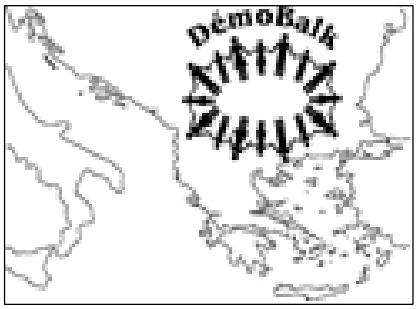

Association Démographie des Balkans
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LA POPULATION DES BALKANS À L'AUBE DU XXI^{ÈME} SIÈCLE

THE POPULATION OF THE BALKANS AT THE DAWN OF THE 21ST CENTURY

Cinquième Conférence Internationale de Démographie des Balkans

Fifth International Conference of Balkans demography

OHRID

(21-24 OCTOBRE 2015 / 21-24 OCTOBER 2015)

SEANCE: LA SANTE DES POPULATIONS BALKANIQUES

SESSION: POPULATION HEALTH IN THE BALKANS

Paper

MORTALITY TRENDS AND PROSPECTS OF THE LIFE EXPECTANCY AT BIRTH IN MACEDONIA: -THE SPECIFICS AND FUTURE ASSESSMENTS -

Goran Miladinov*

Abstract

In this paper we describe the prospects of life expectancy at birth in Macedonia in the course of time and in comparison with some other European countries. Also the country specifics of mortality trends and its differences by sex, age and region were explained. We applied a reduced-form model with OLS estimator to investigate the relationship between the crude mortality rates and life expectancy at birth. Using Box and Jenkins procedures and least squared method a univariate ARIMA (1,1,1) model was estimated to be made a future assessments for the Infant mortality rate in Macedonia up to 2020.Vital statistical data from the State Statistical office of the Republic of Macedonia for the crude mortality rates, life expectancy at birth and the infant mortality rate were used for the period 1991-2013. The data shows us that life expectancy at birth in Macedonia rose substantially in the second half of the twentieth century, as it did throughout the whole region of Europe. Over a period of 40 years, a significant progress of life expectancy at birth i.e more than 15 years gain was observed in Macedonia. Mortality in Macedonia has recorded a phenomenal decline during post half of the last century. The Crude Mortality Rate (CMR) of 16.4 per 1000 population observed in 1951 dropped to 7.3 by the close of the last century and is expected to maintain about the similar level in the next decades. The estimation result of the reduced-form model shows that the variable LEAB influences the dependant variable CMR over time and *LR*-test results showed that the lag variable of crude mortality rate is a redundant variable and could be excluded from the model. With this form of the lag structure the model results showed that the influence of a change in the lagged explanatory variable on CMR_t declines over time. ARIMA (1,1,1) yields decreasing trend of infant mortality rate for the next years up to 2020. After some periods the computation of the forecasts become recursive. Then the ARIMA forecasts from this model converged to a constant value where the forecast show the decreasing of 3.78% per year in the log of IMR_t .

Key words: life expectancy at birth, crude mortality rate, infant mortality rate, reduced-form model, ARIMA (1,1,1) model

1. Trends and prospects of the life expectancy at birth in Macedonia

The twentieth century witnessed the most rapid decline in mortality in human history. In 1950-1955, life expectancy[1] at the world level was 47 years and it had reached 68 years by 2005-2010. Over the next 45 years, life expectancy at the global level is expected to rise further to reach 76 years in 2045-2050[2]. The more developed regions already had high expectations of life in 1950-1955 (66 years) and have since experienced further gains in longevity. By 2005-2010 their life expectancy stood at 77.1 years, 11 years higher than in the less developed regions where the expectation of life at birth was 65.6 years. Although the gap between the two groups is expected to narrow between 2005 and mid-century, in 2045-2050 than the less developed regions (82.8 years versus 74.3 years)[3]. Life expectancy has increased over the last 50 years by about 10 years in total, due to improved socio-economic and environmental conditions and better medical treatment and care. Throughout the EU-27, women live longer than men. Female life expectancy at birth was already above 80 years of age in at least half of the EU-27 countries in 2006.The average gap across EU-27 member states between women and men was 6.3 years[4]. Progress in medical research and care has also led to considerable improvements in the infant mortality rate at the EU level. The differences between Member States have diminished considerably. In the European Union, population aging has translated into improvements in healthy life expectancies. But there are great country and gender variations. Women's life expectancies are higher, but their life expectancies under poor health and/or with functional problems are also proportionally higher than those for men[5].

*Ss. Cyril and Methodius University, Faculty of Economics, Skopje, Ph.D student (miladinovg@netscape.net)

[1] Life expectancy in this paper refer to the mean number of years that a new born child can expect to live if subjected throughout his/her life to the current mortality conditions,Source:Eurostat,2009.

