urban/rural main aggregated fertility forecast regions, Kazakhstan 1999 and 2010



Source: stat.kz

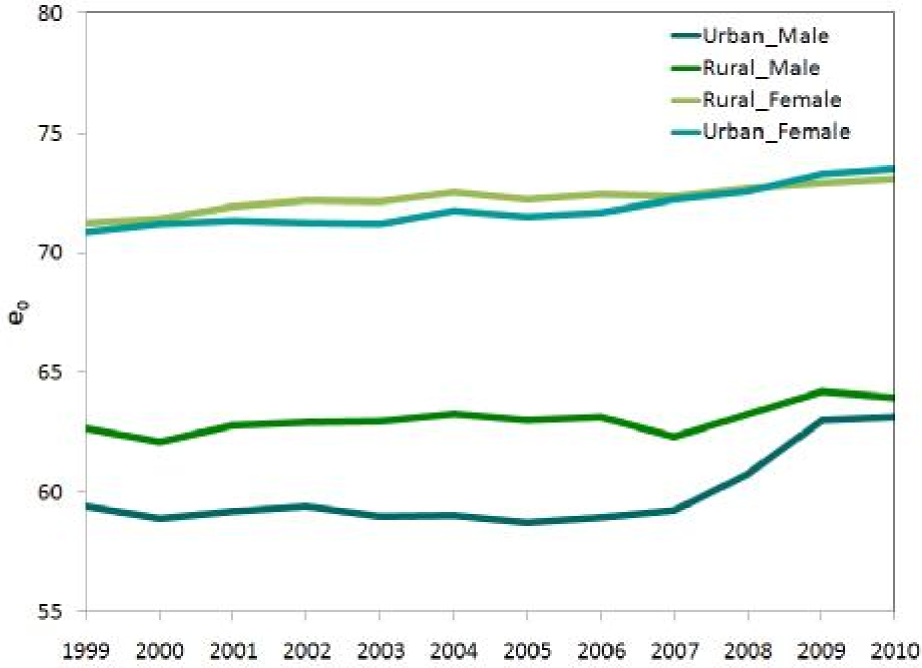
6.2 Mortality

Mortality forecasts are conducted in two stages based on forecasting the mortality level measured by life expectancy at birth which provides a useful summary of the prevailing age specific mortality rates to which a population is exposed at a particular time, and the second, projecting the mortality structure measured by probabilities of death by sex and age, which serve as the basis for the life tables used in the population forecasts.

Kazakhstan being one of the Post-soviet countries has common to the group specifics which are: slow pace of improvements of mortality indicators and very substantial sex differences between them. Another peculiarity of the country's mortality is that in rural areas with worse medical services death rates are lower than in cities and it still holds true for male population and was as well so for females till recent times.

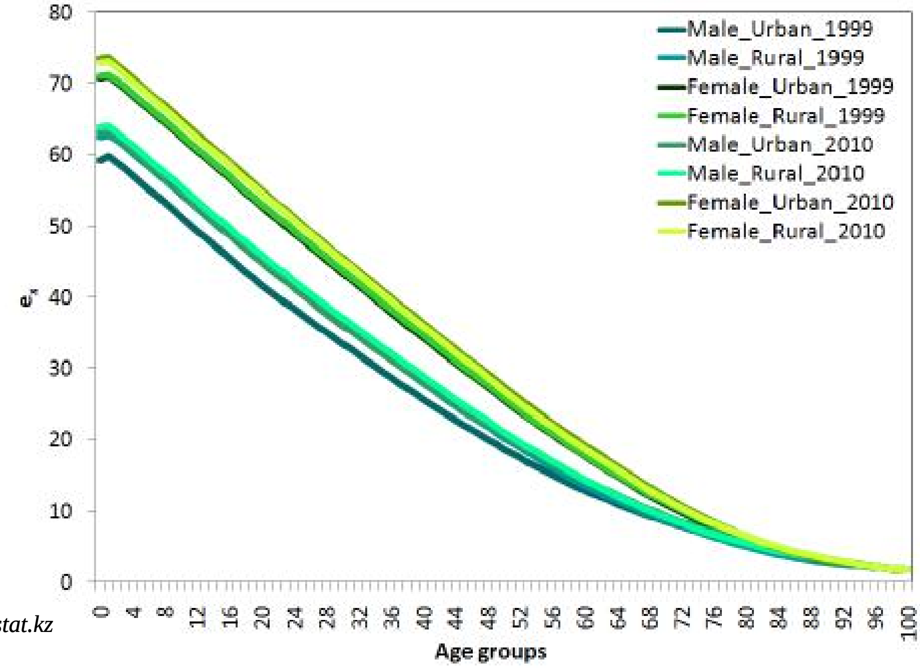
There is a ten years difference between male and female life expectancies at birth in Kazakhstan which is not diminishing with time, however difference between urban/rural life expectancies at birth is narrowing and almost none in case of females (see Figure 41).

Figure 42 - Life expectancy at birth by age, sex and urban/rural place of residence, Kazakhstan 1999-2010



Source: stat.kz

Figure 43 - Life expectancy by age, sex and urban/rural place of residence, Kazakhstan 1999 and 2010

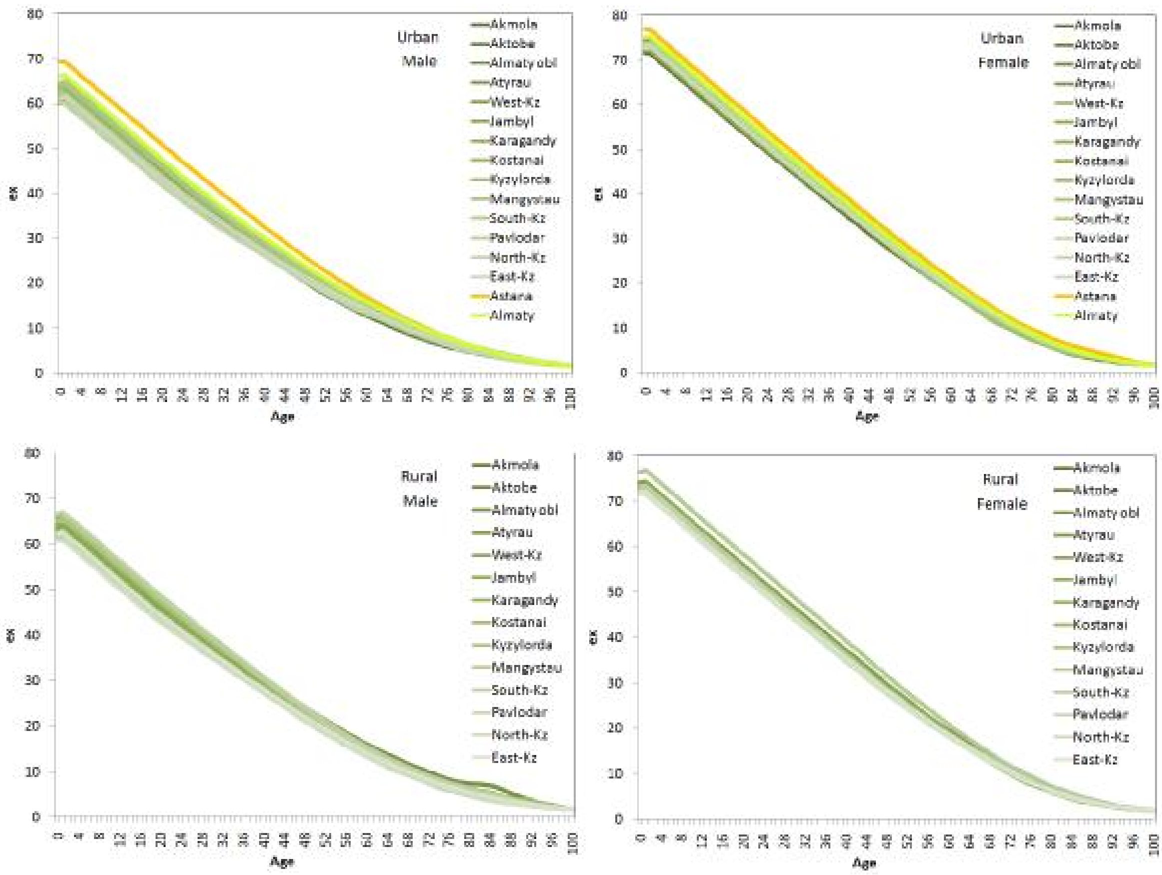


Source: stat.kz

According to Figure 43 the improvement in life expectancy was about three years for males and even less for females during the last decade. The larger progress for males could be explained by fact that males have much lower life expectancy at birth which leaves more room for improvements than for females.

Compared to other components there is a small difference between mortality rates of regions and ethnic groups, since southern regions mostly populated by natives and northern oblasts with non-Kazakhs exhibit almost the same level of mortality. Rural populations of regions have homogeneous levels of life expectancies at all ages (see Figure 44), only for urban populations according to the cluster analysis two capital cities should be treated separately.

Figure 44 - Life expectancies by sex, urban/rural place of residence and regions, Kazakhstan, 2010

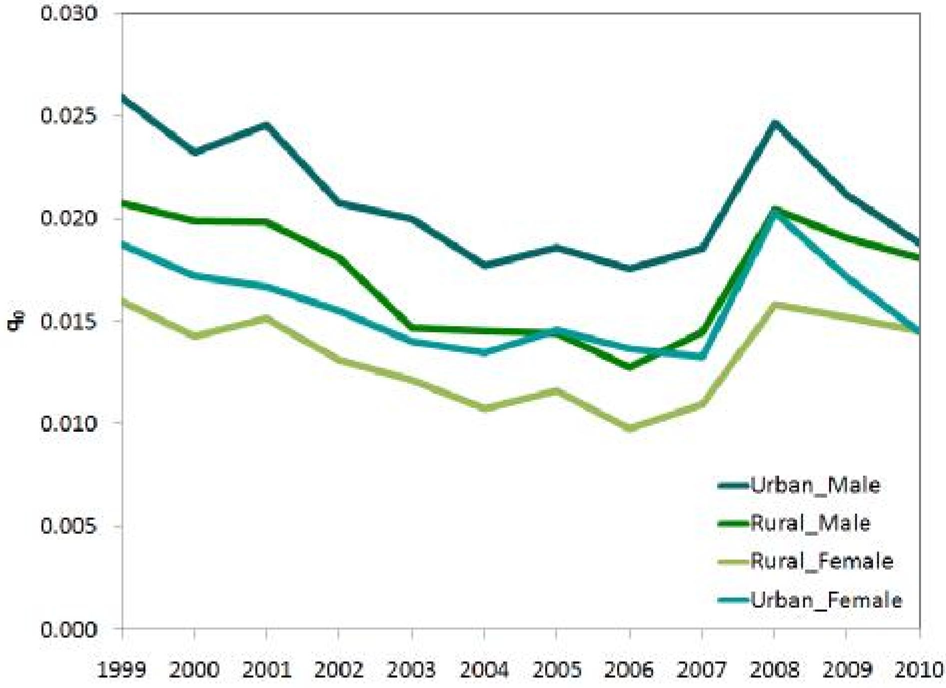


Source: stat.kz

The general trend of probability of death at age 0 is downward, though several years ago it peaked high than quickly resumed its decreasing pace. That increase could probably relate to the fact that in 2008 Kazakhstan accepted the UN definition of a live born which resulted in expected rapid increase of the rates of infant mortality since until that Kazakhstan used to practice the old Soviet definition. However it seems rather questionable how quickly during less than three years infant death rates reached prior to UN live birth definition adaptation level, while before that in order to get to that level almost a decade was necessary (see Figure 45). Another remarkable fact about probability of death is that differences between urban and rural places have almost disappeared for both sexes during the last couple of years.

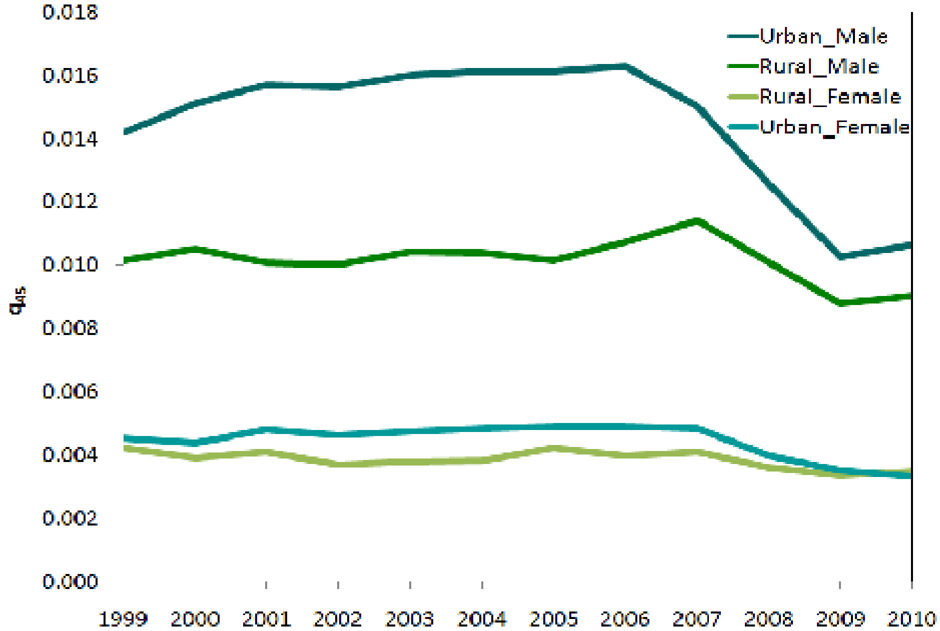
Figure 46 shows probability of death for people aged 45 and that age was chosen due to the high intensities of death at around that age for male population of the country and the difference between sexes are quite remarkable. Men aged 45 have three times higher risk of dying in Kazakhstan than women at the same age, however there seem to occur significant improvements of mortality at that age during the last half a decade in both urban and rural places as well as for both sexes though much less for females.

Figure 45 - Probability of dying at exact age 0 by sex and urban/rural place of residence, Kazakhstan, 1999-2010



Source: stat.kz

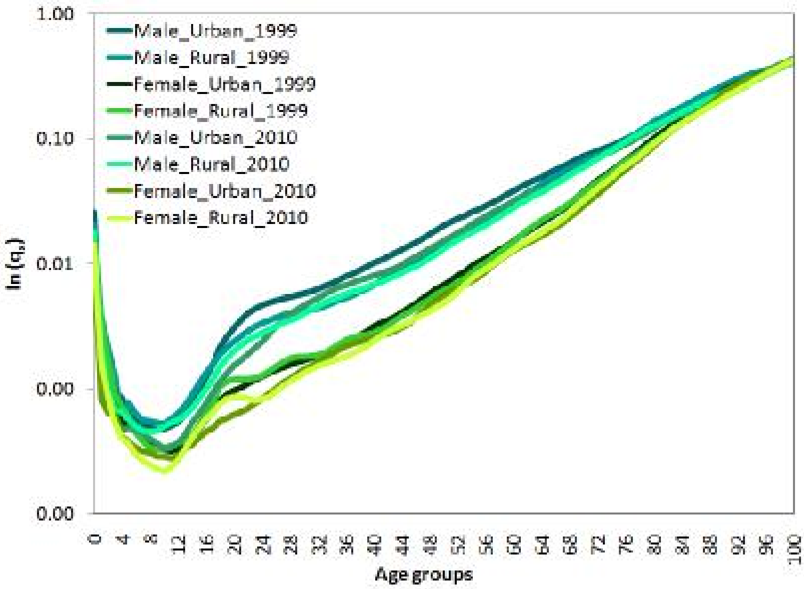
Figure 46 - Probability of dying at exact age 45 by sex and urban/rural place of residence, Kazakhstan, 1999-2010



Source: stat.kz

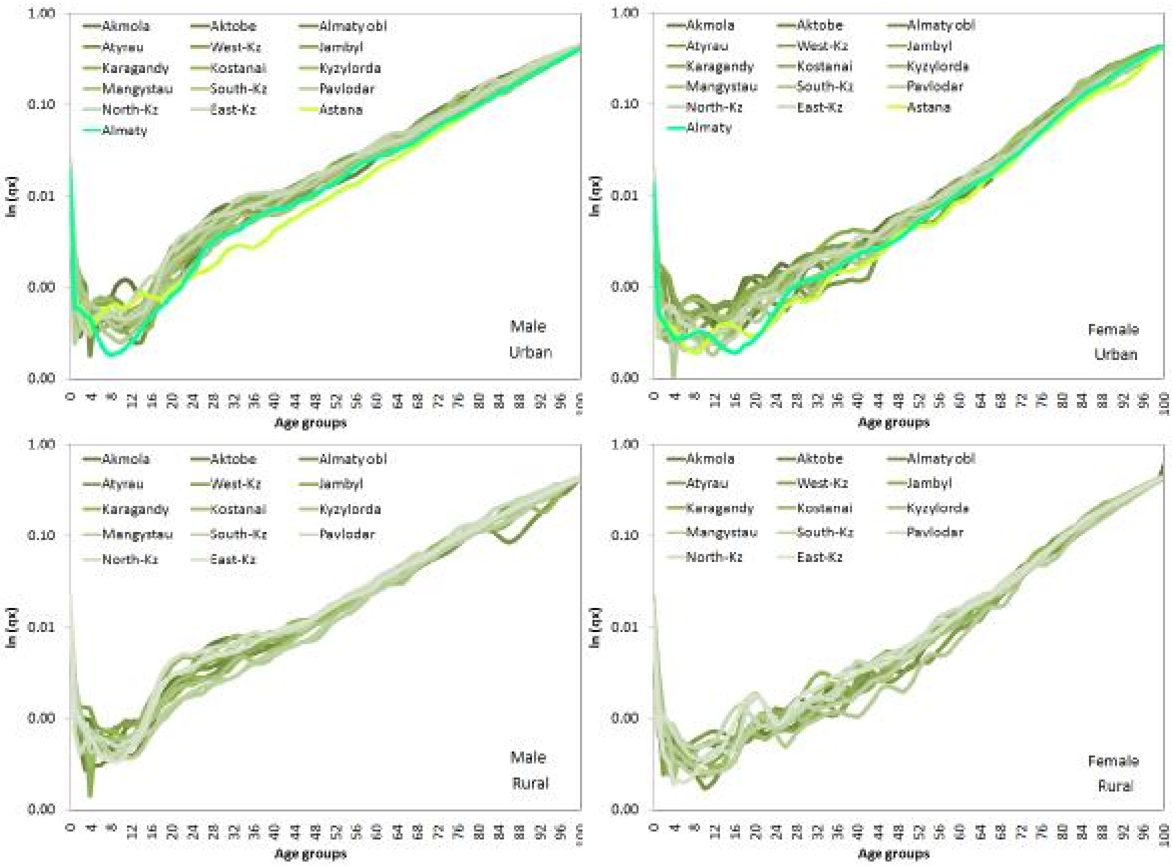
Probabilities of death by ages given in Figure 47 illustrate that differences between male and female values are significant at very early ages than it becomes almost inconsiderable at young ages till 20 when male mortality starts its acceleration and difference increases between ages 50 and 80. There seem to be very little disparity between regions except for some small fluctuations and deviations at older ages and it is evident that in rural places the probability of death is less especially for females at retirement ages (see Figure 48).

