# MIGRATION PROCESSES IN THE SYSTEM OF MODELS FOR INTEGRATED TERRITORIAL DEVELOPMENT OF THE SILISTRA REGION

Boris Mihailov

September 1978 WP-78-42



2361
Laxenburg
Austria

International Institute for Applied Systems Analysis

## Table of Contents

# MIGRATION PROCESSES IN THE SYSTEM OF MODELS FOR INTEGRATED TERRITORIAL DEVELOPMENT OF THE SILISTRA REGION

## INTRODUCTION

The problem for migration processes modelling is complex comprising many aspects:

- migration is closely connected with natural demographic processes, such as fertility and mortality which are in turn defined by deep economic and social aspects;
- the motivations for migration have a psychological basis with many economic, social, and in some cases political aspects;
- migration expresses itself simultaneously in sectorial and spatial aspects. The latter determine its main characteristics:
  - o migration is not only affected by factors of a different character, but on the contrary, it is essentially influenced by the development of different sectors and activities within the region. Therefore this influence can, and has to, obtain a quantitative assessment.

It can, however, be said that *the investigations in the sphere of migration processes modelling to date have been made more on the influences of different factors on migration processes and have inadequately taken into account the repercussions (feedback) of migration processes on the development of different spheres and activities.* In this sense, the problem of migration processes regulation is less elaborated in the regional aspect.

The elaboration of the system of models for integrated territorial development of the Silistra region enables us to improve both the integrated regional modelling and the migration processes modelling. Therefore the lack at this stage of a general concept for the system of models for integrated regional development (IRD) not only would aid migration processes modelling, but the requirements of the migration processes model to the remaining subsystem models of the region will exceptionally facilitate the elaboration of the general concept for the IRD system of models.

Migration processes are connected mainly with the movement of labor resources. In Bulgaria, great importance is paid to the problem of labor resources, their movement and their effective utilization. To this end, many government decisions are accepted, as for example: for the elaboration of a general scheme for territorial distribution of productive forces and national balance of labor resources; for private households development and self-sufficiency of the population with agricultural products, with the aim to fully utilize the work of the total population; for the construction of a system of complex services in territorial aspects which is based on the territorial allocation of the population as a consumer of the services; and for the implementation of two and three shifts per day type of work for enterprises and productive plants with the aim of fully utilizing these.

It can be claimed that mainly in the sphere of the problems connected with labor resources, their movement and utilization, *one feels the lack of the models for decisionmaking in regional aspects and the Silistra project is an appropriate reason for solving this problem.* Migration processes modelling has to be adequate through the economic and social mechanism management on the national and regional level in Bulgaria. It is necessary to stress that the mechanism for economic management in Bulgaria is characterized as centralized, which will reflect to some extend on the assigning of input parameters of the migration processes model. At the same time, the subjective character of the motivation of population behavior, when they decide to migrate will approach the instruments for the regulation of of migration processes in centrally planned economies to those in market economies.

One can also claim that the differences in the management mechanisms in different countries will provoke differences more in the approach and scheme of the calculation cycle connected with the migration processes than in the instruments for their solution, which makes the mutual participation of specialists from different countries working on this complex problem especially useful.

The present investigation is made on the following initial conditions:

- an intraregional input-ouput balance will be elaborated within the region which will serve for the assigning of restrictions to the different subsystem models including the migration processes model; and
- separate models with local criteria will be worked out for the different productive and non-productive subystems in which the problem of labor resources will play an important role.

This will, on the one hand, definitely influence the connections of the separate models with the migration processes model, and on the other, will definitely require the differentiation of the task which will solve the other models and the tasks which have to be solved by the migration processes model.

- Despite local optimums satisfying the separate subsystems strategic-type models will be solved within the framework of the region to satisfy the global optimum of the region.

This will entail additional alterations of the input parameters of the separate subsystem models including the migration processes model. This condition raises the problem of the approach which has to insure convergence between global decisions concerning the region and local decisions concerning the separate subsystems, which is subject to the general concept for the system of regional models.

- The reverse influence of migrations on the separate subsystem development requires that the migration processes be regulated in terms of the appropriate instruments.

