THE EVOLUTION OF ROMANIAN DEMOGRAPHIC PHENOMENA IN TERMS OF GLOBALIZATION

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Abstract

Globalisation and demography are the main forces modelling the development of societies at large and of each nation in particular.

The paper aims to identify and synthetically present some factors of influence which triggered by the end of the 20th century and the beginning of the 21st century a series of characteristics defining the changes of the demographic model and structure of population on age brackets.

The paper presents the results obtained by using the Markov-type model, for studying the development of demographic indicators in Romania, and their forecasting as well.

Key-words: *globalization, demographical evolution, Markov model*

JEL classification: C_{13}, C_{15}, C_{32}, C_{35}, J_{11}, J_{13}, J_{60}

1. **Introduction**

The intensified globalization represents the fundamental feature of the world economy at the beginning of the 21st century. Globalization is characterised by the pervasive trend of barriers' reduction and melt-down between national economies, and increasingly stronger links between economies.

The multiple processes implied by globalisation are inter-conditioned on a wide scale, and these processes generate and develop certain dimensions within globalising policies and strategies which have not all been defined and formalised accordingly yet.

Globalisation has, as well, its own *demographic model*: swift acceleration of individuals' movement from the rural area and the agrarian lifestyle to the urban area which is more closely related to global trends in fashion, foods, markets and leisure.

Globalisation and demographics are the two main forces modelling/driving the development of societies in general and, in particular the European development. Globalisation and demographics provide for opportunities and challenges, based on their particularities and trends in development.

Demographic trends at world level and, implicitly, at European level show increased opportunities of longer and healthier life-spans, yet new questions arise such as the new costs of an aging society, the issue of inter-generational equity, along with other issues posed by family and household life, respectively: higher importance granted to child nurturing and to ensuring balance between the working and personal life by fostering family life values, better inter-generational relations, and alleviating the new poverty threats.

Globalisation, next to the new technologies, provides a huge growth potential. Yet, individuals should be able due to their studies and professional training to take full advantage of these opportunities and adjust to the disappearance of some traditional industrial trades.

The paper intends to analyse the impact of globalisation on the development of the main demographic phenomena. The new technologies driven by and complementary to globalisation provide for a huge growth potential. Yet, for individuals, in order to take full advantage of the opportunities provided, intensive studies and vocational/professional training are required for reaping benefits and adjusting to the disappearance of some traditional industrial trades. In our paper we intend to analyse the impact of globalisation on the evolutions recorded by the main demographic phenomena.

2. **Interdependencies: globalisation – evolution of demographic phenomena**

The last decades witnessed the redesign of the world's economic map due to spectacular changes on the international political scene and to the influence of unprecedented technological shifts occurring at the same time. One of the certainties was the triumph of market economy all over the world. On this background of substantial changes, two basic trends could be outlined. One of them refers to the economic globalisation favoured, among others, by the diminished transportation costs and speedier communication means.

The other confirms the attempt of various nations, connected to their own territory to organise within some regional frameworks defined by geographic and historical proximity connections. In this new context, the power relationships changed under the influence of shifting the heavy weight of world output, meaning the localisation of the latter, determined in its turn by the strategic games implemented mostly by multinational companies acting at present under the power of attraction of national territories. The other trend was influenced by the attempt of various nations residing on their territories to form and organise some regional cooperation frameworks as defined by the geographic and historical proximity links.

2.1. *Brief presentation of the demographic evolution in Romania*

The political, economic and social changes which Romania underwent after December 1989 have left a heavy imprint on population's development, hence on the demographic phenomenon. Several quasi-simultaneous evolutions such as the swift and significant decrease of births' rate, the recrudescence of mortality, the negative impact of external migration of unknown dimensions have all contributed and altered dramatically the demographic landscape of the country.

The 19th year of demographic decline was 2008, when Romania lost almost two million inhabitants that is 8% of the population existing in the records by the beginning of the nineties.

