A DEMOGRAPHIC ANALYSIS MODEL OF ROMANIAN SCHOOL POPULATION

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Abstract: This study presents a statistic analysis model of Romanian school population, model that takes two major interdependences as a basis: between the social- economic phenomena and the demographic phenomena and between the statistical and demographical methodology for social population analysis; the evolution and the structure of school population in Romania are analysed in correlation with the demographic transition and its characteristics in our country, with the help of some specific demographic indicators and instruments.

In the last decades, the majority of European countries confronted with an alarming demographic evolution, having as main characteristics the natality decreasing and the population ageing. With a different causality from each country to another, depending on concrete social-economic conditions, this process became concerning both for national and European authorities.

Within these bounds, Romania makes no exception from the evolutions achieved on the European scale: the last decades were been marked by a continuouos and signifiant decreasing of national population, caused by the deterioration of the structure of the three components of population dynamics: natality, mortality and external migration. The data from the 2002 census of population were placed the whole demographic evolution of Romania in a new perspective, that of the threatening, catastrophic impact of transition to wich it must respond by urgent and firm measures.

Without being a singular phenomenon on the international and European level, this process is shocking by its dimensions and especially by its serious long and medium term consequences. In the new context, the analysing of causes that determined the present, grave situation of Romanian population and the elaboration of some improvement politics for the limitation of negative consequences, become imperative for Romanian society.

The signifiant changes of our population structure have two major causes: one component of this transformations has been due to the demographic transition period and it was similar to that of the developed countries; the Romanian specific component, that had and still has the greatest negative impact at the social and economic level, has been due to the political decisions of the communist society, that considerably influenced the evolution of the demographic phenomena, especially the natality.

The demographic transition became a more complex process, characterized by the interdependences between the demographic and the social-economic variables. The amplitude of this demographic process is also reflected in its components: the mortality transition, the fertility transition, being followed by the age structure transition, the nuptiality transition, the family transition, the education transition.

In our country, the demographic transition was characterized by a specific evolution. During the XX century, excepting the two world wars periods and the nineties, our population was in a continuous increasing; a natural causes increasing before 1967 and artificially maintained by an agressive pronatality policy, between 1967 and 1989. The transformations occured after 1989 in our political system, in economic and social life, produced major changes in our demographic behaviour. Since 1990, our country population decreased every year, with an annual medium growth rate of 0.15%. If in the first two years the decreasing was due to the powerful migratory decrease, since 1992 Romania reached also to a natural decrease.

As a result of major changes endured in the two mentioned periods (the communist period and the social-economic transition period), the structure of Romanian population by age is serious unbalanced, having very numerous generations in the period 1967-1989 (with the highest point of half million live-births from 1967) and a little more than 200000 live-births generations in the last 10 years. The social and economic costs of those lacks of balance in the population structure were and will be still payed by Romania many decades from now on.

The structure by age of Romanian population reflects a slow but continuous process of demographic ageing, essentially caused by the decreasing of natality that led to the decreasing of young population, of 0-14 years (both as absolute and relative value) and to the increasing of full age population, after 65 years, as percentage of total population. The negative effects of ageing demographic process to the economic and social development and also to the future demographic evolutions, are already visibles and they will accentuate in time, causing radical changes at the level of school population, fertile population, work age population and aged population (retired persons beneficiaries of health and social assistance services); the main fields in wich the negative effects of structural changes of Romanian population will be felt are: social assistance, health and education.

If in other fields the reducing of population number will be felt with greater delay, the first domain affected by this will be the education, that has been, for many years, confronting with student generations whose number is in continuous decreasing (table 1). The school population in our country decreased during 1990-2006 with 720450 persons, reaching an annual medium decrease of over 45000 persons, and during 2000-2006 with 219698 persons, with an annual medium decrease of 36616 persons.

The most drastic reducing was achieved in primary and secondary education, whose school population decreased in the period 1990-2006 with 888098 pupils (-55506 pupils per year), and with 569297 pupils in the last period, 2000-2006 (-94882 pupils per year). The reducing of number of pupils enrolled in primary and secondary education will continue in the next years (but with a lower rate) because of unfavourable evolution of demographic phenomena.