Figure 47 - Probability of dying by sex and urban/rural place of residence, Kazakhstan 1999 and 2010



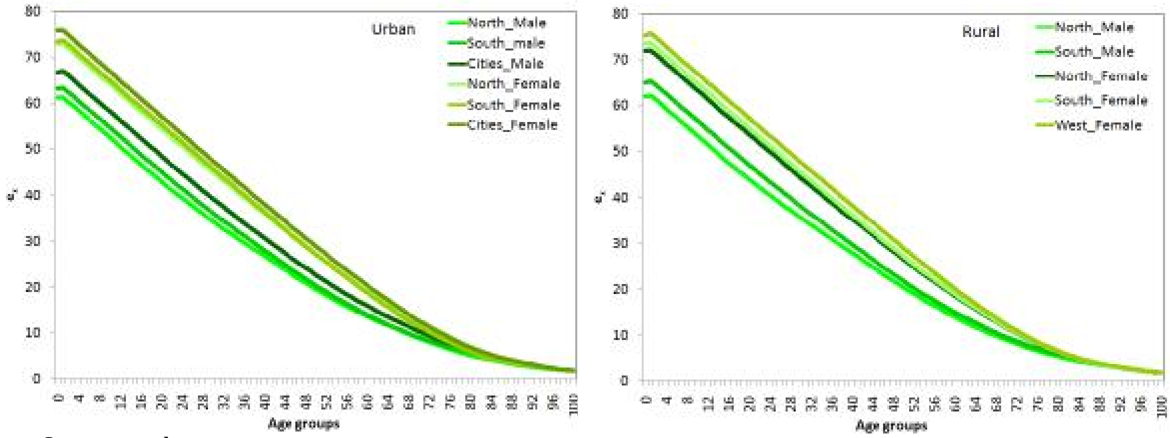
Source: stat.kz

Figure 48 - Probability of dying by sex, urban/rural place of residence and regions, Kazakhstan, 2010



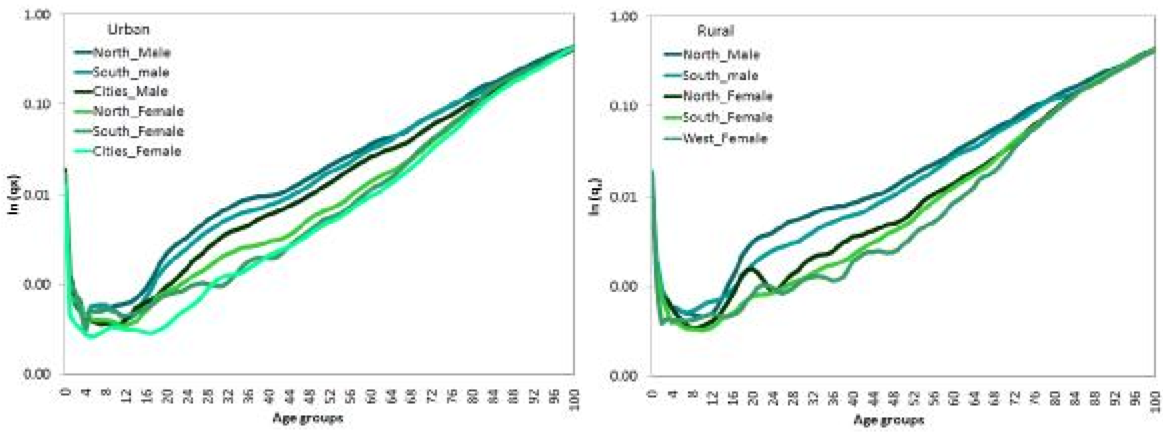
Although mortality rates do not differ greatly between regions except for two cities, the cluster analysis revealed that for the country's population death rates might be united into 11 groups three for each sex and urban place of residence – North consisting of 5 northern oblasts and plus Jambyl; South including 4 western oblast, Kyzylorda, Almaty oblast and Kostanai and Cities which include in addition to two cities South-Kazakhstan oblast in case of male and Aktobe in case of females. The other two mortality forecast units also slightly differ for females. As for rural forecast units, there are two of them for males – North and South and three – North, South and West for females (see Figures 49 and 50).

Figure 49 – Life expectancies for aggregated mortality forecast regions by sex, urban/rural place of residence, Kazakhstan



Source: stat.kz

Figure 50 - Probability of dying for aggregated mortality forecast regions by sex, urban/rural place of residence, Kazakhstan



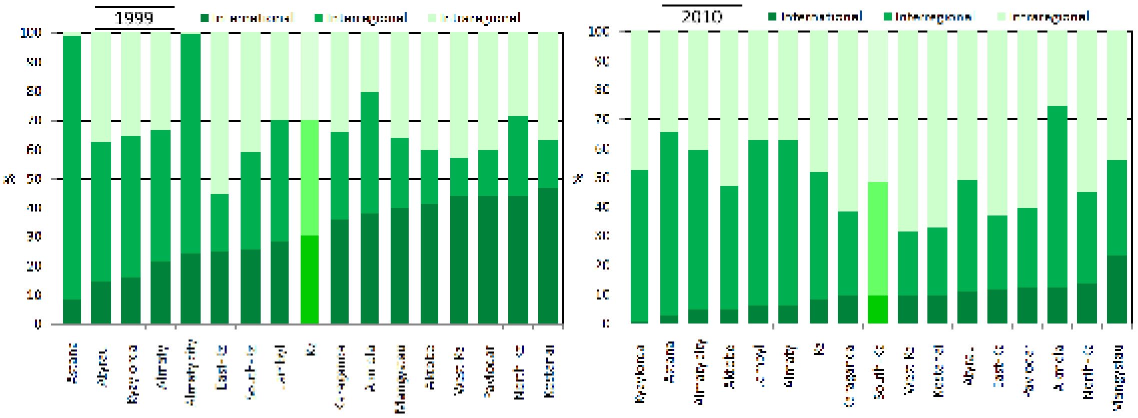
Source: stat.kz

6.3 Migration

Firstly, we begin the analysis of international migration, the share of which according to the Figure 51 from all types of migration in the country fell substantially during the last decade. In contrast, volume of internal movements has increased, especially in case of intraregional migration which probably could be related to improving standards of living that more people can more often afford moving from one settlement to another.

At the regional level, oblasts bordering with Russia used to have the highest shares of international movements and lowest proportion of interregional migration, but presently western oblasts have also joined that high international migration regions, particularly Mangystau oblast.

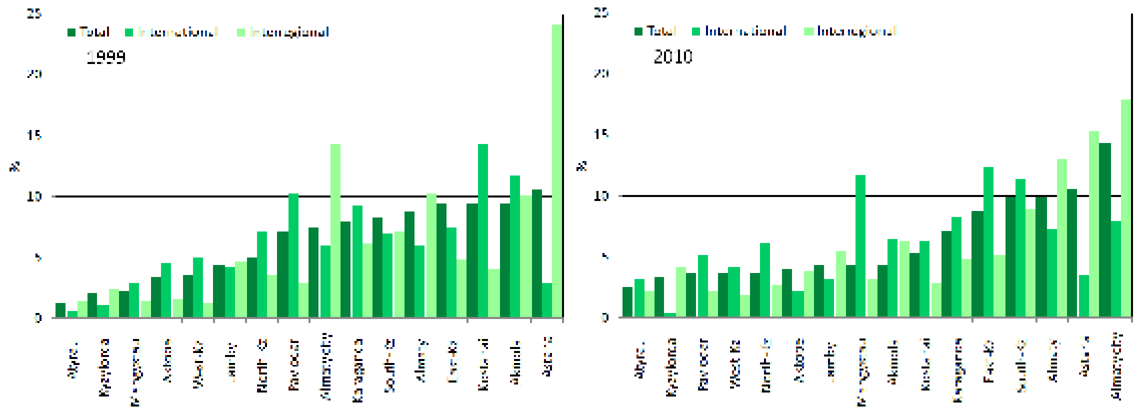
Figure 51 - Share of migration types by regions, Kazakhstan 1999 and 2010



Source: stat.kz

The end of 1990's was time when the new capital city Astana was just being built and many government buildings were moved from the old capital as well as numerous civil workers, which resulted that Astana at that time had the highest share of interregional movements leaving behind even Almaty city which was and still is the financial and cultural centre of the country and one of main constant interregional migrants receivers. However, the new capital city rush is over now and number of people coming to Astana is receding with each year. The regions with the least share of any types of migration are Atyrau, Kyzylorda, Jambyl and West-Kazakhstan which result of the fact probably that these oblasts are least attractive for international as well as interregional migrants (see Figure 52).

Figure 52 - Share of regions in migration types, Kazakhstan 1999 and 2010



Source: stat.kz

Kazakhstan is a country which belongs to the group of the FSU developing states and as it is characteristic to any such country the socioeconomic sphere of it is also in the process of developing which means that it is quite normal that only 2% of the country's population is actively involved in interstate movements. Although the increase of interregional migration volume is not clearly evident on the state level, but at the regional level the situation have obviously changed for many formerly passive oblasts such as Aktobe, Jambyl, Kyzylorda, Mangystau and North-Kazakhstan oblast.

The 2000's were years of dynamic international movements to and fro the country related to out-migration of non-Kazakh ethnic groups and in-migration of oralmans – ethnic Kazakhs and even at that time total number of all international migrants accounted for only about 1% from Kazakhstan's total population and now with repatriation programme terminated and the economic crisis it fell to 0,4% (see Table 6) and that leads to the fact that international migration nowadays plays very insignificant role in population development process of the country.

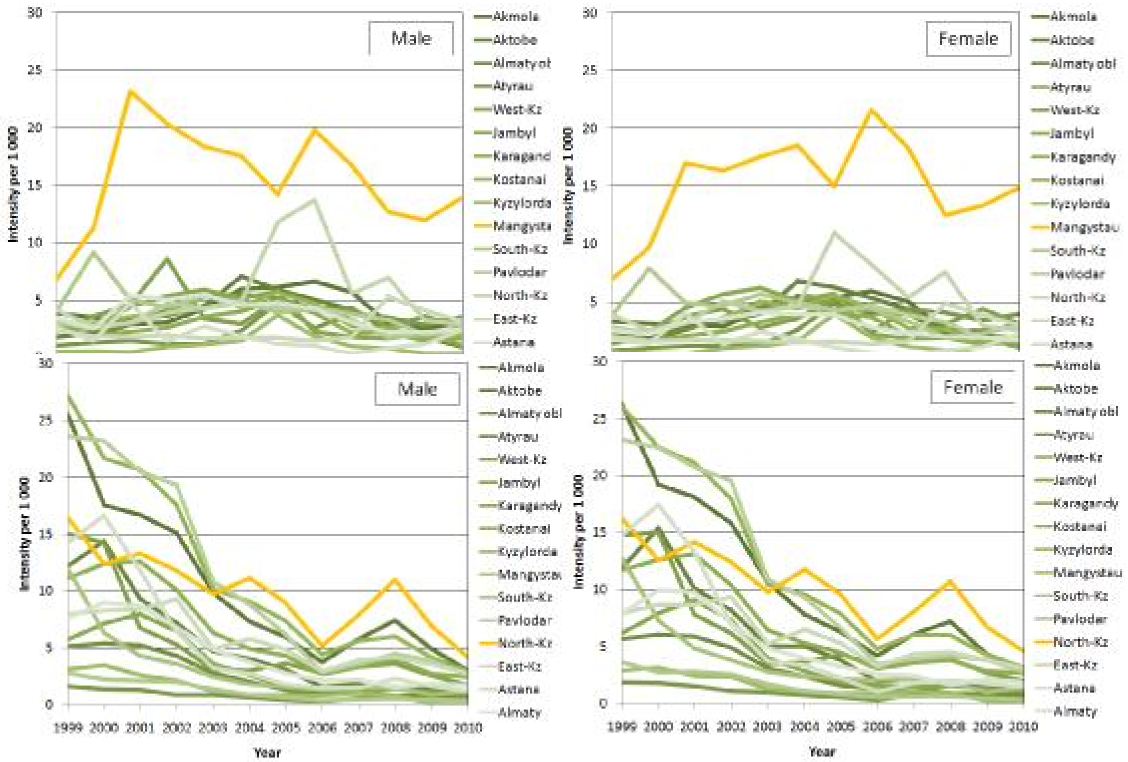
Table 6 - Proportion of migrants from population by regions and migration types, Kazakhstan 1999 and 2010

	Total migration		International		Interregional	
	1999	2010	1999	2010	1999	2010
Kazakhstan	**4**	**5**	**1**	**0**	**2**	**2**
Akmola	8	5	3	1	3	3
Aktobe	3	4	1	0	1	2
Almaty	4	4	1	0	2	2
Atyrau	2	4	0	0	1	1
West-Kz	4	5	2	0	1	1
Jambyl	3	3	1	0	1	2
Karaganda	4	4	1	0	1	1
Kostanai	6	5	3	0	1	1
Kyzylorda	2	4	0	0	1	2
Mangystau	5	7	2	2	1	2
South-Kz	3	3	1	0	1	1
Pavlodar	6	4	3	0	1	1
North-Kz	5	5	2	1	1	2
East-Kz	4	5	1	1	1	1
Astana	22	13	2	0	19	8
Almaty city	4	8	1	0	3	4

Source: stat.kz

During the last decade Mangystau became the oblast with the highest immigration intensity for both sexes at the level of 15 immigrants per 1 000 people, while the rest of the oblasts have less than 5 immigrants per 1 000 people (see Figure 53). The only possible explanation could be that the oblast borders with Turkmenistan and Uzbekistan and people from these countris might be attracted to the oil and gas extracting sector of the region.

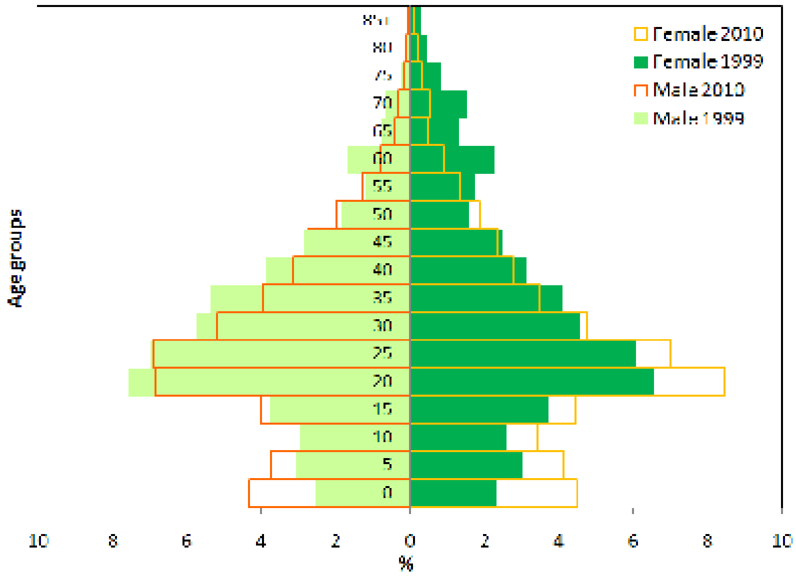
Figure 53 - Intensity of immigration by regions and sex, Kazakhstan, 1999-2010



Source: stat.kz

In the end of 1990s emigration from Kazakhstan was still in full force from northern, central and eastern regions until in the mid 2000s when its volume considerably lessened and in the year 2006 the least number of people left the country. However, with economic crisis which hit Kazakhstan most seriously in 2008 the emigration process again stimulated, but the rise was temporary because its intensity is again gradually falling down at the present days (see Figure 53).

Figure 54 - Age and sex structure of immigration, Kazakhstan 1999 and 2010

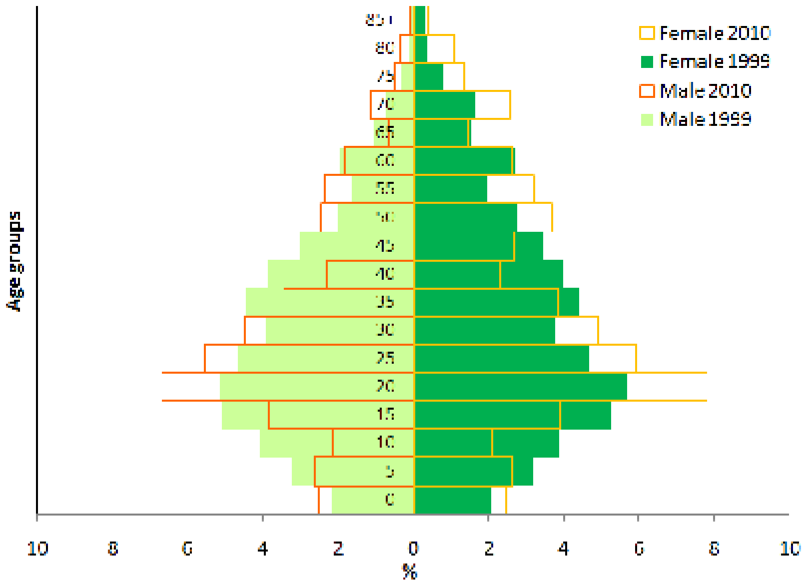


Source: stat.kz

The age and sex composition of international migration have remarkably changed during the last ten years. On average people entering Kazakhstan have become much younger these days than before and the biggest increase took place among the youngest age groups and ages 20-25 also the proportion of female immigrants have much risen (see Figure 54).

In case of emigrants the situation is not so obvious because the shift took place both among working age groups and also among elderly people. The bulk of emigrants at working age groups looks like the brain drain process or more precisely, since increase is most at age 20 it is probable that at this age people generally go to study abroad which became very fashionable lately in the country since more parents can afford to fund the education of their offsprings (see Figure 55).

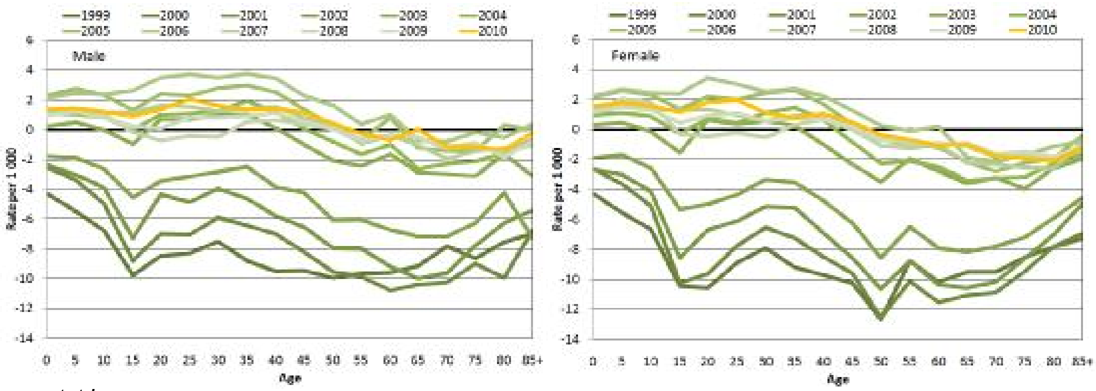
Figure 55 - Age and sex structure of emigration, Kazakhstan 1999 and 2010



Source: stat.kz

In order to unite regions with some common age migration schedules and since international migrants makes up less than 1% of population (problems of small numbers) for many regions the necessity arises of aggregation not only of regions but also of some years. Figure 56 clearly shows that the last decade can be divided into two periods: first one 1999-2002 when all age groups experienced net loss of population and the second one is 2002-2010 with more or less collective trends towards gains in young and working age groups for both sexes.