Romania's demographic variables are no exception from the general trend of evolution when considering the entire European population. We might say that the general European trend is of decreasing values for births, marriages and mortality, while on the other hand the average age of the first marriage, of giving birth to a first child, and the frequency of families' dissolution along with consensual unions are all on an increasing path.

Yet, the main difference between European populations with respect to these shared developments resides in the rate at which they take place and the depth of changes. One of the outcomes is that differentials also may be identified regarding the social issues facing them – with respect to their emergence swiftness and their volume – triggered by the aforementioned developments of the demographic landscape. Therefore, socio-economic determinism plays an important role in influencing them.

The decrease of Romania's population is triggered particularly by the low fertility rate and by the high external migration rate (approximately 2 million Romanian individuals are legally abroad and the number of those illegally emigrated is still unknown).

Additionally, if we take into account also the potential loss of young population as result of the emigration of women of fertile age, then we may appreciate that the total potential negative balance of population could be doubled (emigration to which is added the number of children that could have been born if the women remained in the country). In the period 2002-2008, the share of women in total emigrated population was of about 68.9%, and the number of possible children to be born at a fertility rate of 1.3 children/woman would have represented 90% of the total effectively emigrated population for the respective period (about 10 thousand persons per year).

If we assume that only two-thirds out of the emigrated women would give birth to at least one child, the annual numbers with respect to population loss by births abroad would vary between 3879 persons in 2002 and 7714 persons in 2006, that is the year with the highest level of emigration since the beginning of the present century (14197 persons in total, from which 62.4% were women).

Yet, at the same time Romania records an average mortality rate and of increased life expectancy which triggers a significant population aging. If, currently, from the 21.6 million inhabitants, 10.5 millions are adults, 5 millions – young persons and children and 6 millions are aging persons, over 50 years the demographic picture will differ completely: pensioners will represent more than half of the country's population, the number of adults and children will decrease and the ages' pyramid shall significantly narrow its basis.

Latest data available about Romania provided by the National Commission for Prognosis show that the employment rate of working age population (15-64 years) was 40.9% in 2008 and under the conditions of the financial crisis it is estimated to decrease at 40.6% in 2009. This trend implies an evolution which is opposite to the targets set by the Revised Lisbon Strategy. Moreover, the employment forecasts with respect to the working age population indicates a decreasing trend by 2013 for the total working age population, which is estimated to number 14974 thousand persons against the 15046 thousand persons registered in 2008, hence a loss of 72 thousand persons.

In other words, the danger of severe demographic imbalances emerges for the country triggering harsh economic and social imbalances as well. These economic and social imbalances shall impact on the labour market, on the pensions' system, on the health services, education, and overall, on the social protection system, and on the incomes' and budgetary expenditures system as well, to mention just few aspects. The determinant factor in defining and structuring a viable strategy meant to ensure sustainable development within the country, is population – core element on which should be focused the entire attention of the decision factors and of the Romanian society as a whole as well.

3. **Models for analyzing the impact of globalization on demographic evolutions**

Specialized literature makes use of various models by which attempts are made to determine the impact of globalization and climatic changes on the demographic evolution. These models are used for quantifying the evolutions within the socio-economic development of countries with differing conditions from the viewpoint of their endowment with natural resources, material and human capital, technology and population in a world with particular dynamics of goods, persons, and capital movement, and flexible economies' structures, etc.

By developing scenarios the aim is to quantify the impact of globalisation on various countries depending on the actual conditions in the respective country. The model includes the following important segments: i) the global economic system; ii) the system of natural environmental resources which refers to quality of environment, the capacity of the natural resources to ensure welfare, the output and consumption within the economy; iii) the changes triggered by the population increase and its distribution on age groups for each of the countries taken into account (international migration being also included here).