At the level of high-school and vocational education, as a result of increasing of education demand for these formation stages, the number of students, even if it achieved a reducing for the whole transition period, with 13423 students yearly, respectively 7217 students yearly, it registered a continuous ascending tendency in the period 2000-2006, with 15501 students annually, respectively 1805 students annually; the same tendency expressed both in urban and in rural area. In contrast with the primary and secondary education cycles, in the high-school and vocational education cycle the increase are more signifiant in the rural area, comparing with urban area; thus, in the analysis period of time, at the high-school level, the incresing is of 21000

students in the urban area and of 72400 students in the rural area; at the vocational education, the increasing in the rural area is of 23000 students, and in the urban area, the decreasing is of 12000 students. The favourable differences for rural area at this education cycle represent the effect of the measure of extending to 10 years the compulsory education.

If the negative demographic tendencies achieved in nineties, that produced the decreasing of school aged population in Romania with 1006600 persons in the period 2000-2006, already influence the number of students enrolled in primary and secondary education, in the higher education, the increasing of students number was constant during the entire period of transition, of 592696 persons, with an annual medium increase of 37044 persons and even more pronounced in the last period, 2000-2006, of 252353 persons and an annual medium increase of 42060 persons. The relative rates per 10000 inhabitants, calculated separately for pupils and students, also prove themselves the same dynamics different by education degrees: if for pupils (primary, secondary and high-school education) the rate decreased from 1776 pupils in 1990 to 1525 pupils in 2000 and 1349 pupils in 2006 (-25%), for students the rate incresed from 83 students in 1990 to 238 students in 2000 and 363 students in 2006 (+340%). The effects of negative dynamics of Romanian population on the number of pupils enrolled in high-school are observed since 2005, and on the number of students enrolled in higher education will be felt since 2009 (table 1).

Table 1

Romanian school aged population evolution

Age on July 1, 2006 (expressed in the years reached during the year)	Population (thousand persons)	Year of the entry into high-school (14 years)	Year of the entry into university (18 years))
9	215	2011	2015
10	224	2010	2014
11	222	2009	2013
12	237	2008	2012
13	238	2007	2011
14	257	2006	2010
15	256	2005	2009
16	341	2004	2008
17	340	2003	2007
18	351	2002	2006

Source:Romanian statistical yearbook, 2007

The reducing of school population can be considered benefic on short term, because, even the education expenses remain relatively constants, the medium expenses per pupil or student will grow in the next years owing to the reducing of school population. Though for the entire system, the education indicators can show a reducing of its assignment, on local level new problems appear, that will generate the increasing of expenses necessary for maintaining an expanded school network system, to ensure equal chances of education for each pupil.

A school population analysis model, that especially aims at efficiency of passing through an education system structured in units (classes, cycles) by the students flux, is based both on demographic concepts and on its specific instruments and indicators, adjusted to the characteristics of this social population; the possibility of repeating a

year in a class, represents a first characteristic of this population (if the promoting would be automatic, the school year might be considered as an age year and the classical demographic methods, specific for the biological populations, could successfully applied to that social population.

The structuration of the school system by sequences (cycles), defined by institutional rules, transforms the study of the students passing through one school *status* to another, in a particular analysis case of internal mobility for the social populations. The order of the passing through the stages of the school system being the same for all persons, in point of representing the flows in a classic mobility table, two major differences appear: the repeating of a school year being the exception, on the diagonal line of the internal mobility tables, low intensity flows appear; the accent is placed on the chaining of the passing through the successive stages of the whole school system.

The main demographic instrument used in the school population study is a variant of the Lexis diagram, modified according to the characteristic features of the school mobility. By convention, we represent:

- on columns: the school years (t);
- on rows: the classes of a cycle (c);
- in squares: the number of the students enrolled in each class (stock);
- on the diagonal coridors: the number of the promoted or the graduated students (p);
- on the horizontal coridors: the number of the students that stay down in a class for a second year (r);
- on the vertical coridors: the number of the students that abandon school during or at the ending of the year (a).

The degree of detailing the diagram is decisive, both for the quantization of the incomings and outcomings flux intensity, and for the delimitation between the internal and external flows.The observation levels of the school populations are multiples in the geographical and institutional space:

- the geographical levels of observation are influenced by the definition of the national space: the school abandon (external mobility) for a school unit or locality becomes transfer (internal mobility) at regional or national level;
- the institutional space is, generally, expressed in: degrees (primary, secondary and high), cycles and classes.