[2] UN(2009),World Population Prospects, The 2008 Revision, Department of Economic and Social Affairs, Population Division, New York,2009

[3] Ibid, UN report 2009

[4] Eurostat (2008), Key figures on Europe 2008 edition, page 54-55

[5] Roberto ham-Chande,Alberto Palloni,Rebeca Wong (2009),IUSSP Policy and Research papers No 22,Aging in developing countries:Building bridges for integrated research Agendas,IUSSP 2009,p. 9

Life expectancy in Macedonia rose substantially in the second half of the twentieth century, as it did throughout the whole region of Europe. Between 1950-1955 and 1995-2000, life expectancy at birth for men increased by 15.6 years raising from 55.0 to 70.6 years, for women, the increase was 19.8 years rising from 55.0 to 74.8 years[6]. Over a period of 40 years, a significant progress of life expectancy at birth in Macedonia was identified. It is likely to reach nearly 81.12 years for men and 85.31 years for women by 2045-2050[7]. Life expectancy at birth[8] is one more indicator about quality of living of the population. The values of this indicator for Macedonia shows some mild increasing from 73,12 (70,77 for males and 75,56 for females) in the period from 2000 to 2002 on 73, 62 (71,44 for males and 75,88 for females) for the period from 2003 to 2005, but they are still on the lower level when compared it with "old" 15 member EU states.[9] Since this, there is a need for creating conditions for an increasing of the life expectancy at birth, which should be achieved through health reforms, but also with improving of life conditions. According 2002 data, the projections were that the life expectancy at birth will be increasing continuously until up to 2050. The major characteristics of mortality in Macedonia after the year 1991 have been standstill in the lengthening of life span. From the years 1994 and 2009 life expectancy at birth was improving from year to year, on average 0,15 years for men and 0,16 years for women annually. The difference in the prolongation of life span between men and women is still large, namely 4,1 years in 2012 women lives longer than men. The reasons for such a high male mortality have not been completely explained yet. Many attribute them to unhealthy way of life, above all to excessive consumption of alcohol and smoking. Values of life expectancies at birth are based on mortality experience at all ages or age groups. In the years after 1991 life expectancy at birth increased because of improved survival rates in almost all age groups and for both sexes. This means that the life expectancy at birth is being prolonged due to decreasing mortality rates of children and old persons. In 2012 men's life expectancy at birth was 73.0 years and women's 77.1 years. If we make comparisons with EU countries and candidate countries, the duration of our men's life is the largest from men's life in Serbia, Romania, Latvia, Slovakia, Lithuania, Estonia, Bulgaria, Poland and Hungary and if we make comparisons with women's life, it is the largest from women's life in Serbia, Romania, Hungary and Bulgaria. Our women's life on average is almost 7 years shorter from women's life in the countries as Switzerland, Sweden, Spain, Austria, Iceland and Finland and respectively it is the same for men's life[10].

2. Mortality differences and specifics and life expectancy trends in Macedonia

With the dawn of the twenty-first century, the decline in mortality in some developed countries has given fresh impetus to achieving new maxima in life expectancy, particularly for women. Estimating these potentials requires as assessment of the most likely determinants of future mortality, that is, the most important risk factors, as well as the factors that might cause further reductions in mortality. Mortality in Macedonia has recorded a phenomenal decline during post half of the last century. The Crude Death Rate (CDR) of 16.4[11] per 1000 population observed in 1951 dropped to 7.3 by the close of the last century and is expected to maintain about the similar level in the next decades. According to the known data, the crude mortality rate in Macedonia began to decrease already in the middle of the second half of the 20th century but the fastest decrease was observed in the late 20th century.

From 1991 until 2013 the crude mortality rate increased from 7.3‰ to 9.3 ‰. Also, the rise in the crude death rates in 2013 as compared to their respective values in 1991 does not necessarily mean increase in the level of mortality. In fact, it would be due to ageing of the Macedonian population resulting from fall in the levels of fertility and mortality. The major obstacle preventing further decrease in the crude mortality rate is constant aging of population. Therefore, the analyses of life expectancies are necessary to get insight in changes of mortality levels. The life expectancy at birth was continuously growing in the period of demographic transition in Macedonia. The post transitional progress of life expectancy has been slower than in the transition period. In the period from 1995-2012, life expectancy at birth had been prolonged for about 2.5 years for both men and women. Life was most rapidly prolonged for 11 years during the period from 1960-1990 years, when mortality was still quite constant and then became ever more slower. In the period 1973-1991 we can notice even stagnation. The decline of mortality and the changes in causes of death was accompanied by increasing gender gap. It was the slow decrease of male mortality that caused increasing difference between male and female life expectancy at birth. Male mortality is higher in comparison to female mortality. In Macedonia, there is

[6] United Nations (2000),World Population Prospects, The 2000 revision

[7] Source: IIASA World projections, 2014

[8] Life expectancy at birth is the average number of years a person would live if age-specific mortality rates observed for a certain calendar year or period were to continue, Source: Eurostat-Demographic Statistics and Structural Indicators in Health,2008

[9] Government of the Republic of Macedonia (2008), Demographic development strategy of Republic of Macedonia 2008-2015, February 2008, p.12

[10] http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tps00025

[11] Risteski, Slave (1996), The demographic transition in Macedonia, Faculty of Economics-Skopje, p.58

no any linear trend of the average age of the death persons in the period when the rates started to increase, but however there may be noticed an increasing of the age from 65.8 years in 1994 to 69.7 years in 2004, with a tendency of increasing of the differences between the male and the female[12]. In the next period is expected the mortality rate to be equal with the natality rate and even to exceed the natality rate and that would mean zero i.e a negative natural increase, in other words, in the next period for the 5 to 10 years is expected our country to be under depopulation process[13]. The level of mortality of the population is under the strong influence of its age and fertility. The lowest mortality was observed in those under 55 years of age and the mortality is particularly declined intensively at infants and young children in the age group of 0-4 years, for the latest period. Based on the pursued changes in infant mortality, as well as on the basis of knowledge about the extent and pace of change in mortality of the population, we should expect: further decline in the infant mortality and decline of the mortality of older people, i.e. those after 55. This kind of the mortality trend is due to a more and more participation of the old population in the total population, under a condition that the most number of death persons to be at an older age and because of the improving of standard of living and the circumstances of the health sector.