These instruments have to be based mainly on the impact of the incentives of different population groups and in this way influence their motivation when they make the decision whether to migrate or not.

The substantiation of paramters of the migration processes model in regional aspects, the method in which to connect this model with other subsystem models and the instruments for its solution require that *a system analysis has to be made within the following main problems and in the following sequence:*

1. The scope of the migration processes model has to be defined and differentiated from the other subsystem models of the region.
2. The factors which influence the size of migration flows have to be investigated and to be linked with the parameters of the remaining subystem models within the region.
3. The cycle of the migration processes and their regulation has to be connected with the optimization cycle of the IRD system of models.

The above statement of the problem will add to the existing approaches for the investigation and solution of migration migration processes modelling and obviously the approach for construction of an IRD system of models. Accepting such a statement, we will be preserved on the one hand, from missing the important aspects of the problem concerning migration processes, and on the other, from invading areas which are subject to the solution of other models and subsystems, which occurs very often in practice.

*The main goal of this investigation is* to define such an approach to the construction of an optimization cycle of separate subsystems (in this case of migration processes) which will serve for improvement of the optimization cycle of the unified IRD system of models.

## I. SCOPE AND DIFFERENTIATION OF THE MIGRATION PROCESSES MODEL (MPM)

The investigation of the problems so far connected with migration processes enables us to accept that the subject of MPM is a spatial aspect of demographic processes, i.e. the population movement under the influence of factors of a demographic, economic, and social character; the consequences of that movement and its regulation. Determining the subject of migration modelling in this way requires that special attention be paid to the spatial aspect of the other subsystem models within the framework of the region.

It is obvious that migration processes, in spite of the factors which have provoked them have as a basis natural demographic changes in the population growth and its structure. The population demographic growth in the single-region case may be expressed by the well-known Leslie model (see Keyfitz, 1968)[2]:

$$\{\underset{\sim}{K}_p^{t+n}\} = \underset{\sim}{L}_p \; \{K_p^t\} \quad , \tag{1}$$

where

$\{\underset{\sim}{K}_p^{t+n}\}$ = projected population of the subregion p and time period of projection n;

$\underset{\sim}{L}_p$ = Leslie matrix derived by fertility and mortality rates in the same region;

$\{K_p^t\}$ = column vector of the population under analysis in basic year t in subregion p.

This model has to be used at the intial stage in working out the regional input-output balance.

The Rogers model [7]:

$$\{\underset{\sim}{K}_{ps}^{t+n}\} = \underset{\sim}{G}_{ps} \; \{K_{ps}^t\} \quad , \tag{2}$$

where

$\{\underset{\sim}{K}_{ps}^{t+n}\}$ = projected multiregional population;

$\underset{\sim}{G}$ = multiregional growth matrix (Rogers, 1975) taking into account the spatial distribution of the population differentiated by age groups.

It can be used successfully for forecasting the population growth and structure on a basis for defining the size of migration flows by subregions. The population growth and migration under the conditions of the Silistra region, computed in terms of this model, are expressed graphically in Figure 1. The results computed* are presented in Appendix I.

It is necessary to stress that this approach to derive migration flows does not answer the following question: Which are the factors and how do they influence the deriving of migration rates? (because it is obvious that the influencing factors during the basic year will be different during the projection period). *Hence, if we directly connect the migration coefficients derivations with the factors from which the migrations depend, the above shown approach can be used successfully for forecasting the size and structure of migration flows for a prospective period, changing the magnitude of the migration coefficients in the model* [5].

In this way the MPM can be differentiated as independent with its own significance in the IRD system of models.

## II. FACTORS INFLUENCING THE SIZE OF MIGRATION FLOWS

The differentiation of the population by age groups is of capital importance for the determination of migration flows. In this respect, the working age of the population plays a determining role in the investigation of factors which influence population migration. This enables to investigate the place and role of labor resources in the unified IRD system of models.

In view of the above, we can reach the following main goals:

- more precise differentiation of the MPM and the other subsystem models; (in the latter, labor resources take part in defining the efficiency of their activity);
- the system analysis of factors which influence labor

*The computation is made by D. Philipov.