The model with fundamental discrete time in the dynamics of a feminine population is the matrix determinist model:

$$\mathbf{m}(t+1) = \mathbf{A}\mathbf{m}(t), \quad t \in \mathbf{N} \qquad (1)$$

developed by P.H. Leslie and where: **m***(t)* is an *r*- dimensional vector for which the rank coordinate -*i* represents the number of individuals of the *i*-type (=age group of rank *i*) at the moment in time *t*, $1 \le i \le r$, $t \in \mathbf{N}$. The **A** matrix contains the specific fertilities to various age groups and the survival parameters. Because population growth is influenced by random factors, the introduction of stochastic models was not unexpected. Hence, Z.M. Sykes took into consideration an additive model having the following form:

$$\mathbf{n}(t+1) = \mathbf{A}\mathbf{n}(t) + \varepsilon_{t+1}, \quad t \in \mathbf{N} \tag{2}$$

where: **n***(t)* is a random *r*- dimensional vector the components of which indicate the number of individuals of the *i*-type at the moment in time *t*, $1 \le i \le r$, $t \in \mathbf{N}$, and ε_t, $t \in \mathbf{N}_+$ is a random vector of null-average.

Initiated by Markov, the use of the dependencies called after him in the shaping of some real phenomena has known after the war a proliferation hard to imagine; given the wide range of uses of the Markovian chains they've known an explosive increase in their use in the science about mankind and issues challenging it: demography, theory of social mobility, education systems, ecology, pollution, biology and medicine.

In general, for studying demographic evolutions deterministic demographic models are used. The stochastic models used for this purpose are generated under two forms: a first category using the variable discrete "time" and discrete age scale, and another category in which time is a continuous variable as the age scale.

3.1. *Analysis and forecasting of demographic evolutions through Markovian techniques*

In general, for the study of demographic evolution are used determinist demographic models. Stochastic models used for this purpose are elaborated in two forms: a first category that uses the variable "time" discreet and a discreet scale of age, and another category in which time is a continuous variable as the age scale.

Applying the discreet stochastic model requires a series of *assumptions*, namely:

i) evidence of female population is carried out at intervals of discrete time, *n*=1, 2, 3...;

ii) the female population is divided into age groups k, $k \in Z^{*}_{+}$;

iii) the number of women in age groups, while the *n* is given by the random variable $\eta_n(j)$.

Therefore, the time and dispersion variable string may be written in the form of: $E\eta_n(j) = M_{j,n}$ and $D\eta_n(j) = D_{j,n}$

iv) the probability p_j that a person of the age group *j* at the moment *n* will be in the age group *j+1* after a unit interval of time, is fixed and $p_j > 0$ for $j < k$, and $p_k = 0$. These probabilities are assumed independent, so $q_j = 1 - p_j$;

v) the processes of birth and death are supposed to be independent;

vi) the changes in masculine population structure are assumed to be consistent with the assumption of the constant measure of fertility $\{b_j\}$;

vii) multiple births are ignored;

viii) λ and μ are discrete random variables with full positive values;

ix) λ_1' and λ_2' random variables with binomial distribution $B(\lambda, p_1)$, $B(\lambda, p_1)$ and subject by λ.

Using the relations

$$\begin{cases} \mathbf{E}\lambda_1' = p_1\mathbf{E}\lambda \\ \mathbf{D}\lambda'_1 = p_1^2\mathbf{D}\lambda + p_1q_1\mathbf{E}\lambda \end{cases} \quad (3)$$

$$\begin{cases} \mathrm{Cov}\left[\lambda_1', \lambda_2'\right] = p_1p_2\mathbf{D}\lambda \\ \mathrm{Cov}\left[\lambda_1', \mu'\right] = p_1p_3\mathrm{Cov}[\lambda, \mu] \end{cases} \quad (4)$$

where $q_1 = 1 - p_1$

the Markovian demographic model becomes:

$$\begin{cases} \mathbf{E}\eta_{n+1}(0) = M_{0,\, n+1} = \sum_{j=o}^{k} b_j M_{j,\, n} \\ \mathbf{E}\eta_{n+1}(1) = M_{1,\, n+1} = p_0 M_{0,\, n} \\ \mathbf{E}\eta_{n+1}(2) = M_{2,\, n+1} = p_1 M_{1,\, n} \\ \dots\dots\dots\dots\dots\dots \\ \mathbf{E}\eta_{n+1}(k) = M_{k,\, n+1} = p_{k-1} M_{k-1,\, n} \end{cases} \quad (5)$$