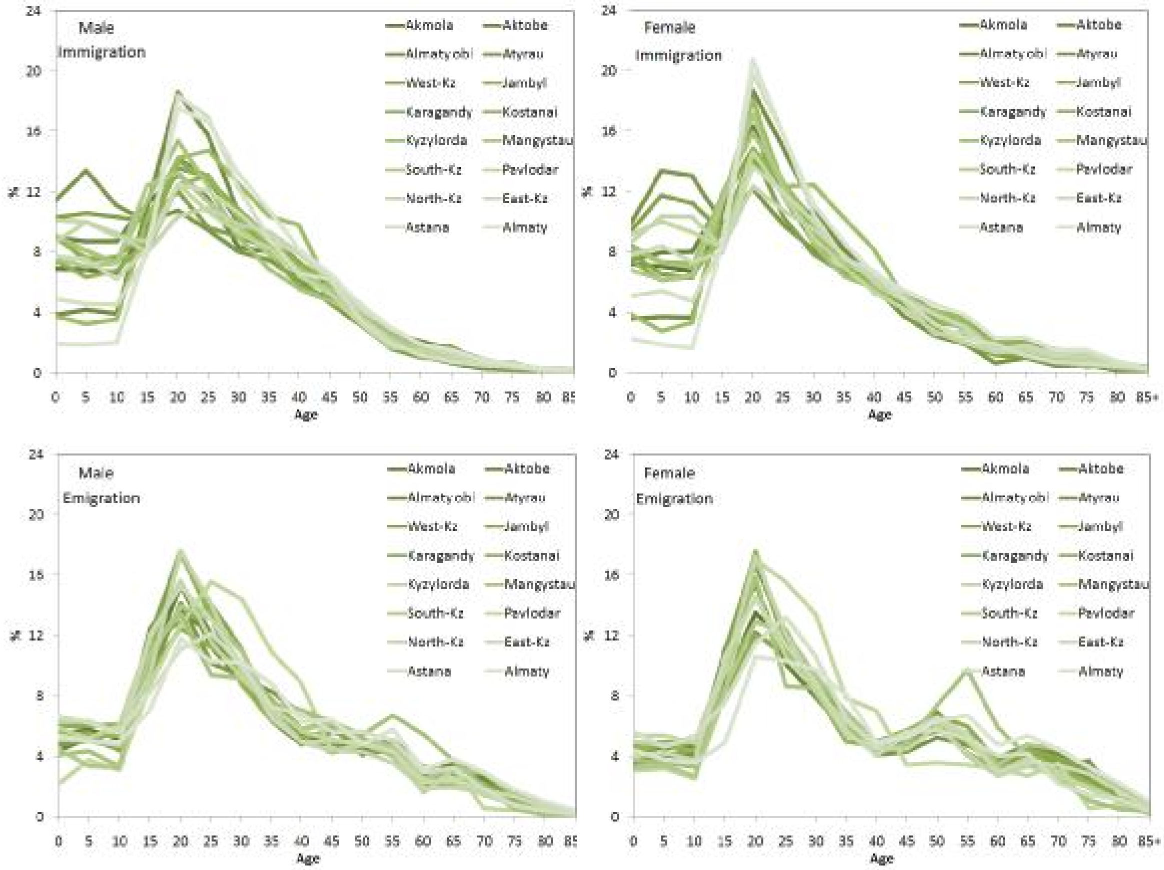
Figure 56 - Net international migration rate by age and sex, Kazakhstan 1999-2010



Source: stat.kz

The main differences in age structure of international migrants according to the Figure 57 are among the share of children and working age groups for immigrants and among working age and elderly people for emigrants. Thus we decided to unit regions with low, medium and high child migration for immigrants and low and high adult migration for emigrants.

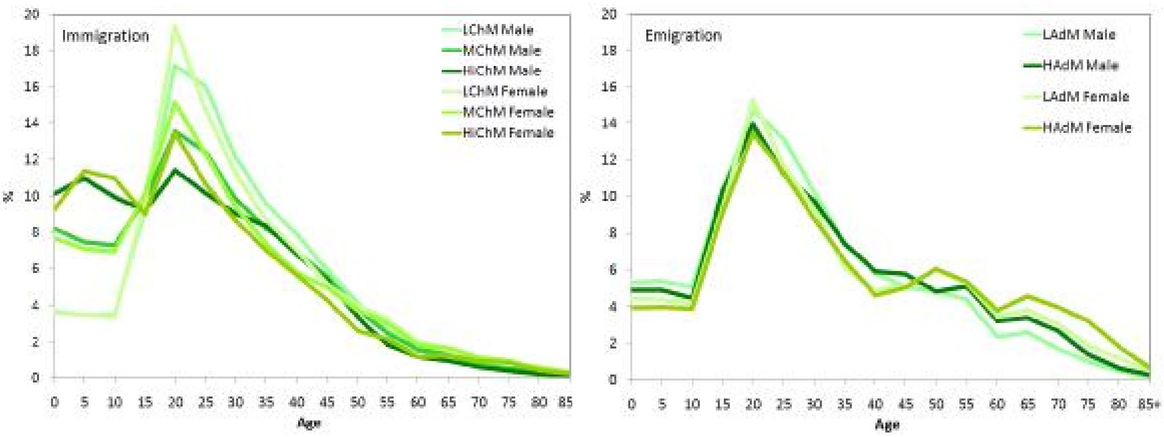
Figure 57 - Age and sex composition of international migrants by regions, Kazakhstan 2004-2010



Source: stat.kz

In case of immigrants we obtained six age schedule, three for each sex depending of the level of child migration. Low child migration unit includes Astana, Almaty, Almaty oblast and Kyzylorda. Medium child migration unit consists of oblast such as Akmola, Aktobe, Jambyl, Karagandy, Kostanai, Mangystau, South and East-Kazakhstan.

Figure 58 - Aggregated age schedules of international migration by sex, Kazakhstan

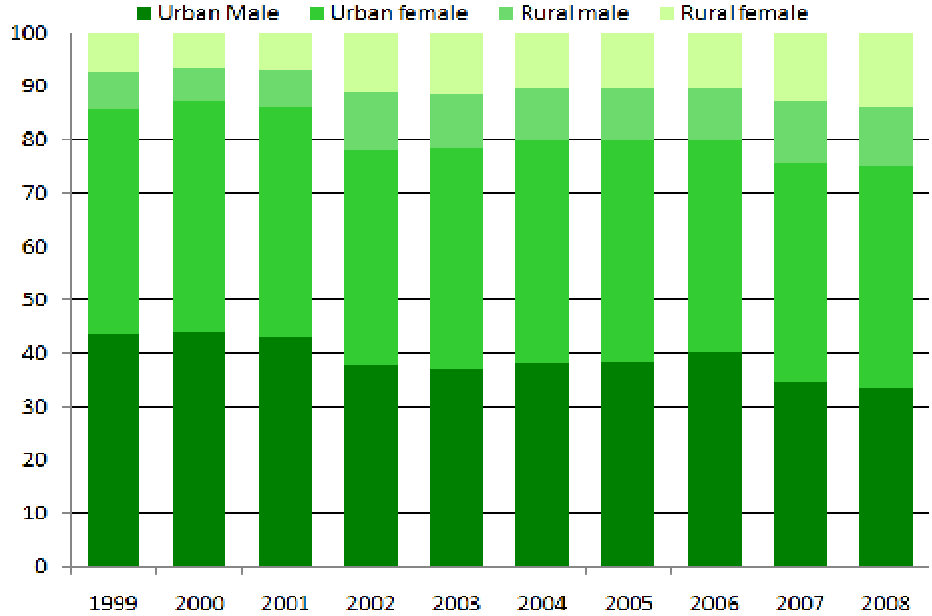


Source: stat.kz

And high child migration unit inludes are Atyrau, Pavlodar, West and North-Kazakhstan for both sexes. For emigration we joined all regions into two groups for males and two groups of regions for females depending on adult migration participation. The first unit with high adult mortality covers oblasts Atyrau, Aktobe, Almaty oblast, Almaty city, Akmola, Mangystau and South-Kazakhstan and the rest regions made up the second unit with low adult migration (see Figure 58).

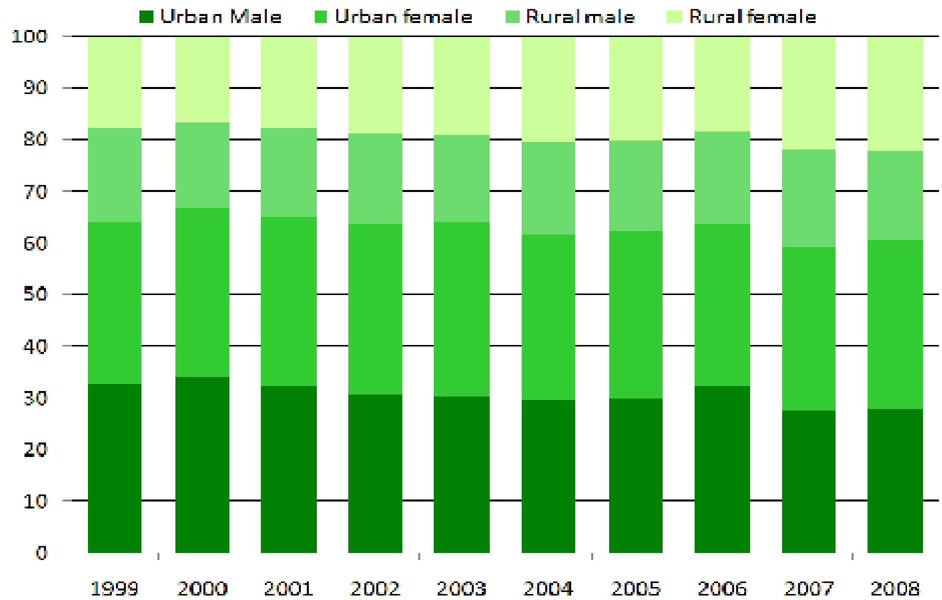
Now we turn to analysis of interregional migration, though numbers of migrants are quite small but there exist all the prerequisites for future increase of volume of interstate migration.

Figure 59 – In-migration destination shares by urban/rural place of residence and sex, Kazakhstan, 1999-2008



Source: stat.kz

Figure 60- Out-migration destination shares by urban/rural place of residence and sex, Kazakhstan 1999-2008

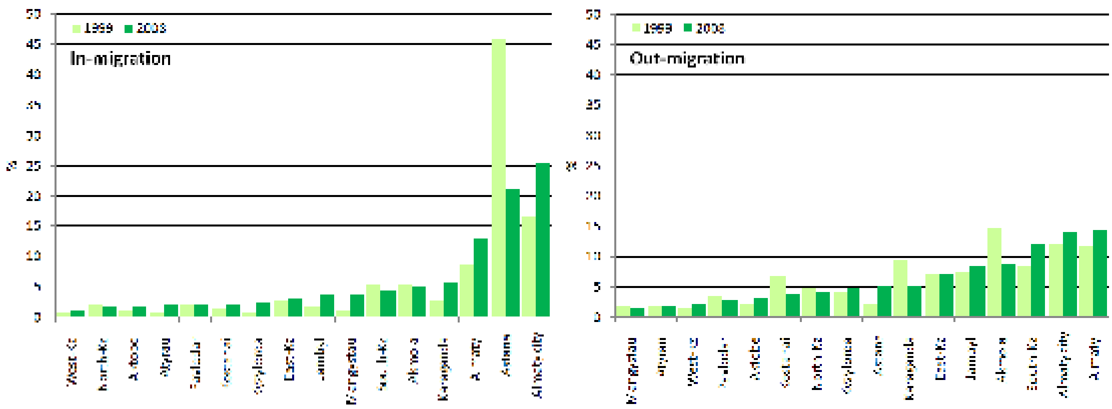


Source: stat.kz

According to Figures 59 and 60 more than 60% of movements within the country is in the direction of urban to urban, however the share of rural to rural migration is gradually increasing too. From total interregional migrants around 70% of them move to cities of which 60% comes from the direction of other cities and 10% from rural places.

There are three main interregional migration receiving centres in Kazakhstan – Astana, Almaty and Almaty oblast (see Figure 61). Main donors are South-Kazakhstan oblast, Jambyl and Akmola, which means that those three recipients get migrants from the closest regions around.

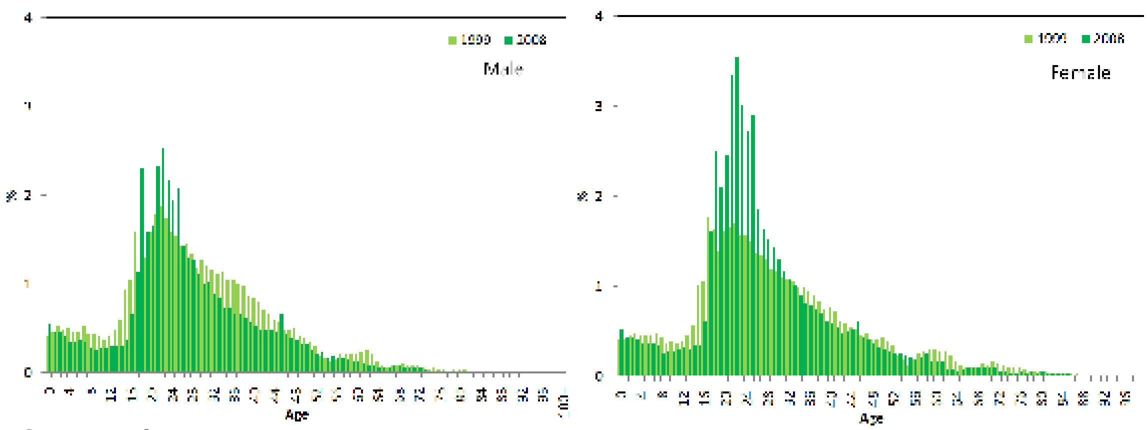
Figure 61 - Share of regions in interregional in and out migration, Kazakhstan 1999 and 2008



Source: stat.kz

The age structure of interregional migrants has become much younger during the last decade for both sexes but especially for females (see Figure 62). The main reasons for changing a place of residence are employment and education and sometimes it could relate to marriage. Therefore, bearing in mind those reasons we decided to join in and out-migrants of regions separately with more or less common age schedules.

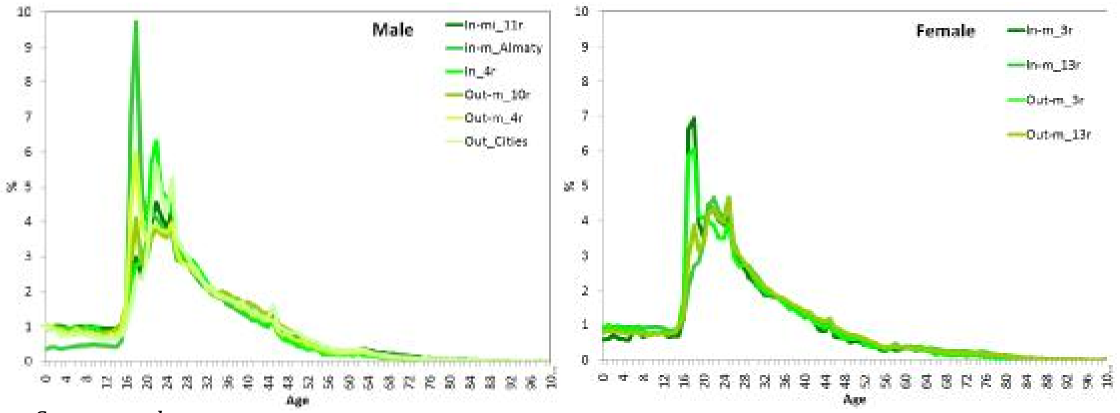
Figure 62 - Age and sex structure of interregional migrants, Kazakhstan 1999 and 2008



Source: stat.kz

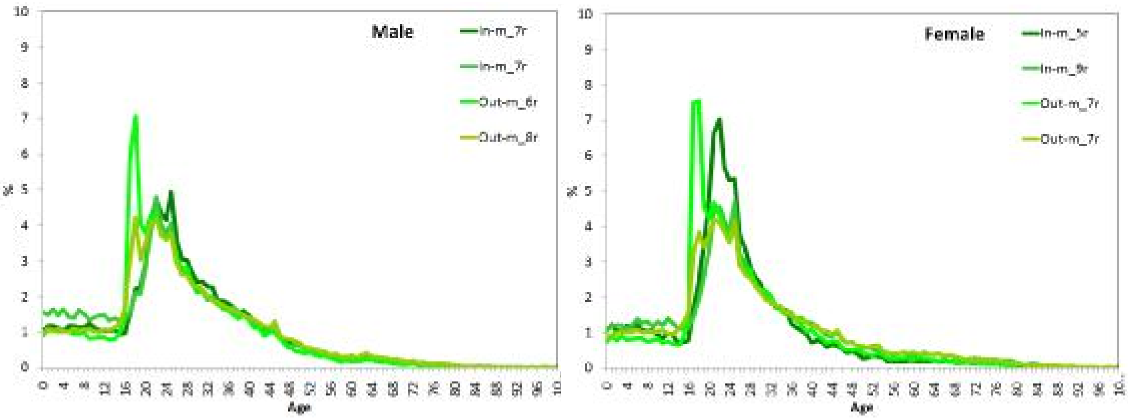
We obtained six age patterns for male urban migrants: three units for in-migration – one for 11 regions with high share of family migrants with children, then separately Almaty city with high share of student-migrants and one for 4 regions with high share of working age migrants and another three age schedules for male urban out-migrants with somewhat identical to in-migration unit patterns but with less volume (see Figure 63). In case of female urban migration we divided regions into 4 units two for in and two for out migrants with patterns of family and student migrants. The rural migrants of regions were joined into 8 units for each sex and by two units for each in and out-migrations (see Figure 64). It became evident that from rural places people mostly out migrate for education and employment purposes for both sexes and in-migrate probably due to marriages.

Figure 63 - Aggregated age schedules of interregional urban migration by sex, Kazakhstan



Source: stat.kz

Figure 64 - Aggregated age schedules of interregional rural migration by sex, Kazakhstan



Source: stat.kz

Chapter 7

Formulation of assumptions and forecasting model parameters

Making consistent and reasonable assumptions about the future course of population components is the most crucial stage of the population forecasting process. The proper assumptions about the demographic future are more important for the success of a forecast than a sophisticated model (Ascher, 1978). Referring to Keilman (Keilman, 1990) we distinguish several levels at which assumptions could be formulated. We start assumption-making from a general level considering socioeconomic, cultural, political and legal aspects of population development. Next, a qualitative assessment of the aggregated indicators (e.g. the total fertility rate, the life expectancy) will be given. Finally, the resulting aggregated indicators will be disaggregated into detailed parameters.

In view of the theories and facts mentioned above together with the past trends of demographic components, the assumptions developed in this section attempt to evaluate the effect of demographic changes on the future population of Kazakhstan. According to the previous chapter all assumptions will be formulated for the aggregated forecast units of corresponding components. A detailed unification of forecast regions is given in Table A1 (see Annex).

7.1 Fertility

As was stated above we will start from general assumptions. The current situation as well as the future course of fertility in Kazakhstan is the results of past trends. The present fertility boom in the country could be in my opinion the last of its kind and the current birth rates could be the highest they could ever get in the foreseeable future. Because, firstly, at present days the second wave of baby-boomers born in the mid and late 1980s are in the process of procreation which coincides with realization of postponed during the transition period mostly greater order births by older generations. And this birth accumulation by several different generations cannot possibly last long or repeat itself again. It was actually blessing in disguise for the country after a dramatic political and socioeconomic upturn of 1990s.

Secondly, the mentioned transition period crisis has obviously had negative effect on the future fertility by creating relatively small generation of future mothers, who will have when reaching reproductive ages considerably different attitudes towards family, children and traditions. It is already evident (through growing number of out of wedlock births, practice of cohabitation, rising divorces), in urban places mostly so far, that the current generations are being constantly and heavily influenced by attitudes and behavioral patterns of more developed world due to widespread access to Internet and more opportunities of experience exchange.

The influence of traditions such as having a son who will continue a family line or having several children because it is unseemly to have only one since he/she needs a playmate still persists with generations born before 1990s. Many people in Kazakhstan especially residing in rural places view children as their caretakers when they get old and they rarely stop to speculate about giving education and future of their children when they settle to have the fourth or fifth ones because they themselves often have only basic education and rarely any vocational or college. However, the new generations even born in rural places already have different attitudes, more self-oriented and they are much more curious about the world around them than their parents.