Two aspects must be underlined: the concept of the school abandon is uncertain at the global level at the school system (by a narrow margin, any definitive outcoming before reaching the pyramid head, can be considered as an *abandon* from the point of view of the school system); the comparisons in this field must be payed attention, because the generalization in all world countries of the pyramidal structure, realized at the beginning of the past century in the Western countries, creates an imaginary homogeneity of naming that ignores the qualitative differences.

The statistic observation of a school population can be realized in two different ways: from the point of view of the school system and from the point of view of the student. In the first case, we follow the measuring of the system internal efficiency, as a ratio between the number of the graduated students and the number of the enrolled students in the period of a cycle (the number of the students repeating a year is considered as a *loss*). In the second case, the repeating of a school year is not a loss, the

purpose being to reach the level or the diploma depending on the individual objectives, external for the school system.

In the demographic analysis of a school population, the observation methods can be various: the stock can be measured by the number of the students enrolled during a year or by direct survey and the flows can be measured by comparing the successive enrollments (transversal analysis) or by following some students samples in time (longitudinal analysis).

The main demographic indicators that can be measured based on data about the evolution of a real students cohort, data obtained by a longitudinal continuous observation for many school cycles, based on a Lexis diagram, are:

- **the class transition rates**: *the promotion or graduation rate*, calculated as a relative ratio between the number of the students promoted from a class and the number of the students enrolled in that class; *the repeating rate*, calculated as a relative ratio between the number of the students that repeat another year in a class and the number of the students of that class; *the abandon rate*, calculated as a relative ratio between the outcomings of the system during or at the ending of the school year and the number of the students of that class; the sum of these three rates is 100%;
- **the cycle efficiency and the loss rates**; the cycle efficiency rate is calculated as a relative ratio between the outcomings (graduated) and the incomings: *the partial efficiency rate during the cycle*, whose numerator is the number of the graduated students that passed through the cycle in its *theoretical time* (the number of the students that leave the cycle as graduated without repeating any school year); *the total efficiency rate*, whose numerator is the number of the graduated students irrespective of the graduation year (in this case, the repeating students are not included in the *loss* category); if the partial efficiency rate is an indicator for the efficiency of the whole school system, the total rate is an indicator for the efficiency of the students;
- **the internal efficiency rates:** *the efficiency rate*, calculated as a ratio between the number of the graduated students, multiplied by the normal duration of the cycle and the total number of the *years-students*, consumed for their *producing* (it permitts the comparing of the total efficiencies, taking into account the effective time for passing through a cycle); *the loss coefficient*, representing the number of the years-students necessary for an *efficient* year, is calculated as a ratio between the number of the years-students consumed for a graduated (diplomated) and the normal duration of the cycle (this indicator is the reverse value of the efficiency rate).

In reference to the meaning and using of these indicators, two aspects must be underlined: when the continuous observation of the students cohorts is possible, the calculation of the efficiencies can be detailed depending on the social-economic criteria for measuring the inequalities of the social groups in front of the school success; according as, on the medium term and in a given cycle, the year-student is a good indicator for the whole incomings (the student work, the teacher work, the infrastructure, the social expenses) and the efficiency rates can be indicators of internal *productivity* of the school system.

In statistical practice, more often, we dispose only of data about annual enrollments, stocks whose composition is heterogeneous – new incomings in the system, students remained for the second year in the same class etc. – and to whom we

do not know the cohorts of origin. For that reason, the indicators previously presented, obtained in the ideal case of observing a real cohort of students by specific longitudinal analysis methods, must be adjusted to this situation, existing in our country too. In this case, of transversal analysis, the annual enrollments by cycles and classes give us the *stock* of number of students enrolled every year, and the *apparent flux* of students are obtained by comparing these successive transversal momentary data.

The apparent rates of sending to school – in the absence of data by age for the students, they are calculated as a relative ratio between the number of enrollments in the classe of a cycle and the population by age corresponding to that cycle, according to the institutional rules. Based on the table 2 data and on the data referring to the Romanian population distribution by age, in the period 1990-2006, in the table 3 are calculated the apparent rates of sending to school for our country.