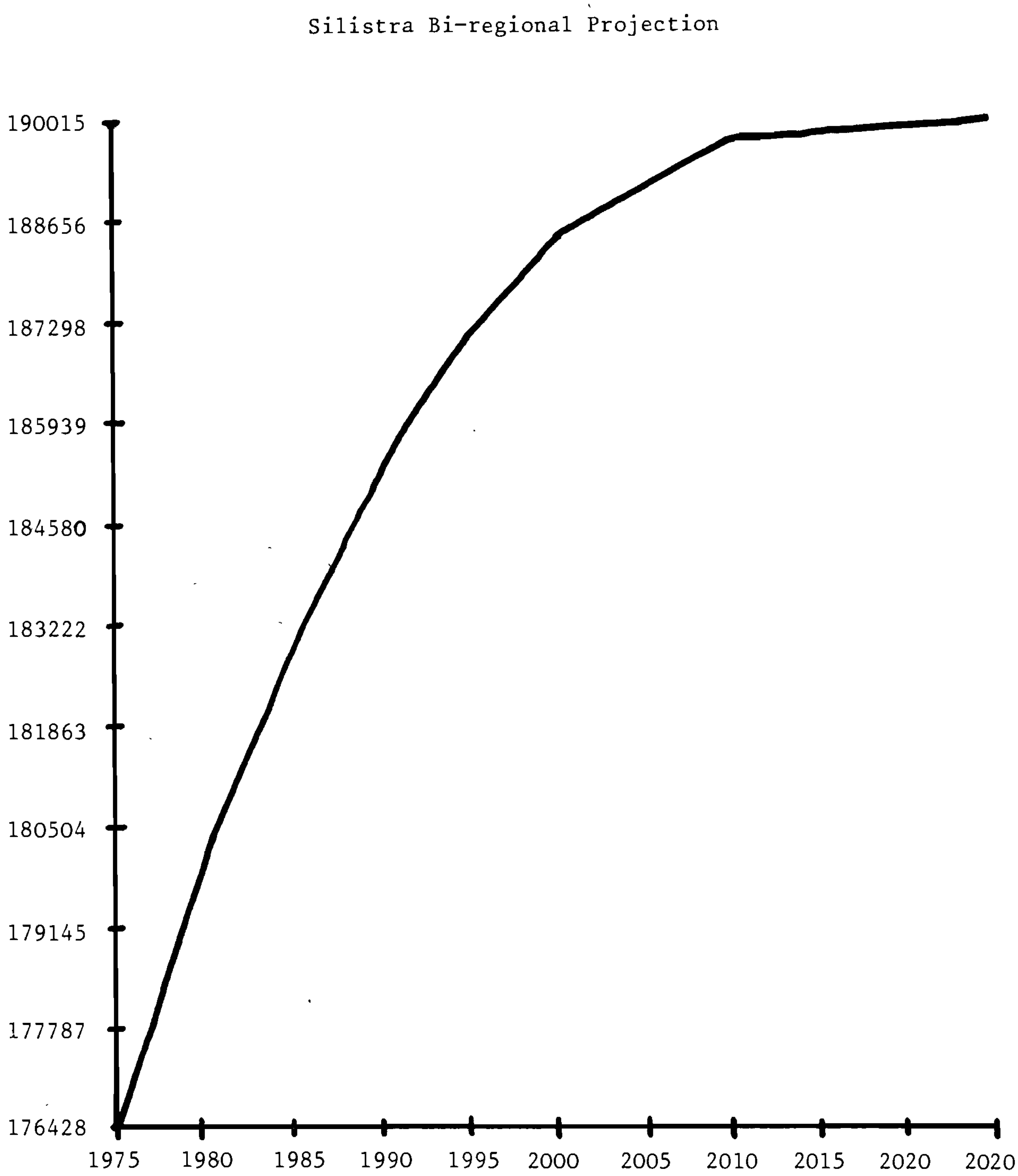
Silistra Bi-regional Projection
190015
188656
187298
185939
184580
183222
181863
180504
179145
177787
176428
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
2020

Figure 1

resources migration;

- the MPM requirements can be sent to the other subsystem models; and
- more precise definition of the MPM interdependencies with the unified IRD system of models.