Although slowly but evident improvements of standards of living in the country are taking place. Not all but many rural places are being provided with more or less new technologies which lead to gradual diminishing of urban/rural diversities in many aspects of life. It means that in several decades there is a probability that differences in reproductive behaviour between urban and rural population might also decrease.

Apart from mentioned factors it is also wroth to note that ecological situation in the country, which is far from improving, may play some role in changing demographic behaviour of the population too. For example, during the last decade the cases of infecundity become more and more often. Many young couples without evident reasons seem to have problems with conception, which certainly influences fertility.

Table 7 – Expected values of the Total Fertility Rate by type of settlement

	Total			Urban			Rural		
	Medium	Low	High	Medium	Low	High	Medium	Low	High
2012	2.560	2.550	2.590	2.324	2.310	2.329	2.750	2.700	2.800
2013	2.550	2.525	2.589	2.314	2.285	2.328	2.740	2.675	2.799
2014	2.540	2.500	2.588	2.304	2.260	2.327	2.730	2.650	2.798
2015	2.530	2.475	2.587	2.294	2.235	2.326	2.720	2.625	2.797
2016	2.520	2.450	2.586	2.284	2.210	2.325	2.710	2.600	2.796
2017	2.510	2.425	2.585	2.274	2.185	2.324	2.700	2.575	2.795
2018	2.500	2.400	2.584	2.264	2.160	2.323	2.690	2.550	2.794
2019	2.490	2.375	2.583	2.254	2.135	2.322	2.680	2.525	2.793
2020	2.480	2.350	2.582	2.244	2.110	2.321	2.670	2.500	2.792
2021	2.470	2.325	2.581	2.234	2.085	2.320	2.660	2.475	2.791
2022	2.460	2.300	2.580	2.224	2.060	2.319	2.650	2.450	2.790
2023	2.450	2.275	2.579	2.214	2.035	2.318	2.640	2.425	2.789
2024	2.440	2.250	2.578	2.204	2.010	2.317	2.630	2.400	2.788
2025	2.430	2.225	2.577	2.194	1.985	2.316	2.620	2.375	2.787
2026	2.420	2.200	2.576	2.184	1.960	2.315	2.610	2.350	2.786
2027	2.410	2.175	2.575	2.174	1.935	2.314	2.600	2.325	2.785
2028	2.400	2.150	2.574	2.164	1.910	2.313	2.590	2.300	2.784
2029	2.390	2.125	2.573	2.154	1.885	2.312	2.580	2.275	2.783
2030	2.380	2.100	2.572	2.144	1.860	2.311	2.570	2.250	2.782

Considering all above mentioned, the supposition that fertility in Kazakhstan will inevitably decline both in quantum as well as in tempo might be highly possible. Since we will make forecasts on the three level, that is state, urban/rural and 16 administrative units which have been clustered to forecast units, the assumptions are made correspondingly. The three variants of TFR development for Kazakhstan in general and urban/rural values are given in Table 7 (see also Table A7).

Currently TFR for the country is slightly more than 2.5 and it could be assumed as a medium variant that in the coming twenty years it will decline but will stay above the replacement level. Although serious changes are expected in reproductive behaviour of the population, however these changes require time and the time horizon of the present forecasts is not quite enough to capture some great alterations, thus the lowest possible level of TFR for the country is 2.1. All the probable reasons of high TFR variant which is very slightly more than the current level are explained above.

In case of urban/rural fertility, in rural places it is expected that decline of the birth rates will be more pronounced than in urban areas. For both places, the high variants of TFR are lower than the present levels. The difference between urban and rural TFRs is more or less constant for the coming twenty years, but it probably might accelerate in later years.

Table 8 – Expected value of the Total Fertility Rate by forecast units

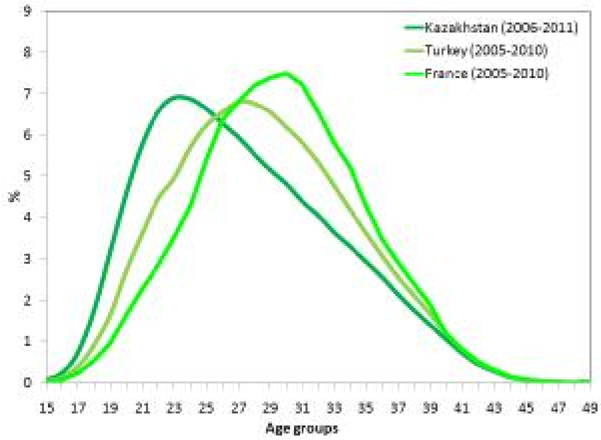
	2012			2017			2022			2027			2030		
	Medium	Low	High	Medium	Low	High	Medium	Low	High	Medium	Low	High	Medium	Low	High
Urban															
North	1.977	1.967	1.986	1.927	1.867	1.981	1.877	1.767	1.976	1.827	1.667	1.971	1.797	1.607	1.968
S-E-W	2.767	2.757	2.776	2.717	2.657	2.771	2.667	2.557	2.766	2.617	2.457	2.761	2.587	2.397	2.758
S-W	3.333	3.323	3.342	3.283	3.223	3.337	3.233	3.123	3.332	3.183	3.023	3.327	3.153	2.963	3.324
Rural															
North	2.328	2.318	2.337	2.278	2.218	2.332	2.228	2.118	2.327	2.178	2.018	2.322	2.148	1.958	2.319
S-W	3.564	3.554	3.573	3.514	3.454	3.568	3.464	3.354	3.563	3.414	3.254	3.558	3.384	3.194	3.555
South	4.030	4.020	4.039	3.980	3.920	4.034	3.930	3.820	4.029	3.880	3.720	4.024	3.850	3.660	4.021

The sole purpose of making regional forecasts was to take into account regional diversities of demographic indicators, especially fertility. Table 8 shows the probable future regional TFR values for selected years. We will mainly discuss a medium variant of TFR. It is assumed that for urban units decline of fertility will be less significant than for rural ones. Urban northern regions are already well below replacement level and their TFR is going to decline even further and TFR for rural northern regions might fall to replacement level in twenty years and it is going to be the lowest level of rural TFR among units. The highest levels of TFR are associated with southern and westerns regions in both urban as well as rural cases and southern regions seem to continue to experience rather high fertility in coming decades due to its deeply rooted habit of preserving traditions and very retarded change of attitudes.

It is presumed that the age structure of fertility might also change, and in order to find out the probable pace of change the experience of more developed countries were studied. It was found out (by studying development of TFR and peak age of fertility) that the most suitable for future urban fertility of Kazakhstan is the age structure of the French women, while for future rural fertility is seems to fit the age structure of the Turkish females (see Figure 65).

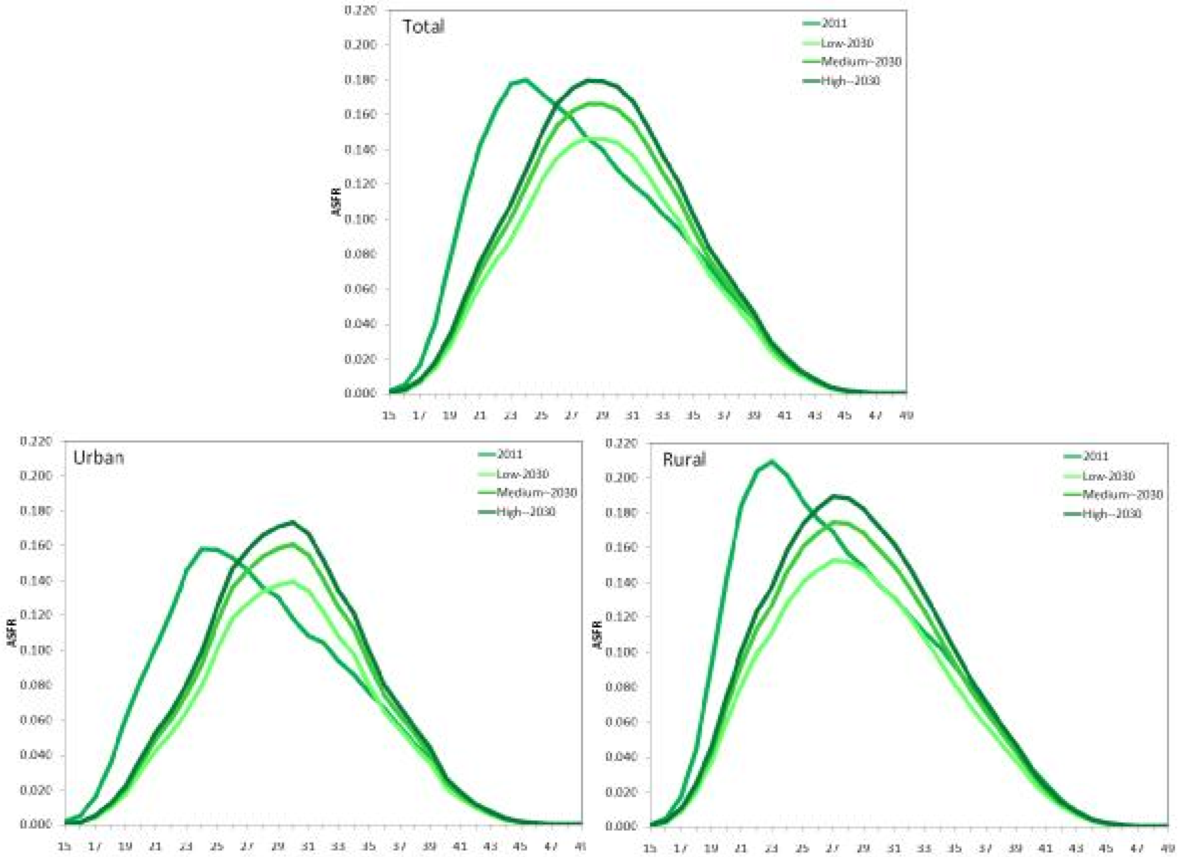
Nowadays, the peak age of fertility in the country is at ages 23 and 24 and the shape of the 'bell' is rather wide due to the present boom of higher order births, and it is distorted to younger ages. It could be expected that in the coming twenty years the peak age of fertility might shift to higher ages, to much higher 30's for urban females, when the shape of the 'bell' gets more symmetric and narrower due to the fall of high order births and late first births, and to the late twenties for rural women. These suppositions coincided with the French (2005-2010) and the Turkish (2005-2010) age-specific percentage distributions of fertility.

Figure 65 – Percentage distribution of fertility rates in Kazakhstan, Turkey and France



In order to get the future total distribution of the age-specific fertility for the country we summed the urban/rural distributions of the age-specific fertility and used the obtained average. For all variants the peak age of fertility shifted to the late twenties and the shape of the peak becomes more round and covers wider range of ages (see Figure 66). The only difference between variants is in intensity of fertility, for example, a medium variant - the changes occur both in intensity of fertility as well as in birth concentration, whereas in a high variant - the intensity will stay the same with changes taking place only in ages of fertility.

Figure 66 – Age-specific fertility rates: Low, medium and high variants and 2011, Kazakhstan

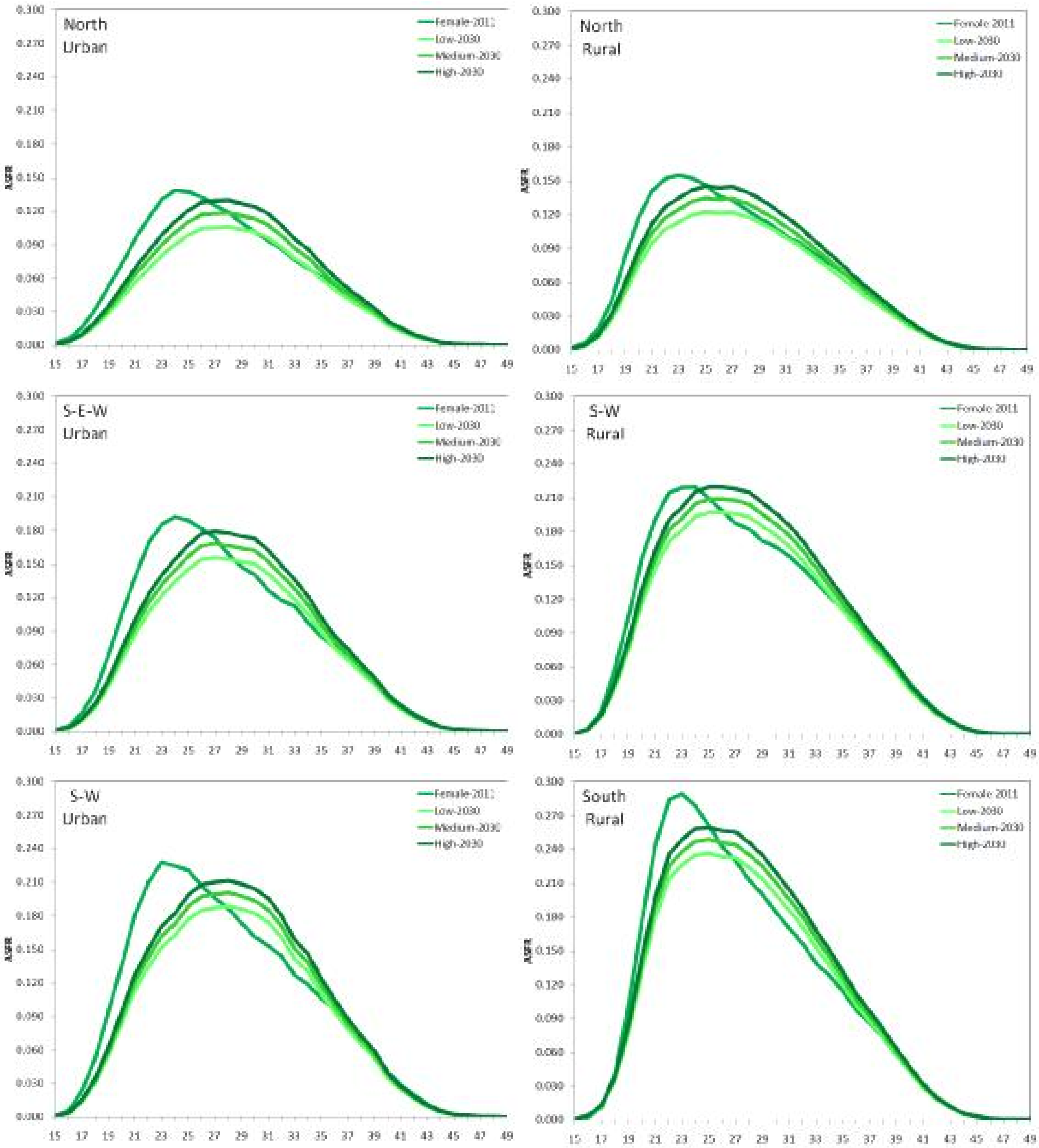


In case of urban fertility the intensity at the peak fertility ages may rise since the shape of the 'bell' narrows and more births may start to concentrate in narrower age groups. In rural fertility the shift of the peak age fertility is slightly less, but the fall of intensity is more pronounced (see Figure 66).

The future distributions of the age-specific fertility for forecast units were obtained by application of the total urban/rural distributions for respective units (see Figure 67). Again, it is very evident that the shift in age structure of future fertility is more significant for southern and western regions as well as for rural fertility. Northern and urban regions are usually tend to have more advanced and less traditional reproductive behaviour which leaves less room for further changes.

Looking at the current level of fertility one may assume that such changes are rather hard to imagine to happen to the country, however the lack of apparent sings does not mean that some undercurrent symptoms and signals are nonexistent such as rising mean age at marriage, increasing mean age at childbearing and growing contraceptive prevalence.

Figure 67 – Age-specific fertility rates: Low, medium and high variants and 2011 by forecast units

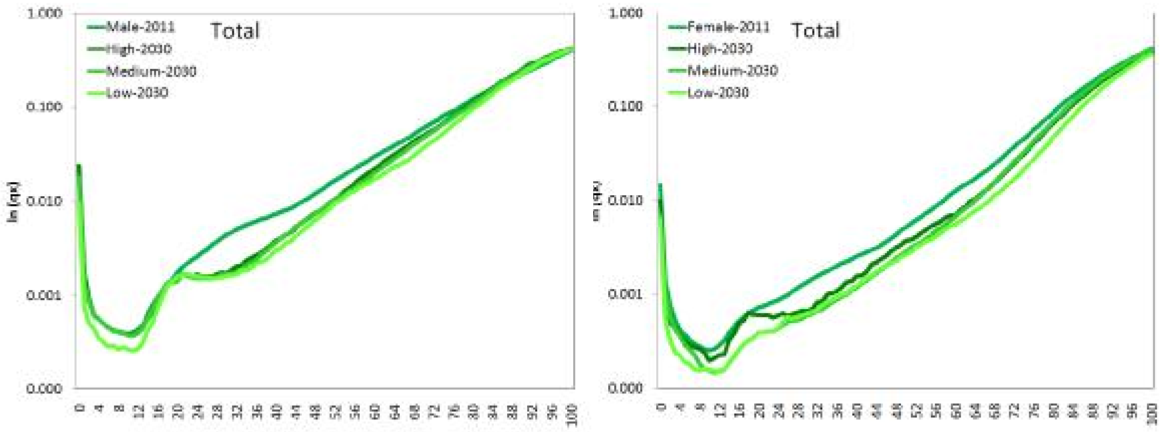


7.2 Mortality

Kazakhstan is a developing country with a corresponding level of mortality; in addition it has the Soviet legacy expressed in low life expectancy at birth, big difference between sexes and the cardiovascular system diseases as a main cause of death. As in many other Post-soviet countries the mortality trends in Kazakhstan were improving till the collapse of the Union, but the transition period hit the country with such a force of a brake that the entire system went backward. Only recently mortality indicators of Kazakhstan reached the level of the late 1980s, it has required twenty years in order to recover and get to the zero point. Hence, it could be assumed that from these days onward mortality will have only improving character though very gradually.

In order to get the future age structure of mortality age composition of some ten western, central and eastern European countries were examined bused on life expectancy at birth by sex comparable to Kazakhstan’s present levels. The closest to the probable future Kazakhstani mortality age schedule turned out to be France’s and Hungary’s and the former’s was chosen as a model age structure. The urban/rural versions of the future mortality age structure were obtained by application to the model structure of the differences of urban/rural age patterns from the country’s total (see Figure 68).