Using the relations (3) and (4) we obtain

$$\begin{cases} \mathbf{D}\eta_{n+1}(j+1) = D_{j+1,\, n+1} = p_j^2 D_{j,\, n} + p_j q_j M_{j,\, n}\ ,\ j \ge 0 \\ \mathbf{D}\eta_{n+1}^{(j)}(j+1) = b_j^2 D_{j,\, n}^2 + b_j d_j M_{j,\, n}\ ,\ j \ge 0 \end{cases} \quad (6)$$

$$\begin{cases} \mathrm{Cov}[\eta_{n+1}(j+1), \eta_{n+1}(h+1)] = p_j p_h \mathrm{Cov}[\eta_n(j), \eta_n(h)] \quad ,\ j, h \ge 0,\ j \ne h \\ \mathrm{Cov}\left[\eta_{n+1}^{(j)}(0), \eta_{n+1}(h+1)\right] = b_j p_h \mathrm{Cov}[\eta_n(j), \eta_n(h)] \quad ,\ j \ne h \\ \mathrm{Cov}\left[\eta_{n+1}^{(j)}(0), \eta_{n+1}^{(h)}(0)\right] = b_j b_h \mathrm{Cov}[\eta_n(j), \eta_n(h)] \quad ,\ j \ne h \end{cases} \quad (7)$$

If by definition, $\eta_{n+1}(0) = \sum_{j=0}^{k} \eta_{n+1}^{(j)}(0)$ then

$$\mathbf{D}\eta_{n+1}(0) = \sum_{j=0}^{k} \mathbf{D}\eta_{n+1}^{(j)}(0) + \sum_{j\ne h}\sum \mathrm{Cov}\left[\eta_{n+1}^{(j)}(0), \eta_{n+1}^{(h)}(0)\right] = \sum_{j=0}^{k}\left(b_j^2 D_{j,n} + b_j d_j M_{j,n}\right) + \sum_{j\ne h}\sum \mathrm{b_j b_h} \mathrm{Cov}[\eta_n(j), \eta_n(h)] \quad (8)$$

hence:

$$\mathrm{Cov}\left[\sum_{j=0}^{k} \eta_{n+1}^{(j)}(0), \eta_{n+1}(k+1)\right] = \mathrm{Cov}\left[\eta_{n+1}^{(j)}(0), \eta_{n+1}(h+1)\right] + \sum_{j=0}^{k} \mathrm{Cov}\left[\eta_{n+1}^{(j)}(0), \eta_{n+1}(h+1)\right] = \mathrm{b_h} p_h D_{h,n} + \sum_{j\ne h} b_j p_h \mathrm{Cov}[\eta_n(j), \eta_n(h)] \quad (9)$$

Equations (8) - (9) completely define the relations for the recurrence mean, variance and covariance of the sample study subject. In a matrix form they can be written:

$$\begin{pmatrix} \mathbf{M}_{n+1} \\ \mathbf{V}_{n+1} \end{pmatrix} = \begin{pmatrix} \mathbf{A} & \mathbf{O} \\ \mathbf{B} & \mathbf{AxA} \end{pmatrix} \begin{pmatrix} \mathbf{M}_{n} \\ \mathbf{V}_{n} \end{pmatrix} \tag{10}$$

where vector V contains elements variance and covariance $D_{ij,n}$, and A is a Leslie matrix, defined by:

$$\mathbf{A} = \begin{pmatrix} b_1 & b_2 & \ldots & b_{k-1} & b_k \\ p_0 & 0 & \ldots & 0 & 0 \\ 0 & p_1 & \ldots & 0 & 0 \\ . & . & \ldots & . & . \\ . & . & \ldots & . & . \\ . & . & \ldots & . & . \\ 0 & 0 & \ldots & p_{k-1} & 0 \end{pmatrix}$$