Like fertility, there has been a wide variation in the pattern of mortality decline in some of the regions in Macedonia. In the Pelagonia,Vardar and the East Region, as a result of the unfavorable age structure and the low fertility, the number of deaths exceeds the number of births[14]. Mortality is lower in the Polog region, Skopje region and Southwest region than in the other regions of the country. In terms of life expectancy at birth e_0^0 the most of the regions have shown the same picture as its level of mortality observed in the last period . The regions which us shows the highest death rate, as Pelagonia region for example, has also the higher average age (70,9 years), in comparison to the regions which shows lower mortality rates as Polog region which has 68,9 year with more explicit differences between the genders (71,7 for females and 66,5 for males).

3. Modeling mortality and life expectancy in Republic of Macedonia

We specified a reduced-form model with exogenous and lagged dependent explanatory variables where time series data are modeled. We wanted to observe the changes in the properties of the OLS estimator by the inclusion of a lagged endogenous explanatory variable allowing for dynamic behavior in the model.

The hypothesis that will be investigated is a simple relationship where life expectancy at birth influences the crude mortality rate on a national level. A lagged dependent variable of crude mortality rate also was included in the equation. The relationship is analyzed for the variables transformed into their logarithms and then into their first differentiation. The Correlogram test was applied to detect the stationarity of the variables. The sample concerns annual data from 1991 to 2013.The regression equation was specified as follows:

$$d(CMR_t) = \beta_1 + \beta_2 d(LEAB_t) + \beta_3\, d(CMR_{t-1}) + u_t \qquad (1)$$

This equation is not a classical regression model but a reduced–form model because of the lag of the crude mortality rate. When hypothesis were tested, EViews computes the value of the test statistics and its probability or "*p*" value. We have lost one observation by making the model dynamic with the specification of lags. From the EViews estimation results we can see that only LEAB have a significant influence (p =0,0112). The only conclusion is that because of no residual serial correlation estimation results indicate that the regression specification is a good method for determining the relationship between CMR_t and $LEAB_t$[15]. The coefficient of determination R^2 is close to 1 i.e 0.87 and it is an indication that $LEAB_t$ gives a good description of the CMR_t.

The estimation results show that $LEAB_t$ has influence on the crude mortality rates and the inclusion of $LEAB_t$ is sufficient to show the influence of the $LEAB_t$ on CMR_t .That would mean that the variable $LEAB_t$ influences the dependant variable CMR_t over time. After the model have been estimated the Likelihood ratio test (*LR*-test) was used to test the hypothesis that the variable CMR_{t-1} can be excluded from the model. The *LR*-statistics has a χ^2 distribution (1) and for the CMR_{t-1}variable *LR*-test showed *p*-value of 0.0663 and accordingly it means that CMR_{t-1} is a redundant variable and could be excluded from the model. With this form of the lag structure the influence of a change in the lagged explanatory variable on CMR_t declines over time and this can be a realistic assumption. This assumption implies that the influence of the lagged explanatory variable did fade away over time. The model results suggest that the mortality trend of the population is under the strong influence of its age and that this trend is due to a more and more

[12] Ibid,Government of the Republic of Macedonia (2008),Demographic development strategy of Republic of Macedonia 2008-2015,February 2008, p.11

[13] Risteski Slave (2009), The intensive process of the demographic transition and the implications over demographic development of Republic of Macedonia,UDK:314(497.7)"1948/2002", p. 203

[14] State Statistical office (2012), The regions of the Republic of Macedonia, Skopje 2012, p.14

[15] The *p*-value of the Ljung-Box statistics for time lags up to 12 is 0.916 and it is > 0.05

participation of the old population in the total population because of the improved quality of living of the population and the improved circumstances of our health sector over the years. From these findings we can say also that the population aging in Macedonia recently has translated into improvements in healthy life expectancies. And this means that the life expectancy at birth is being prolonged due to decreasing mortality rates of children and old persons but also in the decreasing mortality trends in the other age groups.

4. Infant mortality rate, children under five mortality and maternal mortality trends in Macedonia

An overview of current global prevailing causes of child mortality[16] is of great interest, as child deaths depend on socioeconomic differentiations and environmental factors, making them frequently avoidable. Mortality differentiations between the developed and developing regions of the world are more pronounced in childhood (ages one to under five years) than at any other age. While some developing countries have substantially reduced the level of mortality in childhood, in others it remains very high. In contrast, in the most developed countries (within the MDC space), child death rates are now so low, that they no longer serve as useful measures of public health.