A general idea concerning the relations between the labor resources and other subsystem models in the region is shown in the scheme presented in Figure 2.

Generally we can see from the scheme that the relations of labor resources with the other subsystems are interrelated: labor resources supply other subsystems with a labor force while the other subsystems supply the labor resources with commodities, facilities and lifestyle scenarios.

The formation of the labor resources by subregions and their movement can be expressed in the following way:

$$L_{ps}^{t+n} = K_{p}^{t+n} - N_{p}^{t+n} \pm M_{ps}^{t+n} \pm CP_{ps}^{t+n} \quad , \qquad (3)$$

where

$Kp$ = demographic growth of local population in subregion p (defined by formula 1);

$N_p$ = population in out working age in subregion p (defined by formula 1);

$M_{ps}$ = the number of migrants between subregions p and s (defined by formula 2);

$CP_{ps}$ = number of commuters between subregions p and s.

Since the basic regional input-output balance will play an important role in the equilibrium of subsystem elements within the region (including labor resources) it is necessary to include in this the differentiated separate subsystems as a basis for the allocation of labor resources.

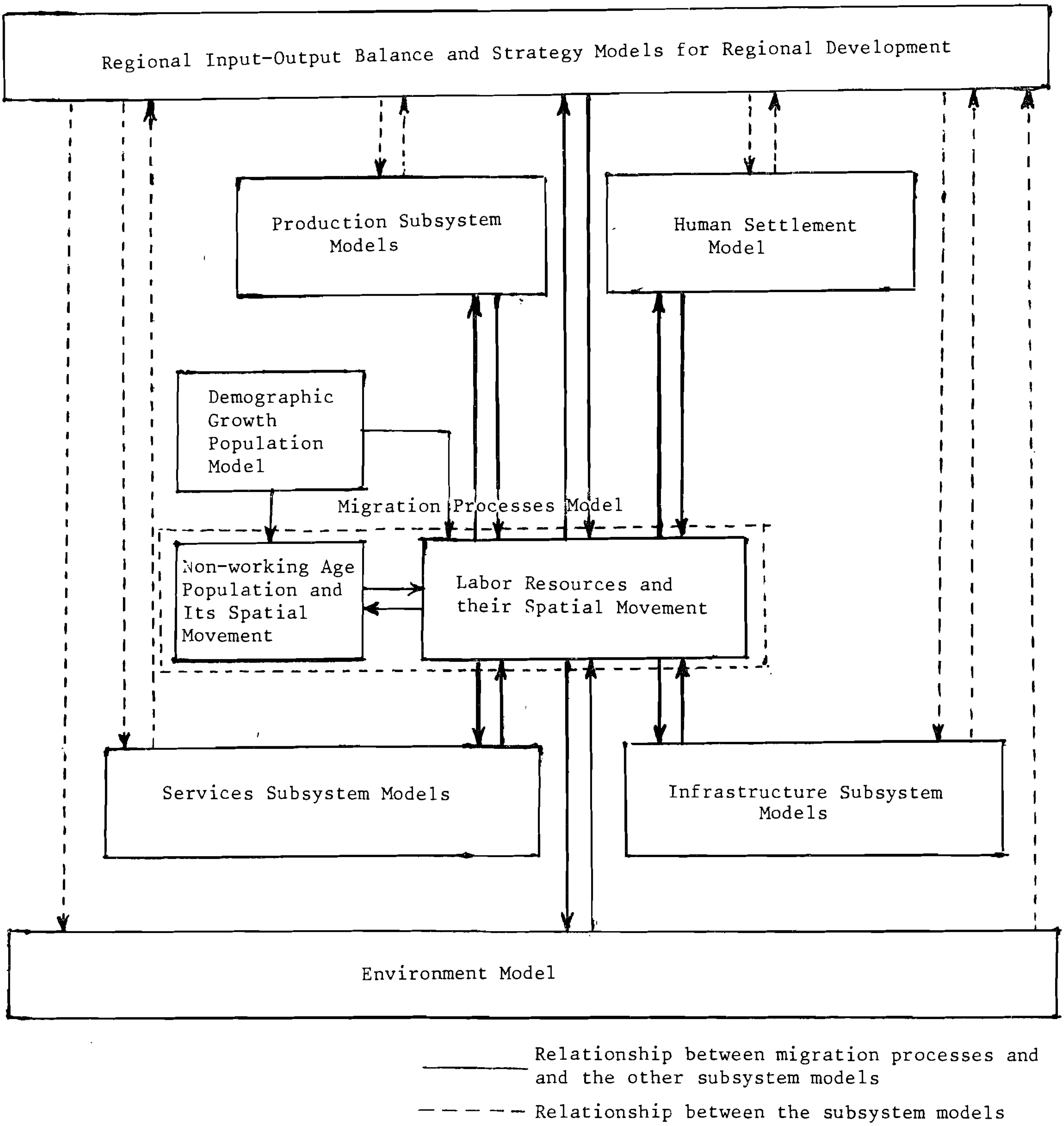
Regional Input-Output Balance and Strategy Models for Regional Development
Production Subsystem Models
Human Settlement Model
Demographic Growth Population Model
Migration Processes Model
Non-working Age Population and Its Spatial Movement
Labor Resources and their Spatial Movement
Services Subsystem Models
Infrastructure Subsystem Models
Environment Model
Relationship between migration processes and and the other subsystem models
Relationship between the subsystem models