This leads to the creation of the following relationships between variance and covariance

$$\mathbf{V}_{[n]} = (\mathbf{A}x\mathbf{A})^n \mathbf{V}_{[0]} + \sum_{i=1}^{n} (\mathbf{A}x\mathbf{A})^{n-i} \mathbf{BM}_{i-1} \tag{11}$$

Observing: $\boldsymbol{\mu}_i^{'}(n) = (\mu_i^1(n), \ldots, \mu_i^p(n))$, this relationship may be written as a matrix:

$$\boldsymbol{\mu}_i^{'}(n+1) = \mathbf{C}\boldsymbol{\mu}_i^{'}(n) \tag{12}$$

with ***C*** **as** diagonal matrix.

Consequently:

$$\mathbf{E}_i\left(X^{j+i}(n-1)\right) = \mu_i^{j+l}(n-1) = \begin{cases} 1, & if \quad j = l = 0 \\ in^{j+l-1} + \sum_{r=2}^{n}\sum_{k=1}^{r} \lambda_r^{p-1} v_r(j+l) u_r(k) i^k, & j+l > 0 \end{cases} \tag{13}$$

where

$u_r^{'} = (u_r(1), \ldots, \mu_r(n))$ is the independent vector to the left associated to its own value λ_r

$v_r^{'} = (v_r(1), \ldots, v_r(n))$ is the independent vector to the right

Hence, for *j>0* with respect to shifting probabilities the following expression results:

$$p(n, i, j) = \begin{cases} C_n^j \sum_{l=0}^{n-j} (-1)^l C_{n-j}^l n^{-j-i} \sum_{r=2}^{n}\sum_{k=1}^{r} \lambda_r^{p-1} v_r(j+l) u_r(k) i^k, & if \quad j \neq n \\ \frac{i}{m} + n^{-n} \sum_{r=2}^{n}\sum_{k=1}^{r} \lambda_r^{p-1} v_r(n) u_r(k) i^k, & ifj = m \end{cases}$$

3.2. *Analysis and forecast of the evolution of Romanian demographic phenomena using the Markovian techniques*

In order to study and forecast the evolution of demographic phenomena in Romania by Markovian methods we have used the data from the Statistical Yearbook of Romania 2000-2008 and other publications of the National Institute of Statistics.

The used database includes: Romania's population (on July 1st annually), population by age group; live births (in absolute data and rate per 1000 inhabitants), deaths (in absolute data and rate per 1000 inhabitants), born dead (in absolute data and rate per 1000 inhabitants), deaths at an age less than 1 year, the general fertility rate (number of children born to a woman during her fertile life), urban and rural population, emigrants, immigrants.

The variables considered in the model were: live-births, deaths, dead-born children per 1000 birth (live-birth and still-births), infant deaths per 1000 live-births, average age of mother at birth, by area, general fertility rate, rural and urban-population, population by age group and gender, emigrants and immigrants.

The study of evolution and forecasting demographic phenomena by means of the Markov chains method involves several steps, respectively: the calculation of the structures for considered indicators, the calculation of transition matrices (crossing from one state to another). Each calculated transition matrices highlights the changes in the structure of each indicator in a given year over the previous year, the calculation of the total transition matrix, the calculation of transition probability matrix (transition); determination of structure expected.

The analysis of demographic phenomena has been made on the historical period 2000-2008, and their forecast was made up to 2010.

For instance, the following variables are considered: live-births (X1), deaths (X2), still-born (X3), deaths under 1 year of age (X), urban population (X5), rural population (X6), emigrants (X7), immigrants (X8), population on age groups: age group 0-14 years (X9), age group 15-65 years (X10), age group 65-85 years (X11) and the fertility rate (X12).

The analysis of the projection using Markovian techniques highlights that after a decrease in the live-births rate to 10.5 ‰ in 2000 at 10.0 ‰ in 2007 and a slight increase in 2008 (10.3 ‰) the birth rate reached nearly 10.6 ‰ in 2010.