Table1*: Infant Mortality rates in selected European countries in 2013:*

Country	**Infant Mortality rate**
Austria	3.1
Serbia	6.3
Slovenia	2.9
Greece	3.7
Croatia	4.1
Macedonia	**10.2**
Romania	9.2
Bulgaria	7.3
Albania	7.9
Turkey	10.8

Source: *Eurostat*[17]

On the whole, children as well as infant deaths can be attributed to respiratory, circulatory as well as other reasons[18]. Moreover, there are environmentally related illnesses of childhood that are increased nowadays and can lead to death. Broadly speaking, the EU has witnessed a very significant reduction in mortality during the last century or so-both in terms of reduced infant mortality and as a result of declines in infectious and degenerative disease. The progress made in medical health care service is reflected in a decreasing infant mortality rate. Indeed, as a result of declining infant mortality rates, most of the member states are now among a group of countries with the lowest infant mortality rates in the world, for example, 1.8 deaths per 1000 live births in Luxembourg or less than 3 deaths per 1000 live births in Slovenia, Finland or Sweden[19]. By far the most important causes of death among men and women in the EU-27 in 2006 were cancer (malignant neoplasm) and ischemic heart diseases.

Enormous progress has been made in reducing infant and child mortality. Wide disparities remain, however, between regions and different social groups within the country. The level of infant mortality rate was reduced for two and a half times in Macedonia from the period 1995-2012, and for almost four times for the period 1990-2012. In the year 1990 each thirty live-born child died in the first year of life, in 1995 each forty-fourth and nowadays each hundred and eleven born child died in the first year of live. This means that during at the period of 1990-2012 not only infant mortality was highly reduced but also mortality of those under 5 decreased significantly. Such values of infant mortality still rank us, in the European scale, approximately somewhere on the top. Infant mortality-the mortality of children under the age of one year- decreased substantially in Macedonia during the end of the twentieth century. Child mortality has been improving equally for boys and girls. The dynamics of mortality decline was changing over the period observed. Infant Mortality Rate[20] (a health outcome) has been selected as one of the priority problems in the Republic of Macedonia. The infant mortality rate[21] was very high (over 100‰) in the 1960s, the "rapid" decline in the next two decades, reaching the value of 31.6%o in 1990. Macedonia has experienced a sharp fall in infant mortality rates, from 22.7 per 1000 live

[16] Child mortality rate is the probability of dying between the exact ages of one and five, if subject to current age- specific mortality rates. The probability is expressed as a rate per 1 000

[17] http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tps00027&plugin=1

[18] Goutas et al."Trends in Infant and Child Mortality",The Open Forensic Science Journal,2011,Volume 4,p.1-2

[19] Eurostat (2009),Yearbook 2009,"Europe in figures", p.223

[20] Infant mortality rate is defined as the number of infants who die within the first year of life divided by the number of live births(per 1000 live births).Source:Eurostat,2008

[21] Infant mortality rate, a key indicator of a population's social, economic, health care, and cultural levels

births in 1995 to 11.9 per 1000 live births in 2001. The number of deaths under the age of one year is directly dependent on the complex socioeconomic factors[22]. The pace of these declines results in a rapid transformation of the age patterns of mortality in the first years of life. Therefore the height of the mortality of this population group is used as an important indicator for assessing the health of a particular territory. In assessing the demographic trends in some country, the rate of infant mortality and the overall mortality have special significance, because the issues relevant in the first year must be seen in context with other demographic indicators of the environment. The rate of infant mortality in many areas of the world is taken as a relevant indicator of the overall development of a country or a region i.e its social and economic development[23]. World Health Organization (WHO) takes this rate as a relevant indicator of the health of the entire population of a country and as an indicator for the development of the health care in a country. The level of infant mortality rate placed Republic of Macedonia among those European countries that make significant progress towards achievement of WHO target for healthy live start, but is still much higher than the most developed countries especially there are significant differences in different geographical region and for different social and ethnic groups in Macedonia. The highest infant mortality rate was reported among infants born by mothers with uncompleted primary education (39.3 per 1000 live birth) comparing with the infants born by highly educated mothers (3.2 per 1000 live birth)[24]. (The correlation ratio between infant mortality rate and educational level of mothers was very high (R =-0.97). There is strong evidence that spending on the education of women and the quality of health care is cost-effective in reducing the Infant Mortality Rate. The leading causes of death among infants in 2007 were perinatal complications, accounting for 61.5% of the deaths, followed by congenital malformations (accounting for 20.9%), and symptoms, signs or other abnormal clinical findings (10.3%). According to the data from State Statistical Office a positive trend has been observed in the group of infectious diseases, whose share in the causes of death among infants dropped from 16.4% in 1990 to 5.9% in 2003 and to 3.4% in 2007[25] .

Macedonia's under five mortality rate was 11 deaths per 1,000 in 2008, higher than Northern Tier CEE (6 deaths per 1,000) and lower than Southern Tier CEE (15 deaths per 1,000)[26]. The under-five mortality rate has dropped from 33.3 in 1990 to 12.6 in 2003, that is, 11.1 per 1,000 live births in 2007[27].The implementation of the so called horizontal programs has largely contributed to these results. In 2006 with total death children of 291 from 0 to 4 years, under five mortality rate was 12.9 of 1000 live born in Republic of Macedonia[28]. Macedonia's infant mortality rate was 9.7 deaths per 1,000 live births in 2008; it has been declining steadily since 2004 (13.2 deaths per 1,000 live births). Mortality rate under five means what is probability for a child to live since he/she is born until the end of his/her fifth year of life. This indicator is very important for the children's development and its well–being condition. UN projections are that the values of this mortality rate will have decreasing continually.