Figure 2

$$\sum_{j\varepsilon J} X_{ip}^{rt} + \sum_{q\neq r} X_{ip}^{qrt} = \sum_{j\varepsilon J} A_{ij}^{r} X_{jp}^{rt} + \sum_{j\varepsilon J} B_{ij}^{r} X_{jp}^{rt}$$

$$+ \alpha_i Z_1^{rt} + \beta_i Z_2^{rt} + \sum_{q\neq r} X_{ip}^{rqt} , \qquad (4)$$

$$i \varepsilon I , \quad j \varepsilon J , \quad p \varepsilon P ,$$

where

$X_{ip}^{rt}$ = volume of i-th product produced in p-th subregion of the region during basic year t;

r = subregional index within the region;

q = import-export index to and from the subregions of the r-th region;

$A_{ij}$ = volume of i-th product needed for the production of unit of j-th product (for current productive consumption of the separate subsystems);

$B_{ij}$ = production fund coefficient;

$\alpha_1 Z_1$ = volume of i-th product for final non-productive consumption ($\alpha_i$ = assortment coefficients for participation of the i-th product in total volume of the production for consumption);

$\beta_i Z_2$ = volume of the i-th product for consumption by the non-productive subsystems ($\beta_i$ coefficients analogous of $\alpha_i$).

The differentiation of subsystems in the regional balance makes it possible to differentiate the labor resources allocation viewed as productive resources which may be expressed in the following way:

$$\sum_{j\varepsilon J} L_{mp}^{rt} + \sum_{q\neq r} L_{mp}^{qrt} = v_{m1} X_{jp}^{It} + v_{m2} X_{jp}^{IIt} + v_{m3} X_{jp}^{IIIt}$$

$$+ v_{m4} X_{jp}^{IVt} + \sum_{q\neq r} L_{mp}^{rqt} , \qquad (5)$$

where

$L^{rt}_{mp}$ = quantity of local resources in region r by m-th type of qualifications ($m = 1,2,\ldots,n$) in p-th subregion during basic year t;

q = index of labor resources movement to and from other regions;

$v_1, v_2, v_3, v_4$ coefficients for relative labor resources participation in subsystems producing products for current consumption, for productive funds, for final consumption and for non-productive subsystems.

Summarizing the labor resources by columns of the balance makes it possible to derive the total quantity of labor resources used by different types of qualifications in the different subsystems and by the subregions of the region:

$$L_{mp} = \sum_{i\varepsilon I} v_{mj}X_{jp} \quad . \tag{6}$$

The gross wage by subsystems and subregions of the region may be expressed as follows:

$$V_{jp} = \sum_{i\varepsilon I} v_{mj}\gamma_{mi}X_{jp} \quad , \tag{7}$$

where

$\gamma_{mi}$ = normative wage by m-th type of qualification in i-th sector.