The comparative analysis of the results obtained through Markovian techniques for this indicator with the results projected by the Centre for Demographic Research (CDR)-NIER, Romanian Academy; underpin the existence of insignificant differences, if the scenario of a medium forecast against these is taken into consideration.

Thus, the CDR forecast, according to the medium version, projects that the population in 2010 will be 21641 thou persons and the number of live births will be 202.1 thou persons. By Markovian techniques applied for that same year, the population will be 21510.154 thou persons and the number of live births will be 215.9 thou persons.

The analysis of the forecast using Markovian techniques for the indicator "deaths rate" points out that after an increase at 11.8 ‰ in 2008, it decreased at 11.49 ‰ in 2010 (to 12.6 ‰ determined by the Centre for Demographic Research in medium scenario). In absolute data, this means that, for example, in 2010 the number of deaths should be of 251.6 thousand persons.

In terms of mortality rate at birth, by applying the same technique from both the historical and the forecast period viewpoint a downward trend results. If in 1990 the record was of 2231 born-dead, the number decreases in 2008 to 993, and in 2010 to 832.

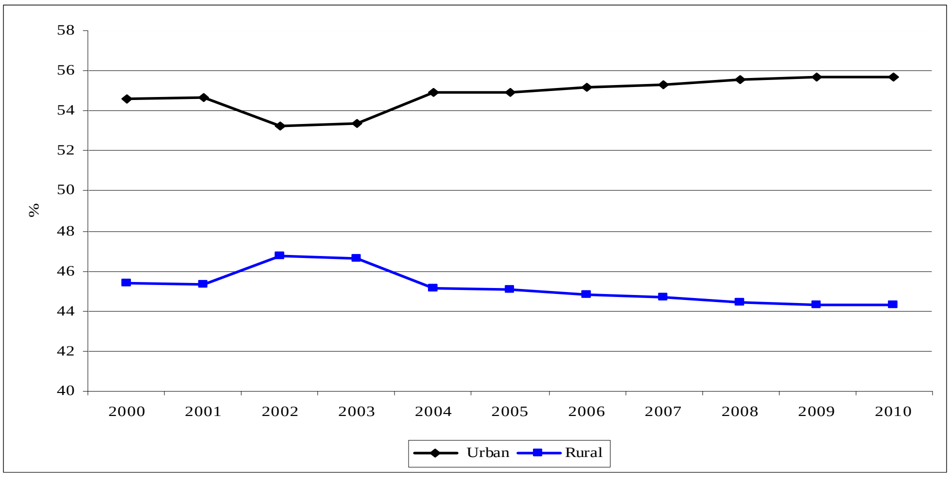
For the indicator "infant deaths per 1000 live-births" the scenario developed according to the Markovian model highlights a downward trend, the share of this population segment decreasing from 26.9 ‰ in 1990 to 18.6 ‰ % in 2008 and 11.34 ‰ in 2010 (Figure 1).

Source: *Statistical Yearbook of Romania 2000-2008*; for other years – the author's calculations.

Fig. 1. *The evolution of some demographic indicators of population during 2000-2010*

Population growth was recorded in 1997 for the urban areas (among others also as result of the opening of the main cities) as it reached 55.02% of total population, after which a reverse trend is registered, the share of population in urban areas decreasing in total population to up to 53.26% in 2004.