[22] Cyril Janev,Olga Ivanova, Krste Gruevski (1985): Mortality of the population and population losses in SR of Macedonia, proceedings from the scientific meeting:"Problems of demographic development of SR of Macedonia", scientific meeting in Leunovo,3 and 4 november 1983,Macedonian academy of arts and sciences, Skopje,1985, p. 153

[23] Starova Vulnet (1985):"Primary factors that determine high mortality of infants in SR of Macedonia", proceedings from the scientific meeting:"Problems of demographic development of SR of Macedonia",scientific meeting in Leunovo,3 and 4 november 1983,Macedonian academy of arts and sciences,Skopje,1985, p.159

[24] State Statistical office, UNICEF Project TRANSMONÉE "Analytical Report on the situation of children and young people" (At regional level), Skopje 2004, p.12

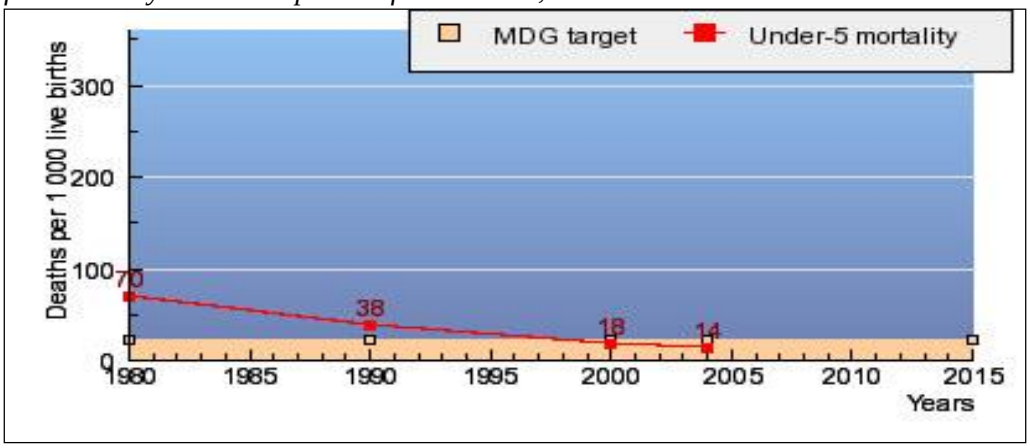
[25] UNDP,Government of the Republic of Macedonia(2009):Report on the progress toward the millennium development goals, Skopje June 2009, p.47

[26] USAID (2011),Macedonia Gap Analysis Europe and Eurasia Bureau,USAID Strategic Planning and Analysis Division March 22, 2011, p.7

[27] Ibid,UNDP,Government of the Republic of Macedonia:Report on the progress toward the millennium development goals, Skopje June 2009, p.45

[28] Ibid,Government of the Republic of Macedonia(2008),Demographic development strategy of Republic of Macedonia 2008-2015, February 2008, p.12

Graph 1: *under five mortality rates in Republic of Macedonia, 1980-2015*



Source: i*) WHO mortality data base ii) World Health statistics 2006*

However, despite the achievements and the downward trends, these indicators remain far below the EU average of 4.66 per 1,000 live births in 2005 and are higher than the rates in the wider European Region (8.25). Still, should this trend continue, the set target under this MDG will have been fully met by 2015. The mortality rate of children under five is usually higher among male children. The most common diseases among children under-five are respiratory infections, anemia and acute diarrheal diseases, the prevalence of anemia being higher among children in rural areas. The malign diseases and injuries contribute to more than a third of deaths in children aged 1-4 years[29]. The infant and under-five mortality rates differ in various geographic areas, regions and municipalities and there are differences between urban and rural areas, as well as among the various socio-economic groups. The infant mortality rate in 2007 is lowest in the Vardar region (5.6‰) and highest in the Pelagonija and Polog region (13.0‰)[30]. The assessment of progress towards MDG 4 shows that in Macedonia the target for the under-five mortality rate has already been achieved with 11.5‰, which is lower than the projected rate of 13‰.[31] The success may be attributed to the well-organized healthcare, as well as to the adequate healthcare policy, the strategic documents adopted and the implementation of vertical programs and projects. Child healthcare is provided through a system of healthcare institutions almost equally distributed over the entire territory, particularly in primary healthcare. Over 95% of the preventive examinations of infants are conducted in the public primary healthcare institutions, while the rest are conducted in private healthcare institutions, whereby the coverage of newborn children is over 98%.