Table 2

Evolution of enrolled population in pre-university education (thousand persons)

School year	Primary education (forms I-IV)	Secondary education (forms V-VIII)	High-school and vocational education (forms IX-XII)
1990/1991	1266	1465	1362
1991/1992	1223	1416	1154
1992/1993	1214	1360	1048
1993/1994	1251	1283	1023
1994/1995	1351	1181	1046
1995/1996	1392	1150	1073
1996/1997	1405	1141	1055
1997/1998	1373	1187	1013
1998/1999	1285	1272	946
1999/2000	1190	1309	917
2000/2001	1090	1321	927
2001/2002	1029	1292	963
2002/2003	991	1208	1011
2003/2004	1006	1117	1038
2004/2005	970	1026	1063
2005/2006	940	961	1052
2006/2007	920	923	1031

Source:Romanian statistical yearbook, 2007

The apparent rates of sending to school, having the contents and the meaning of the specialized gross rates of demography, must be utilized with many precautions, because the data can be not directly comparable: at the *numerator*, the annual enrollments do not always correspond with the number of students that really go to school (the sending to school can be with partial or full time); at the *denominator*, the selection of age group corresponding to the institutional standards for entry into school and for duration of a cycle, implies that all students are enrolled at the normal school age and they do not repeat any class of a cycle; the utilizing of the apparent rates of sending to school for time comparisons is not possible only if there were no changes of the conditions of admittance or duration of a cycle.

Table 3

Apparent enrollment rates for Romania (%)

Year	School cycles		
	Primary education	Secondary education	High-school and vocational education
1990	74.5	74.5	72.5
1991	73.6	72.9	61.2
1992	72.9	72.4	53.9
1993	73.0	71.8	51.6
1994	77.3	69.1	52.6
1995	79.7	68.9	54.6
1996	84.6	70.0	54.6
1997	88.8	71.8	54.3
1998	89.6	74.7	53.2
1999	89.3	75.3	53.9
2000	89.5	76.2	55.8
2001	85.8	78.2	59.3
2002	87.0	78.1	61.4
2003	89.5	77.9	61.2
2004	87.5	77.2	61.5
2005	84.7	79.4	61.0
2006	83.7	78.4	62.4

The comparison of the transversal successive data allows the reconstitution of the apparent promotion rates and the simulating of the passing through the school cycles by a real students cohort. For our country, the utilizing of table 2 data, representing the successive pupils enrollments from the first three education cycles (almost equal in duration and covering, mostly, the compulsory education in Romania), allows us to consider as insignificant the incomings during the cycle. In absence of information about the flux, we can calculated only **the apparent promotion (passing through) rates** between cycles, as a relative ratio between the enrollments of two successive cycles (obviously, with a delay of four years, equal to the duration of a cycle) and **the apparent loss rates**, as a difference between 100% and the passing through rates. Based on the data about the students enrollments by school cycles, in the period 1990-2006, we can calculate only nine transition rates between the three cycles (table 4).

It is proper to remark the fact that every cycle loss includes both the repeatings of a class and the abandons during the school cycle, and the number of cycle enrollments based on wich we calculate the indicators, includes, without possibility of those estimation or detailing, both the pupils who repeat a school year and the pupils new entried during the cycle. The apparent transition rates thus calculated are gross instruments and only the comparison of these rates for many successive years allows the discovery of accidental phenomena, the evidencing of evolutive tendencies but also to verify the validity of medium rates calculation for many promotions for the purpose of school population number forecasting.

The promotion medium rate between the primary and secondary cycles, in the analysis period, was of 94%, and the loss medium rate was only of 6%; the average of

promotion rates to high-school and vocational education was of 80.67% and the average of loss rates between the secondary and the high-school education was of 19.33%.

Table 4

Evolution of apparent cycle transition rates for Romanian school system (%)

Year	Transition rates between primary education and secondary education		Transition rates between secondary education and high-school education	
	Promotion rate	Loss rate	Promotion rate	Loss rate
1990	93	7	80	20
1991	94	6	80	20
1992	95	6	81	19
1993	94	5	81	19
1994	94	6	79	21
1995	95	5	79	21
1996	94	6	80	20
1997	93	7	81	19
1998	94	6	85	15

If we imaginate the table 2 data represented in a Lexis diagram, on this diagonals figure the apparent cohorts, because the new enrollments from the real initial cohort were partially dispersed in the next cohorts by repeating, as at every stage, the diagonal classes increased with the repeating students of the previous cohorts and with the new incomings from exterior. For each apparent cohort we can calculate an **apparent partial efficiency rate**, as a relative ratio between the number of enrollments in the high-school education and those of primary education, enrolled 8 years earlier; we can also calculate an **apparent partial loss rate** of cohort students number, as a difference between 100% and the corresponding apparent partial efficiency rate (table 5).