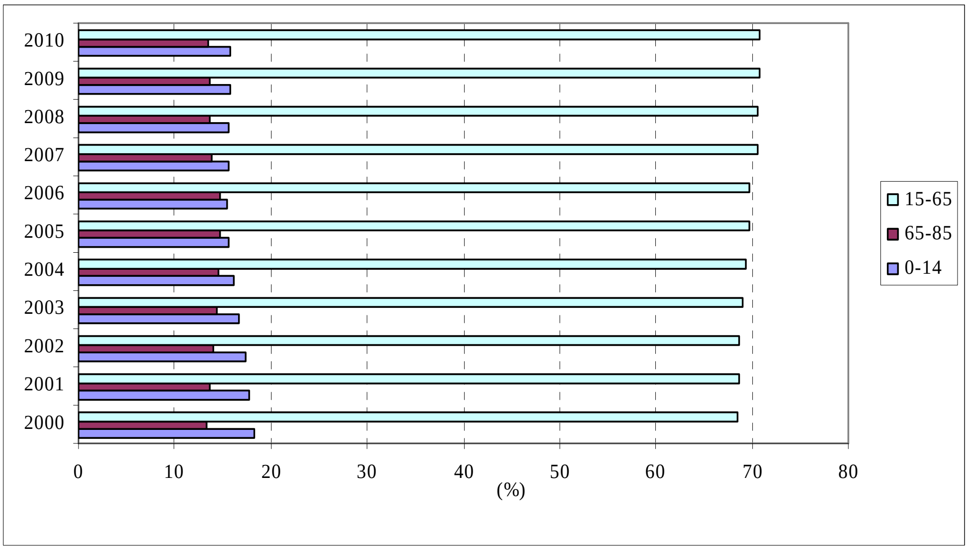
Since 2004, an increase in the share of population in urban areas was underpinned, reaching in 2006, 55.19% of total population. Also, for the period 2007-2010 the results of the evolution of urban populations show small oscillations of their respective shares in total population (Figure 2), but with a general growth trend, and in 2010 it will represent 55.4%. The population of rural areas (Figure 2) is complementary to urban population, and as the scenario develops, it will represent 44.6% of the total population in 2010.



Source: *Statistical Yearbook of Romania 2000-2008*; for other years – the author's calculations.

Fig. 2. *Structure of population by areas during the period 2000-2010*

Regarding the evolution of large population groups by age, in the historical period 2000-2008, was recorded a decrease of approximately 815.763 thousand people in the group aged 0-14 years, 312.21 thousand people in the group aged between 15-65 years, and in the group aged between 65-85 years there is an increase by around 398.5 thousand people (Figure 3).



Source: *Statistical Yearbook of Romania 2000-200*8; for other years – the author's calculations.

Fig. 3. *The evolution and forecasting of population by age*

For the forecast period, the segment of the population aged 0-14 years registered a slight increase in 2008, trend that is maintained during the forecast period. Thus, in 2010, the population aged between 0-14 years will represent approximately 15.75% of the total population (Figure 3).

The evolution of the trend of this segment of the population determined by Markovian techniques is the same as that obtained by CCD, both in the lower and the medium forecast variant.

In the segment of the population in the age groups between 15-65 years of age, both the historical and forecast period highlight an increasing trend. In 2008 it represented 70.56% of the total population of the country, and in 2010 it will be of about 70.72% (Figure 3).

The number of the individuals with ages between 65 years and over had during the historical and forecast period an oscillatory evolution but with a general growth trend. After a slight decrease in the numbers of this segment of the population in 2008: 2713.013 thousand compared to 3191.446 thousands of people registered in 2005, it shall record a value of 2900.934 thousands in 2010 (Figure 3).

This indicates that both on short and medium term, the ageing of the Romanian population shall continue.

The structure of migration flows for the forecast period shall contribute to the ageing of the Romanian population, as well.

As exogenous variables in the model, were included the information on the number of emigrants and immigrants, but as historical data on the evolution of these are available only from official bulletins, the forecast on the future evolution of these indicators of population's movement must be considered from the quality viewpoint and not from the one regarding quantity.

In terms of overall fertility rate (number of children born to a woman during her fertile life), during 1998-2002 this indicator had a decreasing trend, with a marked „drop" in the period 2000-2002 followed by an even more noticeable increase in 2003-2006, and thereafter a moderate growth could be observed.

In the current conjecture, for 2008 the indicator shows a decrease, from 39.6 in 2006 to 38.9 in 2008, a trend underpinned by the forecasting scenario.

Using Markovian models to analyse and forecast demographic indicators can provide useful information to state bodies in developing policies and decisions with respect to population growth, employment, etc.

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