Measuring maternal mortality is a complex process and still involves a high risk of under-registration on global, regional and national levels. Therefore, research and standardized methods have been developed to accurately assess the maternal mortality rate, rather than rely solely on the registration of maternal deaths from causes related to pregnancy and childbirth. According to the assessment of WHO, only 11-17% of the deaths of women attributed to maternal reasons occur at childbirth, whereas 50-70% of the deaths result from complications in the postpartum period. Maternal mortality is directly correlated with the health condition and the quality of healthcare of women in the reproductive period. Additional factors could include the sexual and reproductive health conditions, the development of the healthcare systems, as well as the accessibility of healthcare services during pregnancy and childbirth. The maternal mortality ratio in Macedonia fell by 40% in the decade between 1993 and 2003. The maternal death rate in Macedonia has been decreasing, from 11.5 per 100 000 live births in 1991 to 3.7 in 2003, and 4.4 in 2006, whereas in 2007 there were no cases reported[32]. The maternal death rate in Macedonia in 2001 was higher than the EU average (which is 5.4) but similar to that in the other SEE countries (11-15 cases per 100,000 live births). In 2006, the maternal death rate in Macedonia was similar to that in the EU. The downward trend of the maternal mortality rate between 1990 and 2007 is positively correlated with the upward trend of the ratio of births attended by skilled personnel (doctors, nurses or midwives). However, the annual fluctuations and the relatively small number of maternal deaths may result from incomprehensive and inappropriate reporting:citing other causes of death unrelated to childbirth; incomprehensive monitoring and reporting of maternal deaths occurring between seven and forty-two days after discharge from hospital,

[29] State Statistical office,UNICEF Project TRANSMONÉE "Analytical Report on the situation of children and young people" (At regional level), Skopje 2004, p.14

[30] Ibid,UNDP,Government of the Republic of Macedonia:Report on the progress toward the millennium development goals, Skopje June 2009, p.46

[31] Ibid, p.48, UNDP,MDG

[32] Ibid, p.53,UNDP,MDG

uninsured women who are unable to use the healthcare services and capacities, as well as from the outdated data on women delivering outside the health institutions or without professional assistance by skilled healthcare personnel[33].

5. Forecasting the Infant mortality rates in Republic of Macedonia (2014-2020)

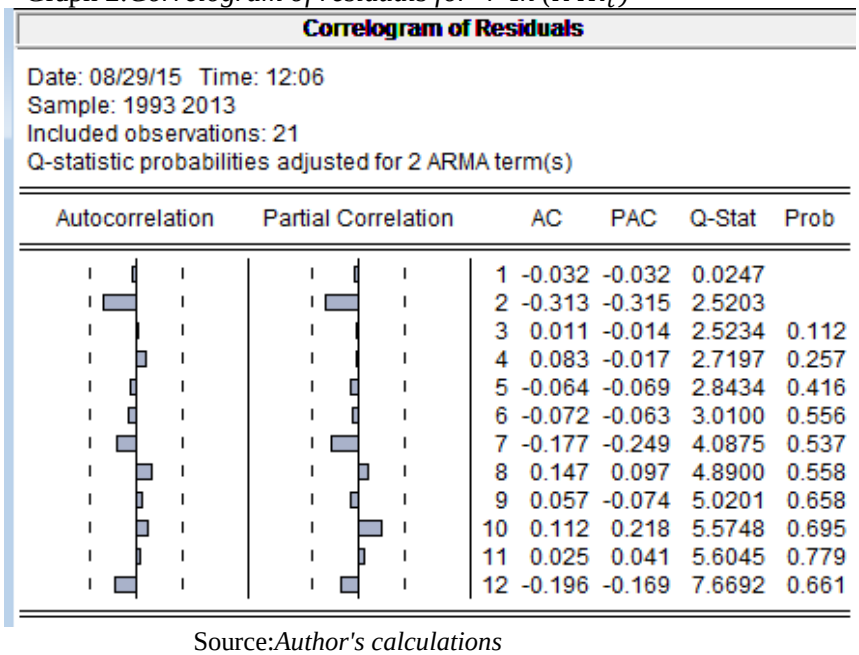
Using Box and Jenkins procedures the identification and estimation of an ARIMA model for the log of infant mortality rate was defined. Predictions for $In(IMR_t)$ were computed. To identify a univariate time series model for $In\ (IMR_t)$ the ACF and PACF were estimated for the sample data of the stationary transformed variable and concluded that $In(IMR_t) \sim$ I (1). An ARIMA(1,1,1) was estimated. Initially the ACF and PACF gave some indication of the order of an ARIMA specification. Estimated ARIMA(1,1,1) model has a lower value both for the AIC and SIC.The number of p and q were chosen in a such a way that absence of residual autocorrelation was also found and the estimated parametars were significantly different from zero.The ARIMA (1,1,1) that has been estimated for the sample period (1991-2013) is:

$$\nabla\ In\ (IMR_t) = -0{,}037788 + 0{,}504196\ \nabla In\ ((IMR_{t-1}) + u_t - 0{,}928512\ u_{t-1} \qquad (2)$$

(0,2465) (0,1796)

With the Ljung-Box test we tested whether the residuals behave like a white noise process.In Eviews 'Correlogram Q statistics' is selected and in the graph 1 is shown the Correlogram of residuals. The graph of the function of Autocorrelation of residuals shows us that there are no coefficients that exceeding the limits of the confidence interval.Also the graph of the function of Partial Correllation of the residuals shows no such a coefficients. Since the appropriate p-value of the Ljung-Box statistics for time lags up to 16 is 0.661 and because this value is greater than the level of significance, 0.05, we accept the null hypotheses that residuals behave like a white noise process[34].The model is a good one i.e adequate for our analysis.