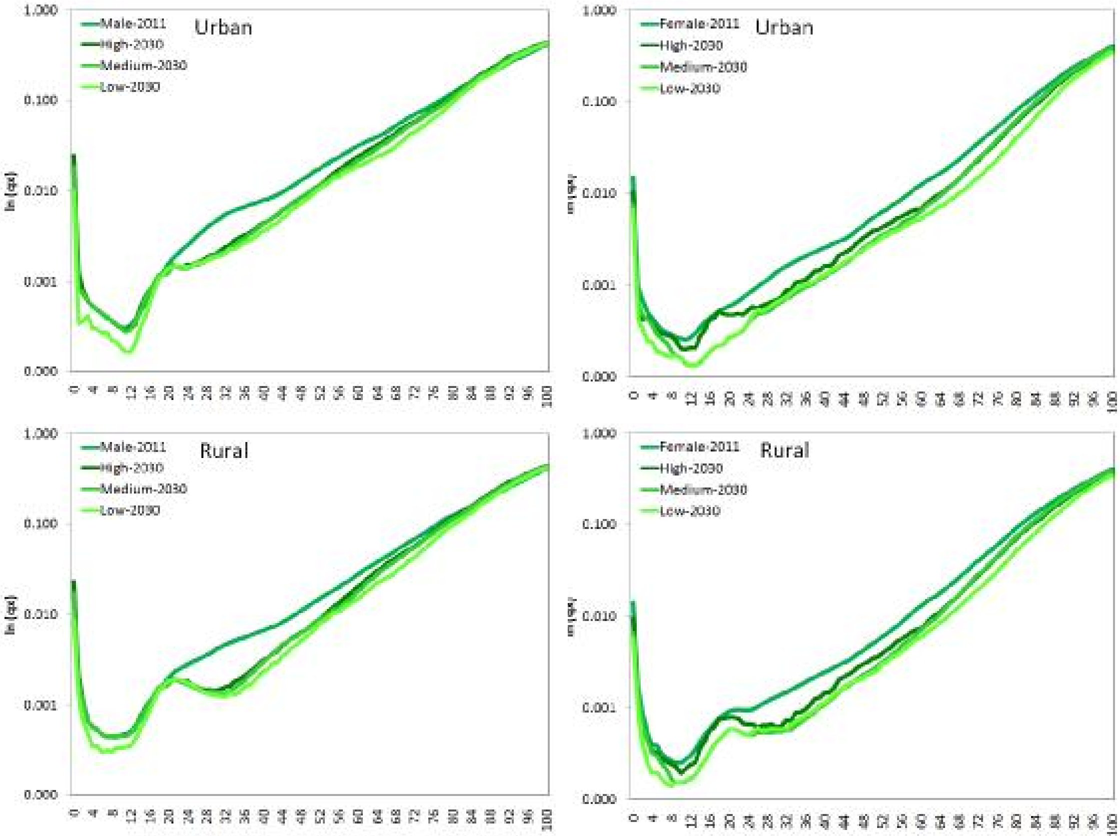
Figure 68 – Probability of dying by sex: High, medium, low variants and 2011



The main improvements in male mortality are assumed to occur in a medium and a low variants for working age population, while in a high variant decrease of infant and of child mortality is also expected. In case of female mortality improvements are presumed to happen for all ages in a high variant and less so in the other two variants.

It is a well known fact that male mortality in rural places is lower than in urban; however probability of dying for females is almost the same in both urban and rural places (see Figure 69). The common for both sexes feature of mortality change over time is that most improvements are expected among people at working ages, which could probably be explained by high potential for mortality reduction at this age and by expected change of lifestyle related to the process of generation replacement. That is, the present intensities and age composition of the working age mortality are derived from the population born during the soviet period, who went through the dramatic transition decade and in the following two decade the most part of the labour force would be replaced and represented by the generations of Independence time with considerably different lifestyle and changed attitudes to health and life in general. Besides, some advancements in standards of living are underway, also a few progressive changes in the healthcare system could probably be expected which would undoubtedly impact on overall death rates. Moreover, the infant mortality is quite high in the country which leaves a great room for further improvements.

Figure 69 – Probability of dying by sex and urban/rural place of residence: High, medium, low variants and 2011



The regional variants of future mortality age schedules were obtained in the same fashion as in the case of urban/rural versions by applying a forecast unit's difference from the general country structure to the model age pattern. The illustrations of regional patterns are given in Figure A1 (see Annex). Although, mortality differences between regions are not as great as fertility and migration, however the regional diversities seem to follow general country pattern, when in urban places males have higher probability of dying than in rural and this difference is assumed to keep existing in the future, also death rates for females between urban and rural units of regions are small as it is characteristic for the country as a whole. In northern regions deaths among the working age population are more frequent compared to southern, and the expected improvements there are smaller than in southern for the same age groups which is true for both sexes. Besides, the differences between three variants are rather small and they get even smaller for urban, male and northern populations. The shapes of the regional mortality age schedules are very uneven with some wild fluctuation present, since probably they are derived from relatively small number of people

It could be assumed that the differences between male and female life expectancies at birth may decrease in the future however not in the close future since it is not likely that male and female lifestyle differences will change significantly within the next several decades. Therefore it stays at around ten years in all three variants (see Table 9).

Table 9 – Expected change of life expectancy at birth by sex, (Kz)

	Medium mortality			Low mortality			High mortality		
Year	Male	Female	Sex difference	Male	Female	Sex difference	Male	Female	Sex difference
2011	63.75	73.42	9.66	63.75	73.42	9.66	63.75	73.42	9.66
2012	63.99	73.65	9.67	64.09	73.74	9.65	63.94	73.62	9.68
2013	64.23	73.89	9.67	64.44	74.07	9.64	64.13	73.82	9.69
2014	64.47	74.14	9.67	64.79	74.41	9.62	64.32	74.03	9.70
2015	64.72	74.38	9.67	65.14	74.75	9.61	64.52	74.23	9.72
2016	64.96	74.63	9.67	65.50	75.11	9.60	64.71	74.44	9.73
2017	65.21	74.88	9.67	65.87	75.47	9.59	64.91	74.66	9.74
2018	65.47	75.13	9.67	66.25	75.83	9.58	65.11	74.87	9.76
2019	65.72	75.39	9.66	66.63	76.21	9.58	65.31	75.09	9.77
2020	65.98	75.64	9.66	67.02	76.59	9.57	65.52	75.31	9.79
2021	66.24	75.90	9.66	67.41	76.98	9.57	65.72	75.53	9.81
2022	66.51	76.17	9.66	67.81	77.38	9.57	65.93	75.75	9.82
2023	66.78	76.43	9.66	68.22	77.79	9.57	66.14	75.98	9.84
2024	67.05	76.70	9.65	68.64	78.21	9.58	66.35	76.21	9.86
2025	67.32	76.97	9.65	69.06	78.64	9.58	66.57	76.45	9.88
2026	67.60	77.25	9.65	69.49	79.08	9.59	66.78	76.68	9.90
2027	67.88	77.52	9.64	69.93	79.54	9.60	67.00	76.92	9.92
2028	68.16	77.80	9.64	70.38	80.00	9.62	67.22	77.16	9.94
2029	68.45	78.09	9.64	70.84	80.47	9.64	67.44	77.41	9.96
2030	68.74	78.37	9.63	71.30	80.96	9.66	67.67	77.66	9.99

Table 10 – Expected change of life expectancy at birth by sex and urban/rural place of residence: (Ks(U,R))

	Medium mortality				Low mortality				High mortality			
	Urban		Rural		Urban		Rural		Urban		Rural	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
2011	63.27	73.85	64.36	73.13	63.27	73.85	64.36	73.13	63.27	73.85	64.36	73.13
2012	63.50	74.10	64.60	73.36	63.60	74.19	64.71	73.45	63.46	74.06	64.55	73.33
2013	63.74	74.35	64.85	73.60	63.94	74.54	65.06	73.77	63.64	74.27	64.75	73.53
2014	63.97	74.60	65.10	73.84	64.28	74.89	65.42	74.10	63.83	74.49	64.95	73.73
2015	64.21	74.85	65.35	74.08	64.63	75.25	65.79	74.44	64.02	74.70	65.15	73.93
2016	64.45	75.11	65.60	74.32	64.98	75.62	66.16	74.78	64.21	74.92	65.35	74.14
2017	64.70	75.37	65.86	74.57	65.34	76.00	66.54	75.13	64.40	75.15	65.55	74.34
2018	64.94	75.63	66.12	74.81	65.70	76.38	66.93	75.49	64.60	75.37	65.76	74.55
2019	65.19	75.89	66.39	75.06	66.08	76.78	67.32	75.86	64.79	75.60	65.97	74.77
2020	65.44	76.16	66.65	75.32	66.45	77.18	67.72	76.23	64.99	75.83	66.18	74.98
2021	65.70	76.43	66.92	75.57	66.84	77.59	68.13	76.62	65.19	76.06	66.39	75.20
2022	65.96	76.70	67.20	75.83	67.23	78.02	68.54	77.01	65.39	76.30	66.60	75.42
2023	66.22	76.98	67.47	76.09	67.63	78.45	68.96	77.41	65.60	76.54	66.82	75.64
2024	66.48	77.26	67.75	76.36	68.03	78.90	69.39	77.82	65.80	76.78	67.04	75.87
2025	66.75	77.54	68.04	76.62	68.45	79.35	69.83	78.24	66.01	77.02	67.26	76.09
2026	67.02	77.83	68.32	76.89	68.87	79.82	70.27	78.67	66.22	77.27	67.48	76.33
2027	67.30	78.12	68.61	77.16	69.29	80.30	70.73	79.11	66.44	77.52	67.71	76.56
2028	67.57	78.41	68.91	77.44	69.73	80.80	71.19	79.56	66.65	77.78	67.94	76.80
2029	67.85	78.70	69.20	77.71	70.17	81.30	71.66	80.02	66.87	78.04	68.17	77.03
2030	68.14	79.00	69.50	78.00	70.62	81.82	72.14	80.50	67.08	78.30	68.40	77.28

Life expectancy at birth values of urban and rural populations differ slightly and stay more or less stable throughout the forecast period at around one year. It is assumed that increase in life expectancy at birth for both sexes might be a bit more in urban places compared to rural. The difference between the highest and the lowest variants of life expectancy at birth is approximately four years for both sexes (see Table 10).

Values of forecast unit life expectancies at birth are as could be expected with northern urban males exhibiting the lowest figures and cities the highest ones. It is necessary to note that the North and South forecast units for both sexes are represented with slightly different groups of oblasts in urban/rural unifications. The overall general trend for males is this, since in rural places death rates are lower than in urban then regions with higher share of rural population are more likely to have higher life expectancies at birth in contrast to regions with higher share of urban population. The situation is slightly reversed in case of females (see Table 11). This fact brings to the conclusion that the urban/rural mortality differences might be closely connected to causes of death.

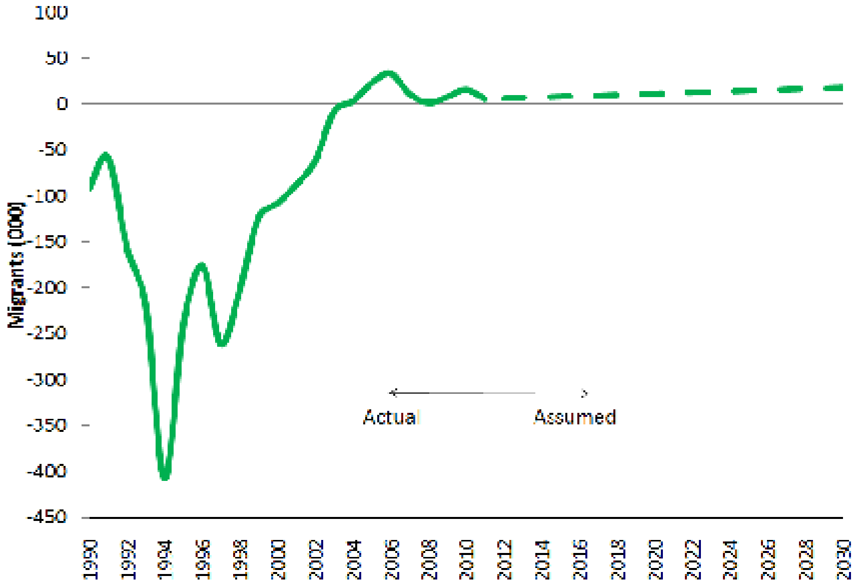
Table 11 –Expected change of life expectancy at birth by sex, urban/rural place of residence and forecast unit

Forecast units	Medium mortality				
	2011	2016	2021	2026	2030
Urban_Male					
North	61.12	62.19	63.31	64.49	65.49
South	63.22	64.38	65.62	66.92	68.02
Cities	66.51	67.89	69.36	70.92	72.24
Urban_Female					
North	72.85	74.04	75.30	76.62	77.74
South	73.36	74.55	75.80	77.11	78.22
Cities	75.64	76.97	78.37	79.84	81.09
Rural_Male					
North	61.95	63.07	64.26	65.51	66.56
South	64.91	66.19	67.55	68.99	70.21
Rural_Female					
North	71.96	73.10	74.30	75.57	76.63
South	73.47	74.67	75.94	77.27	78.39
West	75.18	76.49	77.88	79.34	80.57

7.3 Migration

Migration is a population component which is influenced not only by socio-demographic changes but also by modifications in the legislation system, alterations of economic and political situation. Thus, a prediction of future migration development could rather be erroneous compared to other components. However, in case of Kazakhstan the risk of inaccuracy in future migration trends due to some unexpected fluctuations is not great, because during the last decade the number of international migrants from the total population of the country have fallen to less than 0.5% and the net gain for the last several years was around 5 000 people for more than 16 million population. Therefore, as was described in the previous chapters it is unlikely that there could be expected any massive international movements to and from Kazakhstan in the coming decades. Bearing all these facts in mind it was decided that one - a medium variant of net international migration development will suffice to illustrate the role of international migration in determining the probable future number of the country's population (see Figure 70). As a high variant some additional 3000-5000 migrants could be counted and as a low variant minus the same numbers which would have made rather insignificant changes in the total numbers of population.

Figure 70 – Net international migration, Kazakhstan 1990-2030 (medium variant)



It is assumed that despite a quite volatile recent migration history of the country which was marked by a massive emigration, in the following several decades the country probably will have positive net balance though in small numbers. In case of further economic development these small numbers might increase, since economic improvements usually create new job opportunities which may be attractive to people from neighboring Central Asian countries. The age and sex composition of emigration and immigration was kept constant, because most of immigrants are made up by single young people seeking employment and better life or by families with young children pulled by the same reasons, and leave the country young people for the same reason as immigrants arrive and some elderly people – the remnants of European ethnicity who for some reasons postponed their departure till these days. And it is probable that the changes of international migration age structure may not be really great, which actually is an exchange of labour force only differing in its quality.

In the regional context it is presumed that northern regions will continue losing population, because when the remaining non-native ethnicities will be exhausted it might be replaced by the people with more or less advanced attitudes who feel overqualified and unsatisfied by the opportunities in the country. The gain in international migration will experience southern and south-western regions located close to the Central Asian countries, which could become the main source of immigrants to Kazakhstan (see Table 12). The age structure for regions are also kept stable.

Table 12 –Share of regions in international migration, 2011-2030 (medium variant)

Region	Male				Female			
	Immigration		Emigration		Immigration		Emigration	
	2011	2030	2011	2030	2011	2030	2011	2030
Akmola	5.2	3.0	9.7	11.0	5.1	3.0	8.9	9.0
Aktobe	2.2	3.7	2.8	2.0	2.6	3.0	2.9	3.0
Almaty obl.	9.6	10.0	4.9	4.0	9.3	10.0	4.5	5.0
Atyrau	3.2	4.0	0.6	0.4	3.6	4.0	0.7	1.0
West	3.8	3.7	4.5	5.0	4.6	5.0	4.5	5.0
Jambyl	4.3	5.0	3.1	2.0	4.0	5.0	3.1	3.0
Karagandy	5.8	3.8	12.0	14.0	5.5	4.0	12.1	11.0
Kostanai	4.7	3.0	10.8	12.0	4.4	3.0	10.9	9.0
Kyzylorda	0.5	1.0	0.2	0.1	0.5	1.0	0.3	1.0
Mangystau	15.7	17.0	1.8	0.5	16.5	15.0	1.9	2.0
South	15.4	19.0	2.9	1.0	16.6	19.0	3.1	3.0
Pavlodar	3.8	2.8	8.5	9.0	3.6	3.0	8.4	9.0
North	4.0	3.0	11.4	12.0	3.7	3.0	10.8	10.0
East	10.6	8.0	15.2	16.0	10.5	8.0	15.5	13.0
Astana	3.1	3.0	3.1	2.0	3.0	3.0	3.2	5.0
Almaty	8.1	10.0	8.6	9.0	6.6	11.0	9.3	11.0

Apart from the international migration we will need an account of interregional urban/rural movements for the more detailed forecasts. In the previous chapters it was described that the highest intensity of interregional movements is between cities and from rural places to urban. While in urban in-migrations females have the leading role, this role belongs to males in rural out-migrations (see Figure 71). This means that villages lose mainly their male population, whereas cities gain mainly in female population. The age structure of interregional migrants was also kept stable, it is only expected that the volume of interstate movements will continue increasing, since the better the economic situation in the country the more people tend to move from place to place (see Figure 72).

Figure 71 – Net urban/rural migration by sex (medium variant)

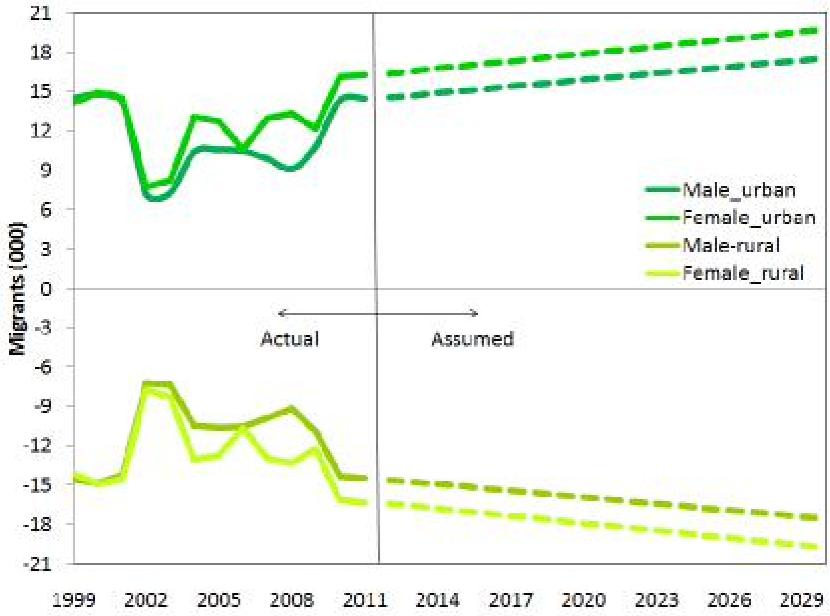
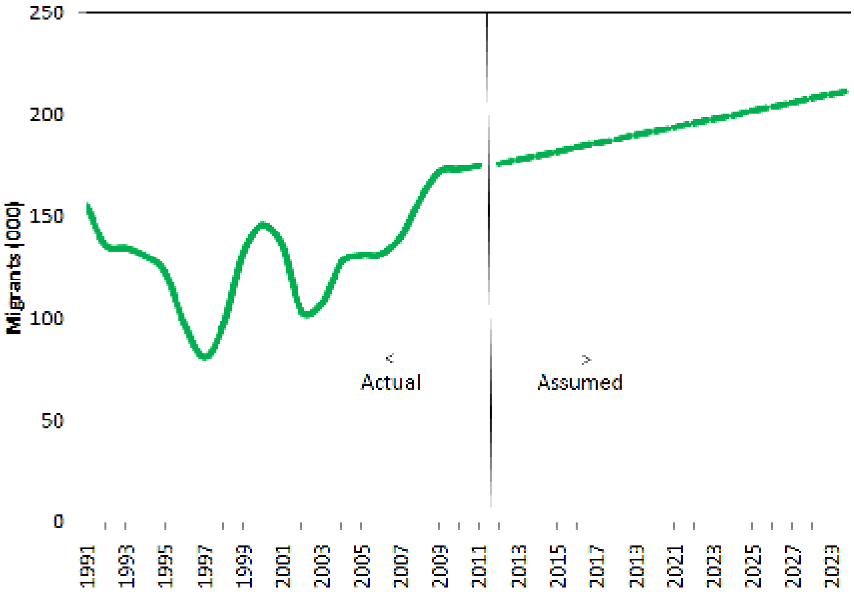


Figure 72 – Actual and assumed interregional migration, 1991-2030 (medium variant)



Although the age structure of interregional urban/rural migration is kept stable, however the shares of regions are assumed to change over time (see Table 13). The two capital cities are still expected to be the main attractive centres followed by Karaganda, but while in-migration to Almaty is presumed to increase the situation is vice versa for Astana. It is obvious that Astana does not have the same financial and social capacity as Almaty and it seems that there are some certain limits to its attractiveness for people from other regions.