The balanceing of labor resources within the region by subregions enables us to derive the differentiation of the conditions by subregions, both with regard to labor resources utilization and to the satisfaction of the labor resources and the population with different products, services and facilities. The differentiation of conditions concerning labor resources, can be shown by subregions within the region, and outside the region as follows:

- the differentiation of labor resources by qualifications ($m = 1,\ldots,n;\ n+q$) where: $n+q$ = index differentiation outside the region;

- differentiation of labor resources by the obtained wage volume $V_j$ $(j = 1,\dots,m;\ m+n)$ where: m+n = differentiation outside the region r;
- differentiation of labor resources participation in different activities:

$$V_{mj} = \frac{L_j}{X_{ij}} \quad , \quad (j = 1,\dots,n; \quad n+q) \quad ,$$

- differentiation of the population by satisfaction with products for current personal consumption:

$$\frac{\alpha_i Z}{K_p} \; ; \; \frac{\alpha_i Z'}{K_q} \quad ,$$

(the second fraction here and further refers to the differentiation outside the region r;
- differentiation of the population by satisfaction of living space:

$$\frac{\beta_i Z_1}{K_p} \; ; \; \frac{\beta_i Z_1'}{K_q} \quad ,$$

- differentiation of the population by satisfaction with public services and facilities:

$$\frac{\beta_i Z_2}{K_p} \; ; \; \frac{\beta_i Z_2'}{K_q} \quad ,$$

- differentiation of the population by potentiality for education:

$$\frac{\beta_i Z_3}{K_p} \; ; \; \frac{\beta_i Z_3'}{K_q} \quad ,$$

- differentiation of the population by availability of health care services:

$$\frac{\beta_i Z_4}{K_p} \; ; \; \frac{\beta_i Z_4'}{K_q} \quad ,$$

- differentiation of the population by availability of cultural facilities:

$$\frac{\beta_i Z_5}{K_p} \quad ; \quad \frac{\beta_i Z_5'}{K_q} \quad ,$$

- differentiation of the population by environmental quality:

$$\frac{\beta_i Z_6}{K_p} \quad ; \quad \frac{\beta_i Z_6'}{K_q} \quad .$$

The above differentiations in living and working conditions of the population and of labor resources in different subregions of the region, by its deep entity, express the factors which form the population's motivation to migrate from one to another subregion of the region, or out of the region. This means that accordingly, the extent of the differentiation by the different factors is necessary to differentiate the relative subregions of potential inflow or outflow of the population within the region and out of the region. This shows, on the other hand, the objective fact that *as a rule, the labor resources distribution by means of the regional input-output balance (respectively by means of subsystem models) will always differ by the real distribution of labor resources expressing the propensity of the population to migrate to different subregions of the region or out of the region.*

In this respect the following inequality will be valid:

$$\sum_{j \varepsilon J} K^{t+n} + \sum_{j \varepsilon J} L_{ps}^{z,t+n} - \sum_{j \varepsilon J} N_p^{t+n} \gtrless \sum_{j \varepsilon J} M_{ps}^{t+n} \quad , \qquad (8)$$

(the elements are taken from formula 3 without considering the commuting patterns and $L_{ps}^{r,t+n}$ is derived from formula 5 through regional input-output balance). The above difference is due to the fact that the deriving of the labor resources size by means of regional input-output balance and other subsystem models has not taken into account the factors which provoke population migration. The above circumstances raises two basic problems to be solved by the IRD system of models: the fist requires that the real size of the migration processes be defined taking into account the factors which provoke them; the second requires that the migration processes be regulated to the direction which would satisfy both the criteria used by planners and the personal incentive of the population.