Table 5

Apparent partial rates of efficiency and loss for Romanian school population (%)

Year (apparent cohort)	Apparent partial efficiency rate	Apparent partial loss rate
1990/1991	74.72	25.28
1991/1992	74.98	25.02
1992/1993	76.36	23.64
1993/1994	76.98	23.02
1994/1995	74.83	25.17
1995/1996	74.56	25.44
1996/1997	75.65	24.35
1997/1998	76.62	23.38
1998/1999	80.23	19.77

The earning rates thus calculated, based on the number of students enrolled in a cycle and without the possibility of taking into consideration the repeatings, are productive rates of the education system, from the point of view of school *production* chain. Only the observation of a students sample could, *a posteriori*, provide a correct measure of students efficiency (analogous with the intensity of a demographic phenomenon into a generation).

For each couple of successive school years, it is possible, with the help of a passing rates series, the calculation of a moment indicator, named **the momentary efficiency rate**; this efficiency conjunctural indicator synthetizes the theoretical passing through of a pupil enrolled in the primary education in the year **t**, who would pass through from one cycle to another with the transition probabilities observed during the years **t** and **t-4** (table 6).

Table 6

Evolution of momentary efficiency rates of Romanian school system

Year	Momentary efficiency rate (%)
1990/1991	77.45
1991/1992	81.38
1992/1993	77.28
1993/1994	74.18
1994/1995	68.91
1995/1996	75.20
1996/1997	73.32
1997/1998	76.14
1998/1999	74.73
1999/2000	74.40
2000/2001	75.75
2001/2002	76.00
2002/2003	79.40

We consider necessary the following specification : the momentary efficiency rate have, in connection with the efficiency rate calculated in a real cohort, the same properties as the conjunctural fertility rate in connection with the final off spring of a generation .

The evolution of the momentary efficiency school rates can be explained either from the viewpoint of cohort effects and from the viewpoint of passing through effects (comparable with the age effects).

The cohort effects can be caused by: the population dynamics, the evolution of entrance capacity in the school cycles, the change of education demand in families, the selection policies for the entry into a school cycle. Irrespective of their causes, the variations of student numbers at the entry into a cycle modify the momentary efficiency rate. In our country, the fluctuations of this indicators in the last decade result both from the unfavourable evolution of the demographic phenomena and from the frequent changes of the admittance system in high-school education cycle.

The evolution of the transition rates between cycles obviously influences the momentary conjunctural indicator dynamics (the efficiency rate of moment), being considered as *passing through effects*. These passing rates are strongly influenced by the entrance capacity in every school cycle, wich is, in its turn, partially dependent on cohort numbers.

The utility of this indicator is double: it allows the characterizing of the entire evolution of school system performances and the evidencing of those determinants; because it can be calculated based on the direct data for only two successive periods of a cycle, the indicator contains the germseed of the school population forecast.

We consider that the efficiency of the analysis model, presented in this study, would considerable increase if the statistic data that are based on, referring to the Romanian school population, will be available in a detailed variant: by classes of the school cycles, by territorial units etc.

The importance of a school demography model like this, that improves, quantitatively and qualitatively, the statistic information of Romanian education, becomes doubly so as the nations that claim an honourable place in the world-wide economy, especially in the globalization context, can not ensure it without real possibilities of competition. The high technological level can not be assimilated by a labor force arose from a low education level population. The increasing of the general enrollment rate, and especially of the secondary enrollment rate, must be a prior objective for the general short term strategy, and the maintaining of a high level for the enrollment rate must be the permanent objective for the general strategy in each country so much the more Romania; for our country are also necessary the following objectives: the reorganization of the school system; the correlating of calification and education system with labor market; the elaboration of portfolios for continuous education; the continuous formation for the adults; the increasing of equality of chances in the school system, between: women and men, rural and urban area, regions and other disadvantaged social groups.

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