The two oblasts receiving the most of rural in-migrants are Almaty oblast because it is the oblast containing the Almaty city, which means people may keep working in the city not actually living there, and South-Kazakhstan, because it probably has agricultural possibilities.
The main donors of interregional migration seem to be South, East-Kazakhstan, Akmola, Jambyl and Almaty oblasts. The situation of high out-migrations from Astana, Almaty and Karagandy could be explained by the fact that these are the main centres of movements in the country the more they pull people the more gets the probability of creating pushing factors.

Table 13 –Share of regions in interregional migration 2011-2030

Region	In-migration								Out-migration							
	Urban				Rural				Urban				Rural			
	Male		Female		Male		Female		Male		Female		Male		Female	
	2011	2030	2011	2030	2011	2030	2011	2030	2011	2030	2011	2030	2011	2030	2011	2030
Akmola	3.5	4.0	3.5	4.0	9.1	7.0	9.1	7.0	6.8	6.0	6.8	6.0	11.6	8.0	11.6	8.0
Aktobe	1.9	3.0	1.9	3.0	1.9	2.0	1.9	2.0	3.9	4.0	3.9	4.0	1.9	2.0	1.9	2.0
Almaty obl.	4.4	4.0	4.4	4.0	38.8	40.0	38.8	40.0	7.0	5.0	7.0	5.0	26.1	28.0	26.1	28.0
Atyrau	2.0	2.0	2.0	2.0	2.1	2.0	2.1	2.0	3.3	2.0	3.3	2.0	1.5	2.0	1.5	2.0
West. Kz	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	1.9	2.0	1.9	2.0	2.3	2.0	2.3	2.0
Jambyl	2.8	4.0	2.8	4.0	6.3	7.0	6.3	7.0	6.7	7.0	6.7	7.0	11.0	13.0	11.0	13.0
Karaganda	7.0	8.0	7.0	8.0	2.7	2.0	2.7	2.0	6.9	8.0	6.9	8.0	2.6	2.0	2.6	2.0
Kostanai	2.0	2.0	2.0	2.0	2.9	3.0	2.9	3.0	4.1	3.0	4.1	3.0	3.8	3.0	3.8	3.0
Kyzylorda	1.1	1.0	1.1	1.0	6.8	8.0	6.8	8.0	4.1	3.0	4.1	3.0	6.0	6.0	6.0	6.0
Mangystau	3.0	3.0	3.0	3.0	6.1	5.0	6.1	5.0	2.2	3.0	2.2	3.0	0.9	1.0	0.9	1.0
South-Kz	2.5	4.0	2.5	4.0	10.0	12.0	10.0	12.0	10.5	11.0	10.5	11.0	14.3	15.0	14.3	15.0
Pavlodar	2.3	1.0	2.3	1.0	1.6	1.0	1.6	1.0	3.4	1.0	3.4	1.0	2.2	1.0	2.2	1.0
North-Kz	0.9	1.0	0.9	1.0	4.7	4.0	4.7	4.0	3.0	1.0	3.0	1.0	7.6	9.0	7.6	9.0
East Kz	2.7	5.0	2.7	5.0	4.9	5.0	4.9	5.0	6.7	6.0	6.7	6.0	8.3	8.0	8.3	8.0
Astana	28.5	15.0	28.5	15.0					8.4	10.0	8.4	10.0				
Almaty	33.9	42.0	33.9	42.0	-	-	-	-	23.7	28.0	23.7	28.0	-	-	-	-

In forecasting the interregional migration in- and out-migrations to and from each region by sex and age were treated separately by urban/rural types. In Table 14 we show only the total net number of migrants for oblasts and they are organized top-down from the oblasts with the highest losses to the administrative units with the highest gains. In urban migration the agricultural southern, northern and western regions have the most negative numbers. In rural migration negative numbers have almost all regions, that is, very few people choose to live in a rural place preferring and believing that in cities they might have better choice. Such state of affairs might probably be an indication of critical conditions of rural settlements making life there very unwelcome and unattractive. Despite all these negative numbers, interregional migrants account for less than 2% of the country's population, while the share of rural population is more than 40%.

Table 14 –Net interregional migration by sex and regions, 2011-2030 (medium variant)

	Urban					Rural					
Region	Male		Region	Female		Region	Male		Region	Female	
	2012	2030		2012	2030		2012	2030		2012	2030
South-Kz	-3902	-3863	South-Kz	-4071	-4006	Jambyl	-2406	-3460	Jambyl	-2676	-3847
Jambyl	-1617	-1255	Jambyl	-1667	-1266	South-Kz	-2766	-3222	South-Kz	-3086	-3601
Kyzylorda	-1450	-1129	Kyzylorda	-1511	-1173	North-Kz	-1603	-2561	Almaty obl.	-2052	-2964
Akmola	-966	-602	Akmola	-972	-581	Almaty obl.	-1755	-2557	North-Kz	-1785	-2844
West-Kz	-344	-477	West-Kz	-350	-488	East-Kz	-1746	-1993	East-Kz	-1943	-2219
Kostanai	-832	-301	Kostanai	-852	-290	Akmola	-2059	-1600	Akmola	-2301	-1792
Aktobe	-759	-126	Aktobe	-776	-93	Kyzylorda	-725	-660	Kyzylorda	-821	-757
Almaty obl.	-711	50	Almaty obl.	-699	104	Kostanai	-670	-526	Kostanai	-748	-592
Pavlodar	-201	175	Pavlodar	-187	197	Aktobe	-270	-351	Aktobe	-304	-395
North-Kz	-481	175	North-Kz	-496	197	Atyrau	-134	-351	Atyrau	-154	-395
East-Kz	-1639	225	East-Kz	-1690	302	West-Kz	-393	-351	West-Kz	-440	-395
Atyrau	175	351	Atyrau	206	395	Karaganda	-349	-351	Karaganda	-394	-395
Mangystau	844	526	Mangystau	918	592	Pavlodar	-394	-175	Pavlodar	-440	-197
Karaganda	1050	1404	Karaganda	1179	1579	Mangystau	702	610	Mangystau	758	657
Astana	14523	5893	Astana	15555	6386						
Almaty	10878	16501	Almaty	11797	17879						

Chapter 8

Forecast results

This chapter is devoted to the presentation of the main results of the three different deterministic population forecasts for Kazakhstan up to 2030. These three types of forecasts include the general, state level forecast for Kazakhstan which we name in our illustrations as ‘Kz’, the second type of the forecasts is for urban/rural population to which we refer as ‘Kz(U,R)’ and the third one is named ‘Kz(16r)’ which means that the forecast is done by considering demographic specifics of the 16 administrative units of the country The population figures illustrated here are obtained by application of the assumptions developed in the previous chapter. In order to analyze the forecast results and to draw some conclusions, this chapter is divided into four sections. Section 8.1 deals with the size of population, section 8.2 focuses more on the population age structure, section 8.3 discusses urban/rural distribution of population and the final section 8.4 addresses the issues of accuracy.

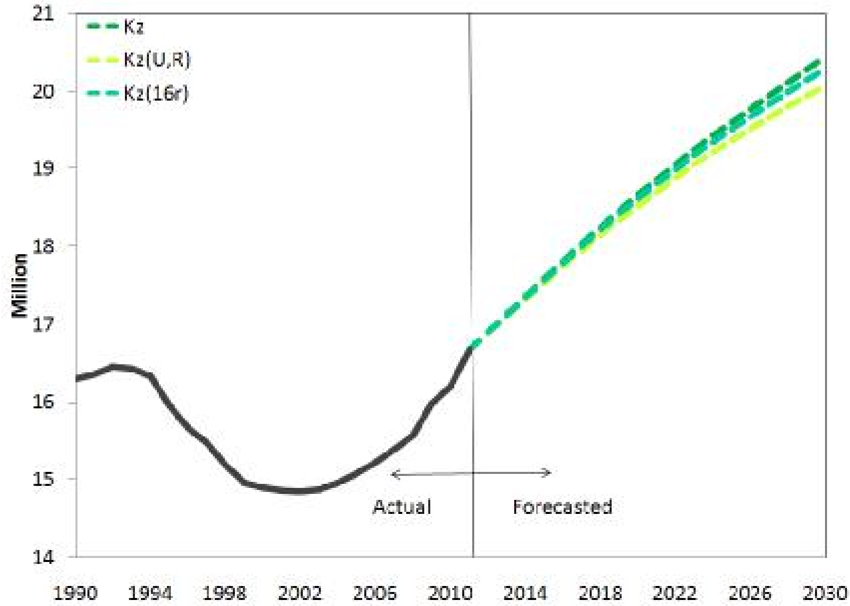
8.1 Population size

During the forecast period, the size of the Kazakhstani population will experience a considerable increase. Currently it is about 16 million and it is expected to increase to around 20 million by the most plausible scenario in 2030. It means that an increase for about 4 million (25%) might take place during a period of 19 years.

One of the primary aims of this study apart from forecasting the future population of the country was to try to find out the most important determinants of the population development process in Kazakhstan. It was assumed that since the country has rather diversified socio-economic and demographic situation in the region it might be possible to make more plausible forecasts of the population if these regional peculiarities would be taken into consideration. Also a supposition was made that the urban/rural demographic specifics might too make some difference in the forecast results.

Figure 73 shows the results of the three types of forecasts and for clarities sake only the medium variants are presented. In general, a medium variant in this study is treated as the most probable and plausible scenario. For comparison of all the forecast types and variants see Figure A2 (Annex). It seems that the more the disaggregation is the lower are the numbers.

Figure 73 – Actual and forecasted population of Kazakhstan: medium variants of three types of forecasts



Although the results of the three forecasts seem to differ but the differences are not as great as they could have been expected. Figure 74 shows that the biggest differences are between the state level Kz forecast and the urban/rural Kz(U,R) one and the longer the forecast period the higher the difference becomes. Dissimilarities between variants of Kz and Kz(U,R) stable and have an upward trend in contrast to Kz and Kz(16r), which is considerably less and even takes an opposite sign for a low variant. The biggest difference between populations is around 400 thousand people which could not possibly relate to the international migration rather to other components, most probably to fertility assumption differences and perhaps some calculation discrepancies.

Figure 74 – Differences between the state level Kazakhstan forecast and other forecast types

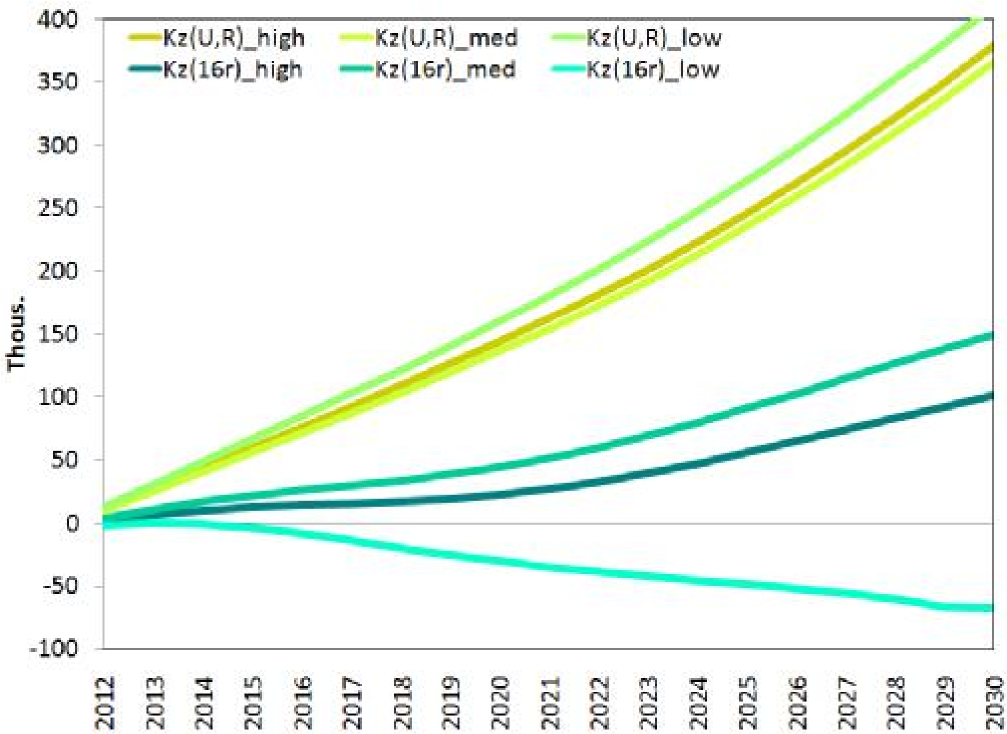


Table 15 shows growth rates for the three types of forecasts. The common for all forecast types trend is that the annual rates of population growth are expected to be continuously declining. The growth rates in the period 2012-2017 are about 1.34 for Kz, 1.25 for Kz(U,R) and 1.33 for Kz(16r) and they are projected to decline to about 0.50, 0.42 and to 0.47 for respective types of forecasts under the plausible (medium) scenario. It is worth to note that for the forecast type which considers urban/rural diversities the growth rate of the population is the lowest.

Table 15– Population growth rates, Kazakhstan 2012-2030 (different forecast types and variants)

Variants	Forecast period			
	2012-2017	2017-2022	2022-2027	2027-2030
Kz				
High	1.41	1.17	1.10	0.62
Medium	1.34	0.98	0.93	0.50
Low	1.28	0.81	0.77	0.38
Kz(U,R)				
High	1.32	1.05	0.99	0.55
Medium	1.25	0.86	0.82	0.42
Low	1.18	0.68	0.65	0.30
Kz(16r)				
High	1.41	1.14	1.07	0.60
Medium	1.33	0.94	0.89	0.47
Low	1.32	0.84	0.80	0.40

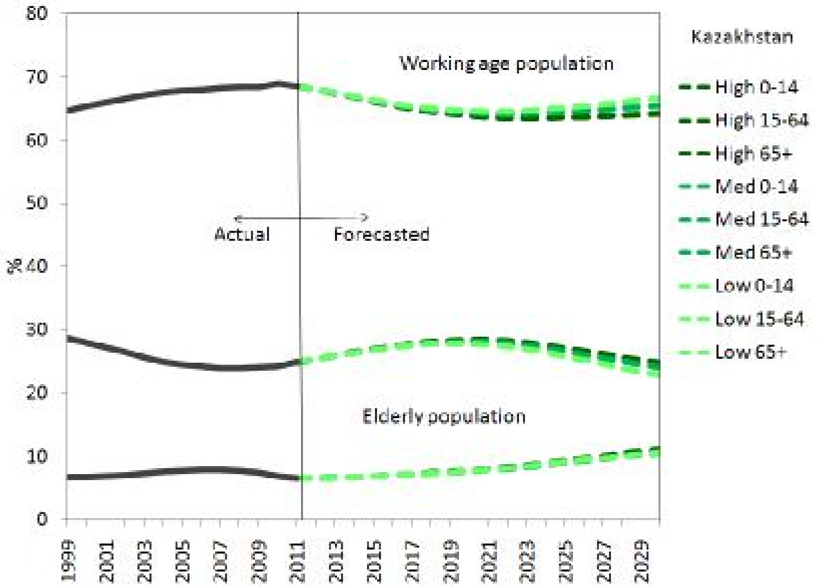
8.2 Age and sex structure

The trends in the proportion of major age groups are illustrated in Figure 75. Although the three types of forecasts differ in total numbers of population but it seems that they do not differ much in their proportions of age groups. Hence we present only one type of forecast (Kz) the illustrations of other two types of forecasts' major age groups can be find in Figure A4 (see Annex). The range of variants is also seems to be not wide, it is very small for elderly population but a bit more for children and working age population. The range widens with the increase of the forecast period.

Despite a slowdown in the first decade of the forecast period the percentage of elderly population will inevitable increase. The opposite is true for the share of children. Due to the momentum effect the percentage of children is assumed to increase and reach its peak at around the year 2020 then it will most probably start its downward trend. It could be assumed that in another 20-30 years the shares of elderly and children might equal and then the proportion of children would probably become less than of elderly people.

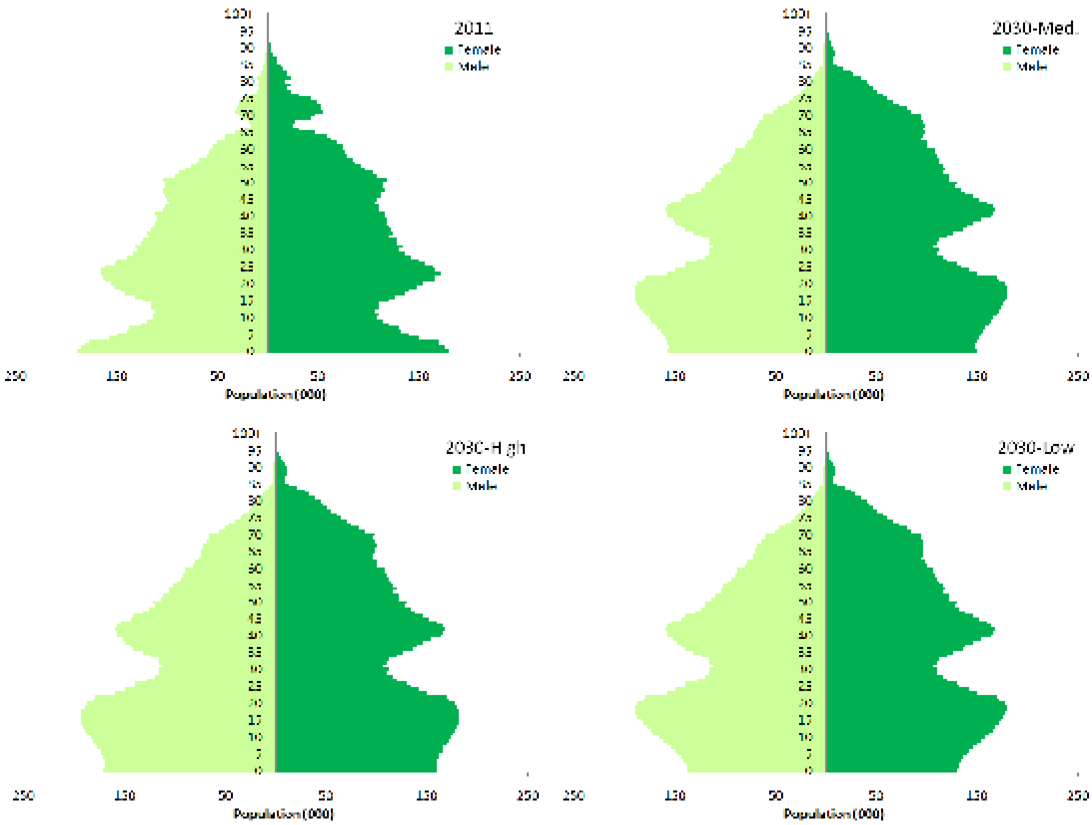
In contrast, the share of working age population is expected to fall in the first decade of the forecast period as the small generations of the transition period reach the working ages. However, when the generations of the recovery decade and of the current boom enter adulthood the proportion of working age population begins to increase.

Figure 75 – Trends in the proportion of major three age groups, 1999-2030 (Kz)



The effect of different assumptions on the age structure of the population is shown in Figure 76. Again, we only present the results of the one type state level forecast (Kz) since there are very little differences between age structures of forecasts (see Annex Figure A5). The main difference between the variants seems to be in number of children. In other words, different variants suggest different scenarios of fertility development and the present boom of births may become a very important event in the population development history of the country. It seems that the current fertility outburst can indeed be called the third baby-boom that is taking place in Kazakhstan during the last 60 years.

Figure 76 – Population pyramid: medium, high and low variants and 2011



The first one, an upper bulk is what will remain of it in the following twenty years. The second boom that happened in the second half of the 1980s will be located in the middle section of the pyramid. The period between the first and the second baby-booms was a relatively stable in many aspects of life for the country and the second boom came as a natural effect of the first one since high numbers of potential mothers. However, the scale of the third boom was a surprise, if not for the dramatic 1990's the third wave would have been rather small in scale. However, it seems that the country was not ready to such a fall of fertility levels which took place during the transition period and births that were "squeezed" i.e. postponed by the crises as a result "burst out" and was coupled by the natural effect of the third boom when girls of 1980's entered their reproductive period.