Graph 2:*Correlogram of residuals for* $\nabla\ In\ (IMR_t)$



Source:*Author's calculations*

The inequality coefficients of the ARIMA(1,1,1) are marginally smaller and the Bias proportion, Variance proportion and Covariance proportion are not larger than 1.Their results are shown in table 2 below:

[33] Ibid, p. 53 ,UNDP,MDG

[34] Risteski Slave,Tevdovski Dragan,Trpkova Marija(2012),Introduction in time series analysis, with application of Minitab and Eviews,Faculty of Economics-Skopje, page 316-317

Table 2 *Forecast evaluations for ARIMA(1,1,1) model*

Forecast evaluations of ARIMA model for *In* IMR_t ,Forecast sample: 2014-2020	
Root mean squared error	0.192949
Mean absolute error	0.153152
Mean absolute percentage error	6.444698
Theil Inequality Coefficient	0.036705
Bias proportion	0.484877
Variance proportion	0.104562
Covariance proportion	0.410561

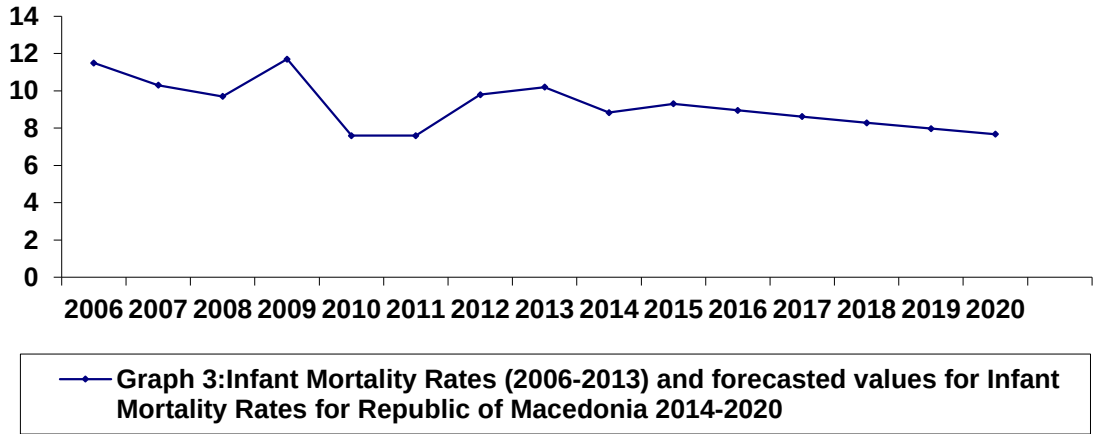
Source:*Author's calculations*

ARIMA(1,1,1) yields decreasing trend of infant mortality rate for the next years.The forecast was computed according to the estimated model and using the last residuals e_n. After some periods the computation of the forecasts become recursive.Then the ARIMA forecasts from this model converged to a constant value. In our case, the forecasts of $\nabla In\ (IMR_{n+i})$ with $i \geq 2$, converge to the constant term of the model, -0.037788. However, the variable is in first differences,which means that the forecast of the change of $In(IMR_t)$ has become constant. These results are illustrated in the table 2 below where the forecast show the decreasing of 3.78% per year in the log of IMR_t.This implies that the trend in $In\ (IMR_t)$ has become constant. The ARMA model is not useful for the computation of long-run forecasts.

Table 3: *Forecast values for Infant mortality rates in R.Macedonia for the period: 2014-2020*

Forecast year	**Forecasted Infant mortality rates**
2014	8.84
2015	9.31
2016	8.96
2017	8.62
2018	8.29
2019	7.98
2020	7.68

Source: *Author's calculations*



Graph 3:Infant Mortality Rates (2006-2013) and forecasted values for Infant Mortality Rates for Republic of Macedonia 2014-2020

Concluding remarks

Life expectancy in Macedonia rose substantially in the second half of the twentieth century, as it did throughout the whole region of Europe. Between 1950-1955 and 1995-2000, life expectancy at birth for men increased by 15.6 years raising from 55.0 to 70.6 years, for women, the increase was 19.8 years rising from 55.0 to 74.8 years. Mortality in Macedonia has recorded a phenomenal decline during post half of the last century. The Crude Death Rate (CDR) of 16.4[35] per 1000 population observed in 1951 dropped to 7.3 by the close of the last century and is expected to maintain about the similar level in the next decades. In the Pelagonia,Vardar and the East Region, as a result of the unfavorable age structure and the low fertility, the number of deaths exceeds the number of births.