Despite such a positive state of demographic affairs at present, ageing of population will certainly be among serious concerns awaiting Kazakhstan in the future. The first signs of ageing could be noticed in median age of the population which is increasing for both sexes but faster for females and in dependency ratio (for the table with full sets of scenarios covering the entire forecast period see Table A2 Annex) .

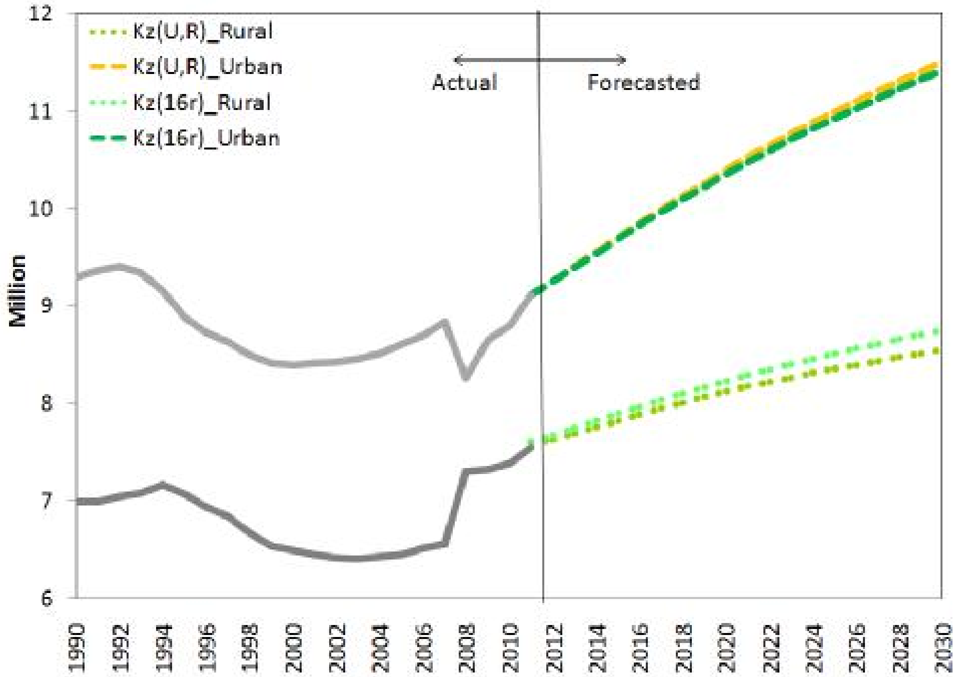
Table 16 – Median age and total dependency ratio by sex (Kz), median variant

	Median age (yr)			Total dependency ratio (%)		
	2011	2020	2030	2011	2020	2030
Male	27.3	28.6	30.0	45.6	55.0	50.1
Female	30.2	32.0	34.1	46.3	56.4	55.4

8.3 Urban/rural distribution

Even though the analysis of the urban/rural future population distribution was not among the principal goals of this dissertation, but since the two types of forecast Kz(U,R) and Kz(16r) enable it the chance was taken.

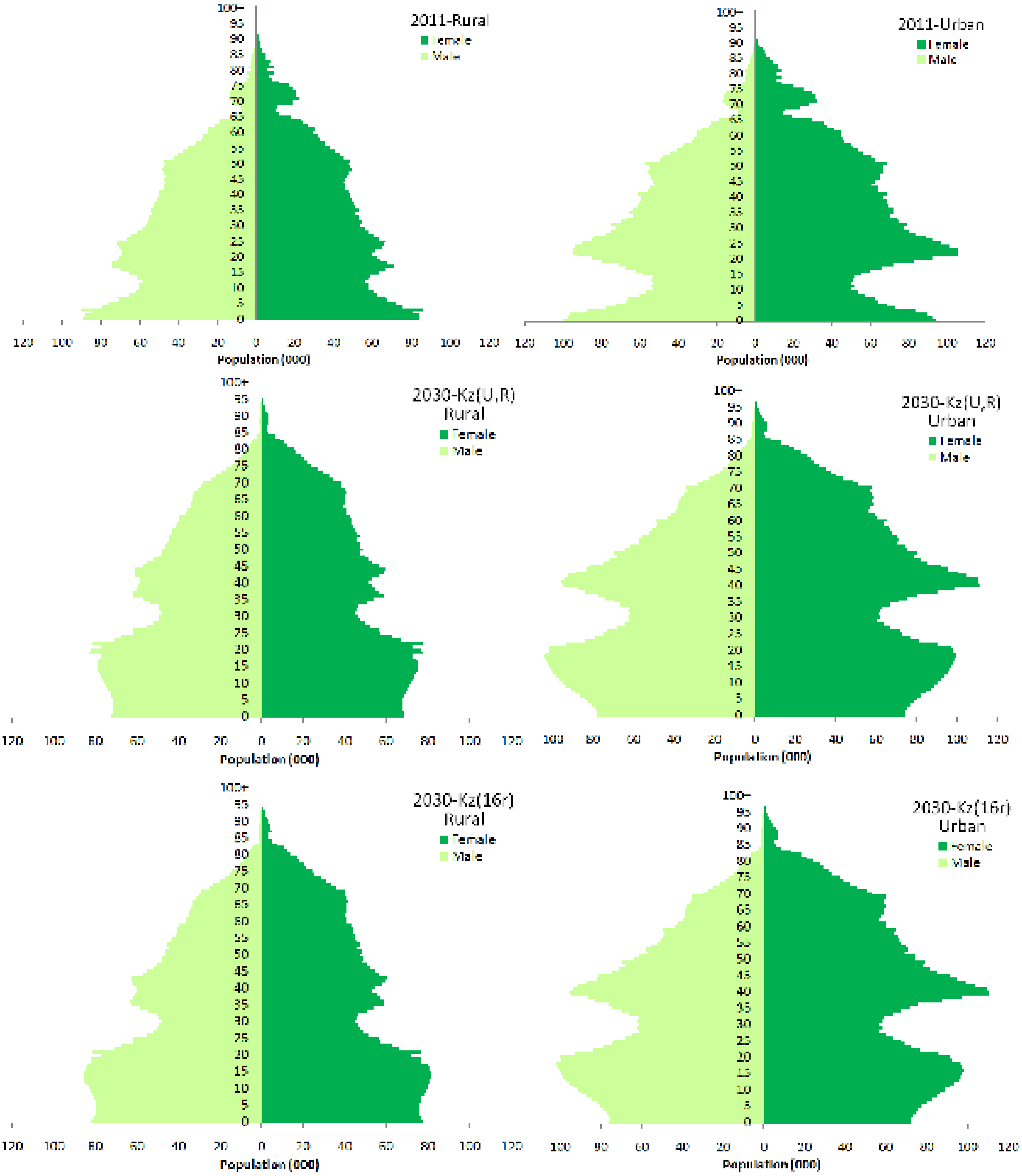
Figure 77 – Actual and forecasted urban/rural population: two types of forecasts (median variants)



Currently about 54% of population in the country live in urban places and from Figure 77 it seems that this share might increase in the future dropping the share of rural inhabitants down. As some explanation to that fact could serve rural to urban migration. It is expected that the interregional movements within the country might probably intensify in the future which means that mainly volume of rural to urban migration will increase since that is the dominant direction of interregional migration in Kazakhstan so far.

Differences between the Kz(U,R) and Kz(16r) forecast results are high in case of the urban population compared to rural but both results show that urban population will experience more rapid increase than rural (for comparison of three variants and two forecast types see Figure Aa Annex).

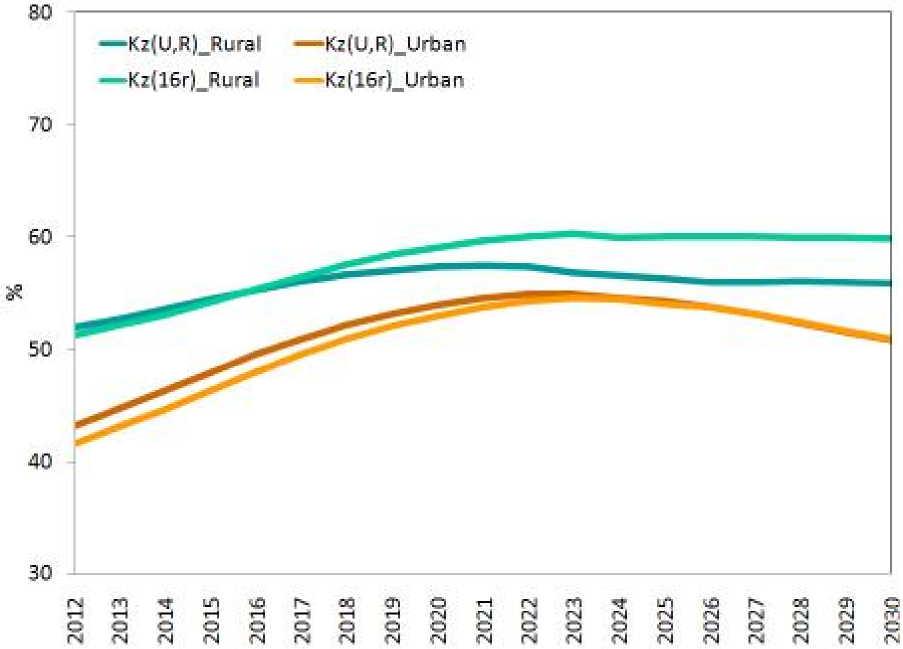
Figure 78 – Urban/rural population pyramid: two types of forecasts (median variants)



One explanation to it could be that urban population more deeply experiences fertility booms than rural because young and working age people moving to cities for reasons of education, employment and marriage often become settled in these cities by that contributing to the potential-parents section of city population. Pyramids in Figure 78 show that most fertility increases happening in the country concern more often urban population rather than rural. However, a bulk among the working age population of cities could not entirely be attributed to rural to urban migration.

Also the Figure 78 illustrates that Kz(U,R) and Kz(16r) forecasts differ in numbers of children especially for rural population. The children resulted from the fertility boom in rural areas are likely to contribute along with elderly people to an increase of economic burden on working age population according to the trends of total dependency ratio from Figure 79.

Figure 79 – Total dependency ratio: two types of forecasts (median variant)



8. 4 Accuracy issues

In many countries population forecasts are published by the national statistical institutes. Because of the uncertainty of forecasts, many statistical agencies call their forecasts projections (Keyfitz, 1982). As was already mentioned above the Statistical Agency of Kazakhstan does not produce any kinds of forecasts and despite the fact that the present study is one of the first and basic attempts to produce a forecast for Kazakhstan I prefer to call it forecast rather than projection because according to De Beer the main reason for labelling a population forecast a projection is uncertainty. Uncertainty implies that forecast errors may occur. Forecast errors should, however, not be mistaken for mistakes. If no relevant, available information is ignored and if state-of-the-art methodology is used in a proper way, the forecaster is not to be blamed for making forecast errors. Forecast errors are unavoidable. Therefore it does not make sense to demand that a forecast will come true. Zero errors are a matter of good luck rather than proof of the quality of the forecast. This does not imply that the size of forecast errors is irrelevant, however acknowledging that forecast errors are inevitable, uncertainty is no reason not to publish a forecast or to label a forecast ‘projection’ (De Beer, 2000). In spite of uncertainty - or rather because of uncertainty - forecasts are needed.

Actual population change will probably differ from forecasted change because it is unlikely that any statistical model can completely anticipate the future. There are several factors which usually influence the forecast results. Choosing a sophisticated and a vigorous technique can not guarantee accuracy. Forecast accuracy depends on the quality of the input data and the assumptions made about the course of future change. There is no single method or technique that can improve accuracy. More complex methods require more data and more detailed assumptions about the course of future change. With forecasts, more is not necessarily better; sometimes, it is just more.

However, there are some basic rules which are applied to all forecasts: (1) the shorter the forecast period, the more reliable the forecast is likely to prove; (2) the larger the geographic area being projected, the more reliable the forecast is likely to be; (3) the lower the current fertility rate and the higher the prevailing life expectancy, the greater will be the reduction in the forecast’s likely margin of error. This is based on the idea that future change in vital rates in such situations is likely to be much less than the situations with high fertility and high mortality.

Generally, forecast results might be assessed by three kinds of evaluation: external examination; internal examination; and ex post facto evaluation. External examination means comparison of the forecast results with the benchmark data and independent estimates in order to verify consistency of the forecast with the demographic situation of the country based on available information. Internal examination involves closer scrutiny of details of the forecast results and ex post facto examination consists of checking the performance of forecasts with observed actual trends in total population by components and by age (George, 2001).

The most widely used measures of accuracy for forecast evaluation are the mean percentage error (MPE), and the root mean square percentage error (RMSPE). Since inaccuracy is unavoidable in population forecasts one common way of handling this uncertainty is to publish more than one series of forecasts and projections. The concept of inaccuracy becomes less meaningful when several series of projections are offered.

All above stated is usually relates to the deterministic type of population forecasts and it is relevant to this study because the forecasts presented here are deterministic in nature. However, there is another way to communicate the uncertainty in population forecast results that is to derive probability distributions for the projected size and characteristics of a population by using a range of different fertility, mortality, and migration rates. Although, nowadays the probabilistic type of population forecasts becomes more advisable and widespread in practice in many population institutions of more developed countries, however since with this work we are making the first steps of professionally addressing the question of population forecasting in Kazakhstan it is better to get started from the simple ones.

Conclusion

The primary aim of the study was to produce three types of deterministic population forecasts for Kazakhstan up to the year 2030, and compare and analyse their differences and try to find out the main factors determining population development in the country. The 20 year time horizon of forecasts was chosen above a longer term because of the fact that currently the country is experiencing rather high rates of fertility and life expectancy is relatively low, which means that fertility level may drop at any time and there is a large room for some sudden mortality improvements. That puts any population forecasts carried out presently under rather high levels of uncertainty.

Before producing the forecasts, this research examined the past and recent demographic developments in Kazakhstan and addressed methodological issues related to population forecasting techniques. A widely used cohort-component method with its ability to preserve age and sex composition of the population was considered. In case of Kz(U,R) and Kz(16r) types of forecasts urban/rural and interregional migration was treated separately and was added in the end to already forecasted population as net numbers of migrants according to sex and age.

Data from the Kazakhstan’s Agency on Statistics was extensively utilized in this research. Using this data source, we could explore demographic scenarios in Kazakhstan from urban/rural and regional perspectives. The data had their limitations, however. They contain hardly any information on age-specific internal migration, on ethnicity as well as more detailed mortality and fertility data. Also, there is an issue of reliability. There were found several inconsistencies in population numbers and in mortality accounts.

As a theoretical background of the research four major theories (demographic transition theory and second demographic transition, the theory of epidemiologic transition and the mobility transition theory) related to population development are selected. They describe and justify general developmental changes of fertility, mortality and migration components relevant to current and future character of population reproduction in Kazakhstan.

The major contributions of this research were to study the *major characteristics determining population development and change in Kazakhstan.* It seems that the main determining characteristic of the population is age or rather generations. Currently there are coexisting two types of demographic behaviour in the country depending on the generation: the Soviet generation i.e. people born before independence and the generation of independence time, born respectively after gaining independence. These two large generations had different types of upbringing and different values and attitudes, which are even further altering for the younger generation. Since matrimonial and reproductive behaviour of people is closely connected to values and attitudes then it comes out to be a determining characteristic of the population. In case of urban/rural and regional specificities in population development process, generally they do play some role on a local level with much less impact on a state.

Also there was the question of ***regional and residential differentials making difference in forecast outcomes and possible persistence of those differences in the future.*** Indeed, the regional and residential specifics of the population do make difference in forecast outcomes, however not as great as it could be expected. Besides, it cannot be said with assurance that the differences between the forecast results were stemmed by their nature (one considering urban/rural demographic specifics and the other taking into account regional diversities). It is a known fact that when populations reach a certain stage of demographic transition they tend to strive to homogeneity. It might be assumed that Kazakhstan with its regions is not an exception to this rule. Although, some regions of the country seem to be close to more or less advanced stage of the demographic transition, but there are other regions which are quite far from it, hence the mentioned homogeneity seems to be part of the far future, certainly not of the following two decades, therefore it might be supposed that the regional dissimilarities are expected to exist and be apparent, but most on a regional level.

Besides, the research concentrated on finding out ***the most probable future population of Kazakhstan and its composition.*** According to the forecast results the country's population will most certainly increase in the coming two decades and the increase might be expected to be quite impressive (for 25%) and that is mostly will be owed to the current fertility boom. All three types of forecasts and all their scenarios seem to coincide on the point of population increase despite some dissimilarity in numbers. Thus, related to the increase of the population and following the fertility boom waves the age structure of the Kazakhstani population is assumed to fluctuate and through these fluctuations a gradual trend towards ageing could undoubtedly be noticed. Female population of the country is more likely to be the first to face the issues of ageing in contrast to male as well as urban compared to rural.

The present research has shown that the variations in three demographic variables - fertility, mortality and migration—together with residential and regional socioeconomic situations have contributed to the dynamics of Kazakhstani population at national and regional levels. However, results of population forecasts have illustrated that despite different assumptions concerning regional demographic parameters the expected total population numbers are not so very different. It may imply that future homogenisation of regions probably will even further diminish the existing presently differences on a national scale.

The possible explanation of little difference between total numbers of the general level forecasts and regional ones could be that we have applied a similar approach to all of them. The next step could involve application of some other approaches to forecasting population.

Likewise, the available data from multiple data sources could be interesting to use in the future analysis, particularly if more attention is paid to the data problems (i.e. censoring and irregular patterns). Furthermore, once we have the appropriate data, the application of multistate demographic analysis could be initiated at the state level at least. Also it would be instructive to extend the future research to other fields, i.e. labor market and employment, nuptiality, and education.

As a concluding remark to the dissertation I would say that Kazakhstan is a relatively newly independent state with the demographic history rich with events and the future full of promises. The existing lack of understanding and application of population forecasts and projections by the current policy-makers will inevitably change with the change of generations. For the time being, the first step in that direction is already done the followings will be much easier to carry on.

References

Anderson, B.A. and Silver, B.D. (1997). Issues of Data Quality in Assessing Mortality Trends and Levels in the New Independent States

Alders, M., and De Beer, J. (2005). An expert knowledge approach to stochastic mortality forecasting in the Netherlands. In N. Keilman (Ed.), Perspectives on Mortality Forecasting (Vol. II.Probabilistic Models, pp. 39-64). Swedish Social Insurance Agency, Stockholm.

Ascher, W. Forecasting: An appraisal for policymakers and planners. Baltimore: Johns Hopkins University Press, 1978.

Alho, J. M. (1991). Effect of aggregation on the estimation of trend mortality. Mathematical PopulationStudies, 2, 53-67.

Alho, J. M., Spencer, B. D. (1990). Error models for official mortality forecasts. Journal of the AmericanStatistical Association, 85(411), 609-616.

Alho, J., and B. Spencer (1985). Uncertain population forecasting. Journal of the American Statistical Association, 80 (390), 306–314.

Alvarez-Plata, P., Brücker, H., and Siliverstovs, B. (2003). Potential Migration from Central and Eastern Europe into the EU-15 – An Update. Report for the EC DG of Employment and Social Affairs. Deutsches Institut für Wirtschaftsforschung, Berlin

Aries, Ph., 1962 : Centuries of Childhood. A Social History of Family Life. New York: Random House.

Bell, W. (1988). Applying time series models in forecasting age-specific fertility rates. Statistical research division. Bureau of the Census. Washington, D.C. Census/SRO/RR 88/19

Becker M. Ch., Urzhumova D. S. (2004) Mortality recovery and stabilization in Kazakhstan, 1995–2001. Economics and Human Biology 3 (2005) 97–122 . Received 26 December 2004; accepted 27 December 2004 , http://www.elsevier.com/locate/ehb

Bijak, J. (2005). Bayesian Methods In International Migration Forecasting. Central European Forum for Migration Research in Warsaw . CEFMR Working Paper 6/2005 . Poland

Bijak, J., Abel. Raymer, (2006). Forecasting international migration: Selected theories, models, and methods

Bogue, D. (1980). Techniques for making population projections: age-sex projections, Chicago, University of Chicago, Community and family study centre, pp. 8-15.

Bojarskij, A. J. (1976) Metodologicheskie voprosy prognozirovaniya naseleniya. In:

Vosproizvodstvo naseleniya i trudovyh resursov. Moskva: Statistika.

Booth, H. (2006). Demographic forecasting: 1980-2005 in review. International Journal of Forecasting 22: 547–581.

Booth, H. and Tickle, L. (2008). Mortality modelling and forecasting: A review of methods ADSRI ,Working Paper No. 3 , downloadable from our website: http://adsri.anu.edu.au/

Bongaarts, J. (2001). Fertility and reproductive preferences in post-transitional societies. Pp. 260-282 in: R. A.

Burcin, B., Hulíková Tesárková, K., Kománek, D. (2012): DeRaS: software tool for modeling mortality intensities and life table construction. Charles University in Prague, Prague. http://deras.natur.cuni.cz

Caselli, G. (1996). Future longevity among the elderly. In G. Caselli & A. Lopez (Eds.), Health and Mortality Among Elderly Populations. Clarendon Press, Oxford.

Crimmins, E. M. (1981). The changing pattern of American mortality decline, 1947-1977, and its implication for the future. Population and Development Review, 7(2), 229-254.

Census of the Soviet Union, (1959), demoscope.ru

Cuhls, K. (2003) Development and Perspectives of Foresight in Germany Fraunhofer Institute for Systems and Innovation Research (ISI) Technikfolgenabschätzung Theorie und Praxis, *Nr. 2, 12. Jahrgang - Juni 2003, S. 20-28*

De Beer, J. (1997). The effect of uncertainty of migration on national population forecasts: the case of the Netherlands. Journal of Official Statistics, 13 (3), 227–243.

De Beer, J. (2000). Dealing with uncertainty in population forecasting. Journal of Official Statistics

Fachin, S., and Venanzoni, G. (2002). IDEM: an Integrated Demographic and Economic Model of Italy. Paper for the 14th International Conference on Input-Output Techniques, Montreal, Canada, 10–15 October.

Fassmann, H., and C. Hintermann (1997). Migrationspotential Ostmitteleuropa. ISR Forschungsberichte, 15. Wien: Institut für Stadt- und Regionalforschung.

Franzmeyer, F., and H. Brücker (1997). Europäische Union: Osterweiterung und Arbeitskräftemigration. DIW Wochenbericht 5/97. Berlin: Deutsches Institut für Wirtschaftsforschung, 89–96.

Girosi, F., & King, G. (2006). Demographic Forecasting. Cambridge University Press, Cambridge.

Gentile, M. (2005) Population Geography Perspectives on the Central Asian Republics. Arbetsrapport/Institutet för Framtidsstudier; 2005:16 ISSN 1652-120X, ISBN 91-89655-745

George M. V. (2001). Population Forecasting in Canada: Conceptual and Methodological Developments Canadian Studies in Population, Vol. 28(1), 2001, pp. 111-154

Gullickson, A. (2001). Multiregional Probabilistic Forecasting Department of Demography, University of California, Berkeley

Häder, Michael and Häder, Sabine (1995): Delphi und Kognitionspsychologie: Ein Zugang zur theoretischen Fundierung der Delphi-Methode, in: ZUMA-Nachrichten, vol. 37, 19.

November1995, p. 12.

Hirschman, C. 1994. Why Fertility Changes. Annual Review of Sociology 20:203-233.

Hoem, J.M., 1973. Levels of error In population forecasts, Statistlsk Sentralbyra, Art. 61, Oslo.

Hyndman, R. J. and H. Booth (2008), "Stochastic Population Forecasts Using Function Data Models for Mortality, Fertility, and Migration," International Journal of Forecasting 24, pp.323-342.

Isserman, Andrew. (1977). "The Accuracy of Population Projections for Sub-county Areas." *Journal of the American Institute of Planners* 43: 247-259.

Inglehart, R., Welzel, Ch., 2005: Modernization, Cultural Change and Democracy. The Human Development Sequence. Cambridge UK: Cambridge University Press.

Kalibova, K. (1990). Prognosis of the Gypsy population in Czechoslovakia up to the year 2005.Demografie, vol 32 no 3,pp 219–24.

Kazakhstan Agency on Statistics (2010). Yearbook stat.kz

Kazakhstan Agency on Statistics (2011). Yearbook stat.kz

Kaneko R. et al, (2008). Population Projections for Japan: 2006-2055 Outline of Results, Methods, and Assumptions. The Japanese Journal of Population, Vol.6, No.1 (March 2008)

Keilman, N. and van Hoorn, W. (1997). Births expectations and their use in fertility forecasting. Luxemburg: Office for Official publications of the European communities. (E4/1997-4)

Keilman, N. (1990). Uncertainty in national population forecasting: Issues, backgrounds, analyses, recommendations. Amsterdam: Swets and Zeitlinger.

Keilman, N. (Ed.). (2005). Perspectives on mortality forecasting (Vol. II. Probabilistic Models). Swedish Social Insurance Agency, Stockholm.

Keilman, N. and H. Cruijsen, eds. (1992) National Population Forecasting in Industrialized Countries. Amsterdam etc.: Swets & Zeitlinger.

Keilman, N. (2003), Perspectives on Mortality Forecasting I. Current Practice. Social Insurance Studies No.1, Swedish National Social Insurance Board

Keilman, N., D. Q. Pham, and A. Hetland (2002), "Why Population Forecasts Should be Probabilistic – Illustrated by the Case of Norway," Demographic Research 6, pp.409-454.

Keyfitz, N. 1972 "On Future Population," Journal of the American Statistical Association.

Keyfitz, N., 1982, Can knowledge improve forecasts? Population and Development Review 4, 729-751

Kiikbaev,N., Torzhestvo leninskoy nacionalnoy "Kazakhstan", 1968, pp. 138-139, 143. Politiki v Kazakhstane, Alma-Ata:

Kirk, D. (1996). Demographic Transition Theory.Population Studies, 50 (1996), 361-387 Printed in Great Britain

Kucera, T. (1998). Regionální populacní prognózy. Teorie apraxe prognózovaní lidských zdrojú v území. *Kandidátska dizertacná práca*. Prírodovedecká fakulta MU. Brno.

Kupiszewski, M.(2002). Modelowanie dynamiki przemian ludności w warunkach wzrostu Znaczenia migracji międzynarodowych. Warszawa: Instytut Geografii i Przestrzennego Zagospodarowania PAN.

Klosterman, Richard E. (1990). *Community and Analysis Planning Techniques*. Rowmand and Littlefield Publishers, Inc. Savage, Maryland. See Chapters 1-3.

Klosterman, Richard E., Richard K. Brail, and Earl G. Bossard. (1993). *Spreadsheet Models for Urban and Regional Analysis*.

Le Bras, H. (1997). Projections of the foreign population: a ten year perspective. Population, vol 52 no.1,pp 103–33.

Leach, D. (1981), Reevaluation of the logistic curve for human populations. Journal of the Royal Statistical Association 144(1), 94-103.

Lee R.D., Carter, L., and Tuljapurkar, S. (1995), Disaggregation in population forecasting: Do we need it? And how to do it simply. Mathematical Population Studies, 5(3): 217-234.

Lee, R. D., Miller, T. (2001). Evaluating the Performance of the Lee-Carter Method for Forecasting Mortality. Demography, 38(4), 537-549

Lee, R. D. (1993), "Modeling and Forecasting the Time Series of US Fertility: Age Distribution, Range, and Ultimate Level," International Journal of Forecasting 9, pp.187-202.

Lee, R. D. (1999), "Probabilistic Approaches to Population Forecasting," Population and Development Review, supp to Vol. 24, pp.156-190.

Lee, R.D. and Tuljapurkar, S. 1994. Stochastic population projections for the United States: Beyond high, medium and low. Journal of the American Statistical Association 89(428), 1175-1189.

Leslie, P. H. (1945). On the Use of Matrices in Certain Population Mathematics. Biometrika, 33 (3), 183– 212.

Lesthaeghe, R. and van de Kaa, D. J. (1986). Twee Demografische Transities? (Two Demographic transitions?). Pp. 9-24 in: D. J. van de Kaa and R. Lesthaeghe (eds.), Bevolking: Groei en Krimp (Population: Growth and Decline), Deventer, Van Loghum Slaterus.

Lesthaeghe, R. Surkyn, J. 1988: Cultural Dynamics and Economic Theories of Fertility Change. Population and Development Review, 14, 1: 1-45.

Lesthaeghe, R. Moors, G. 1995: Living arrangements, Socio-economic position and Values among Young Adults – A pattern Description for France, Germany, Belgium and the Netherlands. In D.Coleman (ed):Europe's Population in the 1990s. Oxford: Oxford University Press, chapter 6.

Lesthaeghe and L. Neidert (2006). "The Second Demographic Transition in the United States: Exception or Textbook Example?" Population and Development Review 32 (December): 669-698.

Long, J. F. (1995). Complexity, accuracy, and utility of official population projections. Mathematical Population Studies, 5(3), 203-216.

Lutz, W. (ed) 1996. The Future Population of The World: What Can We Assume Today? Earthscan Publication Ltd., London. 500 pp.

Lutz W, Goldstein JR, (2004) How to Deal with Uncertainty in Population Forecasting? International Statistical Review, 72(1&2):1-106,157-208 (April 2004)

McDevitt, T. (2008). Consistent projection of fertility for subnational areas using a logistic curve. Population studies branch, International programs center, Population Division, U.S. Census Bureau

Merkov, A.M. 1965 *Demograficheskaya Statistika.* Moscow: Meditsina. Meslé, F., V. Shkolnikov, and J. Vallin

Micheli, G. A. (1996). New Patterns of Family Formation in Italy. Which Tools for Which Interpretations?, Genus LII, 15-52.

Meslé, F., Shkolnikov, V., Vallin, J., 1992, Mortality by cause in the USSR in 1970 1987: the reconstruction of time series. *Revue européenne de démographie*, No.8, p.281-308.

Munz, R. and Ulrich, R. (1997). The future growth of the foreign population in Germany: demographic projections to 2030, Demographie Aktuell no 12,Humboldt-University:Berlin.

Murphy M. (1990). "Methods for Forecasting Mortality for Population Projections", in Population Projections: Trends, Methods and Uses. Occupational Paper 38. OPCS, London.

Murphy, M. J. (1995). The prospect of mortality: England and Wales and the United States of America, 1962-1989. British Actuarial Journal, 1(II), 331-350.

Nault et al., (1995). Population projections of registered Indians in Canada, 1991 2015.Cahiers Québécois de Démographie, vol 24 no 1,pp 109–27.

Notestein, F.W. (1945). Population: The long view, in T.W. Schultz, ed., Food for the World, University of Chicago Press, Chicago, IL, USA. Pp. 36-69.

O'Neill, Brian C. Balk, D., Brickman, M., Ezra, M. (2001). A Guide to Global Population Projections. Demographic research volume 4, article 8, pages 203-288,Published 13 JUNE 2001 www.demographic-research.org/Volumes/Vol4/8/

Okita, Y., Wade D. Pfau., Giang Thanh Long (2009) A Stochastic Forecast Model For Japan's Population. Discussion Paper: 09-06. GRIPS Policy Information Center

Omran, A. R., 1971. The epidemiologic transition: a theory of the epidemiology of Population change. Milbank Memorial Fund Quarterly, 49 (Part 1): 509-538.

Pflaumer, (1992). Forecasting U.S. population totals with the Box-Jenkins approach, in Ahlburg and Land (eds) Population Forecasting, Special Issue of the International Journal of Forecasting 8(3): 329-338.

Pittenger, Donald. (1976). *Projecting State and Local Populations*. Cambridge, MA: Ballinger.

Pollard J. (1987). "Projection of Age-Specific Mortality Rates", Population Bulletin of the United Nations 21/22, 55-69.

Popov, Andrej A. (1993). A short history of abortion and population in Russia. Planned Parenthood in Europe 22(2):23-25.

Rees P (1977) The Measurement of Migration from Census Data and Other Sources. Environment and Planning A, 9:247-272.

Rees, P. H., and A. G. Wilson (1973). Accounts and models for spatial demographic analysis 1: Aggregate population. Environment and Planning A, 5 (1), 61–90.

Rogers, A. (1966). A Markovian Policy Model of Interregional Migration. Papers of the Regional Science Association, 17, 205–224.

Rogers, A. (1975). Introduction to Multiregional Mathematical Demography. New York: John Wiley.

Rogers, A. (1976). Shrinking large-scale population projection models by aggregation and decomposition. Environment and Planning A 8: 515–541.

Rogers, A. (1990). Requiem for the net migrant. Geographical Analysis 22: 283–300.

Rogers, A. (1995). Multiregional Demography: Principles, Methods and Extensions. Chichester: John Wiley.

Rogers, A., R. Raquillet and L.J. Castro. (1978). Model migration schedules and their applications.Environment and Planning A 10: 475–502.

Salahudin, M. (2002). The population of Indonesia: regional demographic scenarios using a Multiregional method and multiple data sources ISBN 90-5170-596-4

Shaw, C. (1994). Accuracy and uncertainty of the national population projections for the United Kingdom. Population Trends, 77, 24-32.

Shryock, H.S. and J.S. Siegel, (1973). The Methods and Materials of Demography. U.S. Bureau of the Census, Washington.

Shryock, H.S.; Siegel, J.S. (1980).The methods and materials of demography. Washington DC: US Bureau of the Census, US Government Printing Office, 1980

Skeldon, R. 1992. On Mobility and Fertility Transitions in East and Southeast Asia. Asian Pacific Migration Journal 1:220-249.

Sinn, H.-W., G. Flaig, M. Werding, S. Munz, N. Duell, and H. Hofmann (2001). EU-Erweiterung und Arbeitskräftemigration. Wege zu einer schrittweisen Annäherung der Arbeitsmärkte. München: IFO-Institut für Wirtschaftsforschung.

Smith, S.K. and T. Sincich. 1992. "Stability Over Time in the Distribution of Population Forecast Errors." Demography 25:461-74.

Smith, S. K., Tayman, J., and Wanson, D. A. (2001). State and Local Population Projections: Methodology and Analysis. Kluwer Academic Plenum Publishers. (pp. 4, 9, 15)

Soboleva, S. V. (1988) Demograficheskie protsessy v regional’nom social’no ekonomicheskom razvitii. Novosibirsk: Nauka.

Stetsenko, S.G., and I.V. Kozachenko 1984 *Demograficheskaya Statistika.* Kiev: Visha Shkola.

Statistics Netherlands (1999). Forecasts of the foreign population 1998–2015. Maandstatistiek van de Bevolking, vol 47 no 4,pp 20–36.

Storkey, M., (2002). A review of literature on ethnic group projections. Chapter 1 in Population projections by ethnic group, a feasibility study. Edited by John Haskey and Simon Huxstep. A National Statistics Publication. Published with the permission of the Controller of Her Majesty’s Stationery Office (HMSO). ISBN 0 11 621556 9

Stoto, M.A. (1983). The accuracy of population projections. Journal of the American statistical association 78:13-20

Stoto, M. A., Durch, J. S. (1993). Forecasting survival, health, and disability: report on a workshop.Population Development and Review, 19(3), 557-581.

Tabeau E. (2001). “A Review of Demographic Forecasting Models for Mortality”, in Tabeau E., A. van den Berg Jets and C. Heathcote (eds.) Forecasting Mortality in Developed Countries: Insights from a Statistical,
Demographic and Epidemiological Perspective. Dordrecht: Kluwer Academic Publishers.

Tayman, J and Swanson, D. (1995). On the Utility of Population Forecasts (pp. 523-528), Demography, Vol. 33, No. 4, Nov., 1996

Toth, F. L., Cao, G., Hizsnyik, E. (2003). Regional population projections for China . Interim Report IR-03 042. International Institute for Applied Systems Analysis Schlossplatz 1 A-2361 Laxenburg, Austria

Tereschenko, T.A. (2002), Immigration to Kazakhstan based on the analysis of the 1999 census data (Immigratsiya v Kazakhstan po dannym perepisi 1999 goda). Available at http://demoscope.ru/center/fmcenter/tereschen.html

UN. (1966).Manual III Methods of calculating future population estimates by sex and age. Princeton University Press, copyright

Volkov, A. G., ed. (1988) Metodologiya demograficheskogo prognoza. Moskva: Nauka

Van Imhoff and Post, (1998), Microsimulation methods for population projection, Population: An English Selection 10(1), 97-138.

Van de Kaa, D. J. (1987). Europe’s Second Demographic Transition. Population Bulletin, 42 (1), Washington, The Population Reference Bureau.

Van de Kaa, D.J. (1999). Europe and its population: the long view. Pp. 1-194 in: D. J. van de Kaa. H. Leridon, G. Gesano and M. Okolski, European Populations: Unity in Diversity, Dordrecht etc., Kluwer Academic Publishers.

Van de Kaa, D. J. (2001). Demographic Transition, Second. International Encyclopedia of the Social & Behavioral Sciences, Vol. 5, pp. 3486-3488.

Wang, C. and Guo, F. (1997). Forecasting minority group populations in Gui Zhou Province. Chinese Journal of Population Science, vol 9 no 3,pp 203–14.

Waldron, H. (2005). Literature review of long-term mortality projections. Social Security Bulletin, 66(1), 16-30.

Westoff, Ch. E. (2000). The Substitution of Contraception For Abortion in Kazakhstan in the 1990s. DHS Analytical Studies No. 1

Whelpton, P.K. (1936). An empirical method of calculating future population. Journal of the American Statistical Association 31, 457-473.

White, K. M. (2002). Longevity advanced in high-income countries, 1955-96. Population and DevelopmentReview, 28(1), 59-76

Willekens, F.J. (1983) Spécification and Calibration of Spatial Interaction Models. A Contingency-Table Perspective and an Application to Intra-Urban Migration in Rotterdam. Tijdschrift voor Economische en Sociale Geografie, 74: 239-252.

Willekens, F.J. and P. Drewe. (1984). A multiregional model for regional demographic projection. Pp. 309 334 in H. ter Heide and F.J. Willekens (eds), Demographic Research and Spatial Policy: the Dutch Experience. London: Academic Press.

Willekens F. (1990). “Demographic Forecasting: State-of-the-Art and Research Needs”, in Hazeu C. and G.Frinking (eds.) Emerging Issues in Demographic Research. Amsterdam: Elsevier.

Willekens, F. (1995). Monitoring international migration flows in Europe. Towards a statistical data base combining data from different sources. European Journal of Population, 10 (1), 1–42.

Wilson, G.R.G. (1975). Fertility forecasting. The Institute of Actuaries Students' society.

Wilson, T., and Bell M. (2004). Australia's uncertain demographic future. Discussion Paper 2003/04.Brisbane: Queensland Centre for Population Research, the University of Queensland.

Wong-Fupuy, C., Haberman, Steven, (2004). Projecting Mortality Trends: Recent Developments In The United Kingdom And The United States, North American Actuarial Journal / Apr

World Health Organization, (1950) Official Records of the World Health Organization, No.28

Zelinsky, W (1971) The hypothesis of the mobility transition. The Geographical Review LX1, 219-249.