Infant Mortality Rate (a health outcome) has been selected as one of the priority problems in the Republic of Macedonia. The infant mortality rate was very high (over 100‰) in the 1960s, the "rapid" decline in the next two decades, reaching the value of 31.6%o in 1990. Macedonia has experienced a sharp fall in infant mortality rates, from 22.7 per 1000 live births in 1995 to 11.9 per 1000 live births in 2001 and about 9.0 per 1000 in 2012. Macedonia's under five mortality

[35] Risteski, Slave (1996), The demographic transition in Macedonia, Faculty of Economics-Skopje, page 58

rate was 11 deaths per 1000 in 2008, higher than Northern Tier CEE (6 deaths per 1,000) and lower than Southern Tier CEE (15 deaths per 1,000).Macedonia's infant mortality rate was 9.7 deaths per 1000 live births in 2008; it has been declining steadily since 2004 (13.2 deaths per 1,000 live births). The infant and under-five mortality rates differ in various geographic areas, regions and municipalities and there are differences between urban and rural areas, as well as among the various socio-economic groups. The maternal mortality ratio in Macedonia fell by 40% in the decade between 1993 and 2003. The maternal death rate in Macedonia has been decreasing, from 11.5 per 100 000 live births in 1991 to 3.7 in 2003, and 4.4 in 2006, whereas in 2007 there were no cases reported. In addition, the maternal death rate in Macedonia in 2001 was higher than the EU average (which is 5.4) but similar to that in the other SEE countries (11-15 cases per 100,000 live births). In 2006, the maternal death rate in Macedonia was similar to that in the EU.

We applied reduced-form model to investigate the relationship between the crude mortality rates and life expectancy at birth for the period 1991-2013.Also using Box and Jenkins procedures a univariate ARIMA (1,1,1) model was estimated to be made a future assessment for the Infant mortality rate in Macedonia up to 2020. The estimation result of the reduced-form model shows that the variable LEAB influences the dependant variable CMR over time and *LR*-test results showed *p*-value of 0.0663 and accordingly it means that the lag variable of crude mortality rate is a redundant variable and could be excluded from the model. This assumption implies that the influence of the CMR_{t-1} variable did fade away over time. The model results suggest that the mortality trend of the population is under the strong influence of its age and that this trend is due to a more and more participation of the old population in the total population because of the improved quality of living of the population and of improved circumstances of our health sector over the years. From these findings we can say also that the population aging in Macedonia recently has translated into improvements in healthy life expectancies. And this means that the life expectancy at birth is being prolonged due to decreasing mortality rates of children and old persons but also in the decreasing mortality trends in the other age groups. With 'Correlogram Q statistics' and Ljung-Box test we tested that ARIMA (1,1,1) is a good model and the residuals behave like a white noise process. ARIMA(1,1,1) yields decreasing trend of infant mortality rate for the next years. After some periods the computation of the forecasts become recursive. Then the ARIMA forecasts from this model converged to a constant value where the forecast show the decreasing of 3.78% per year in the log of IMR_t .

Bibliography

[1] Ayaga A. Bawah and Tukufu Zuberi (2005): Socioeconomic status and child survival in southern Africa, Genus, april-june 2005.

[2] Attane Isabelle and Magali Barbieri(2009):The demography of east and southeast Asia from the 1950 to the 2000s,A summary of changes and a Statistical assessment, Population,2009,Volume 64,Number 1.

[3] Bucevska Vesna (2009), Econometrics with Eviews application, Faculty of Economics-Skopje

[4] Government of the Republic of Macedonia (2008), Demographic development strategy of Republic of Macedonia 2008-2015, February 2008,

[5] Government of the Republic of Macedonia, UNDP (2009): Report on the progress toward the millennium development goals, Skopje June 2009

[6] Goutas et al."Trends in Infant and Child Mortality", The Open Forensic Science Journal, 2011, Volume 4,

[7] Ham-Chande Roberto, Alberto Palloni, Rebeca Wong (2009), IUSSP Policy and Research papers No 22, Aging in developing countries: Building bridges for integrated research Agendas, IUSSP 2009.

[8] Eurostat (2009), Yearbook 2009,"Europe in figures"

[9] Eurostat (2008), Key figures on Europe 2008 edition

[10] MANU (1985), proceedings from the scientific meeting:"Problems of demographic development of SR of Macedonia", scientific meeting in Leunovo,3 and 4 november 1983,MANU,Skopje,1985

[11] Prem C.Saxena (2008),Aging and age-structural transition in the Arab countries:regional variations, socioeconomic consequences and social security,Genus, LXIV (No 1-2), 37-74

[12] Risteski Slave (2009), Demography, methods and analysis. Faculty of Economics-Skopje.

[13] Risteski Slave (2009), The intensive process of the demographic transition and the implications over demographic development of Republic of Macedonia,UDK:314(497.7) "1948/2002",

[14] Risteski Slave,Tevdovski Dragan,Trpkova Marija (2012), Introduction in time series analysis,with application of Minitab and Eviews, Faculty of Economics-Skopje

[15] State Statistical office, UNICEF Project TRANSMONÉE "Analytical Report on the situation of children and young people" (At regional level), Skopje 2004,

[16] United Nations (2000), World Population Prospects, The 2000 revision

[17] UN (2009), World Population Prospects, The 2008 Revision, Department of Economic and Social Affairs, Population Division, New York, 2009

[18] USAID (2011), Macedonia Gap Analysis Europe and Eurasia Bureau, USAID Strategic Planning and Analysis Division March 22, 2011

[19] World Health Organization (2006), Regional Office for Europe, "Highlights on health in The former Yugoslav Republic of Macedonia 2005",

[20] WHO mortality database ii) World Health statistics 2006

Internet sources:

www.stat.gov.mk , State Statistical office of Republic of Macedonia

http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tps00025

http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tps00027&plugin=1