The factors influencing the migration processes are comparatively well investigated, and in this respect, La Bella's investi- with applicable character [4, 5, 6] deserves special attention It is necessary to stress that for potential migrants the factors expressing the differentiation of the potentiality to have different commodities, services, and facilities have an entirely exogenous character and for planners it makes it possible to forecast them and at the same time, to forecast the possible decision of the population to migrate. *The objective character of the migration factors, as previously stated, makes in principle possible the usage of common techniques for forecasting migration flows in both market and centrally planned economies.*

Thus, it may, in principle, be accepted that the index for migration $q_{ps}$, propensity to migrate respectively from the p-th to the s-th subregion of the region expresses the fraction between the number of migrants and the population size in the relative subregion:

$$q_{ps}^{t+n} = \frac{M_{ps}^{t+n}}{K_p^{t+n}} \quad . \tag{9}$$

The above fraction is a function of the differences of the above mentioned factors between the subregions of the migration and the subregions of attraction which provoke differences in the expected profit for the migrant (see A. La Bella [2]):

$$q_{ps}^{t+n} = f(a, \Delta R_{ps}, \Delta C_{ps}, \Delta h_{ps}^{R}, \Delta h_{ps}^{C}, r, L_{ps}, \nu_{ps}) \quad , \tag{10}$$

where

where

$\Delta R_{ps}$, $\Delta S_{ps}$ = existing differentiation in the costs and benefits of population living in different subregions;

$\Delta h^R_{ps}$, $\Delta h^C_{ps}$ = expected differentiation in growth rates of the same factors;

$r$ = discount factor;

$L_{ps}$ = differentiation of the potentiality for finding work;

$\nu_{ps}$ = expected cost of the move.

In this regard it is necessary to stress that the differentiation of the factors for migration by subregions of the region requires that a comparison be made between the subregions of the Silistra region and specific subregions outside the region but not, as some authors propose, with the average level of the country's conditions. This is necessary because the average level of the factors of a country tends to compensate for the differences between the specific attractive subregions and reduces their real power of attraction in the model.

The further investigation of the problem requires that the place of the MPM be shown in the IRD system of models.

## III. PLACE OF THE MIGRATION PROCESSES MODEL (MPM) IN THE OPTIMIZATION CYCLE OF THE SYSTEM OF MODELS FOR INTEGRATED REGIONAL DEVELOPMENT (IRD)

The lack of general concept for the system of regional models requires that only the main stages of the optimization cycle of the system of models for IRD be treated. Therefore, the following statement may be accepted: the optimization of separate subsystems has to be realized with restrictions of the labor resources by separate subregions of the region, which are defined by the natural demographic population growth, (i.e. without population migration) defined by formula 1. The possible population movement (migration processes) has to be defined at the subsequent stage, after deriving the expected real volume of migration flows and taking into account the influence of the factors which provoke them. This makes possible the MPM to be differentiated into an independent model. On the other hand, it is possible at the initial stage of the optimization cycle of the system of models that a solution of the other subsystem models be made in which case the surplusses of labor resources release by subregions of the region. These surplusses influence the optimal decision of these models which is derived considering the final expenditures and efficiency concerning labor resources movement within the region.

*The main stages of the optimization cycle of the IRD system of models with respect to the place of migration processes may be formulated as follows:*

Stage 1: Elaboration of Prospective Regional Input-Output Balance.

This balance may be elaborated on the basis of basic regional input-output balance, the limitations derived by a prospective national interregional intersectorial balance and by the demographic growth of the population model. In this sense the prospective regional input-output balance will appear as follows:

$$\sum_{j\varepsilon J} X_{ip}^{t+n} + \sum_{q\neq r} X_{ip}^{qr,t+n} = \sum_{j\varepsilon J} A_{ij}X_{jp}^{t+n} + \sum_{j\varepsilon J} B_{ij}X_{jp}^{t+n}$$

$$+ \alpha_i Z_1^{t+n} + \beta_i Z_2^{t+n} + \sum_{q\neq r} X_{ip}^{rq,t+n} \qquad (11)$$

$$i \varepsilon I \ , \quad j \varepsilon J \ , \quad p \varepsilon P \ .$$

The prospective regional input-output balance has the following constraints:

$$\sum_{j\varepsilon J} X_{ip}^{qr,t+n} \leq \bar{I} \ , \qquad (11a)$$

- constraints for maxiumum import of production in region r from other regions q;

$$\sum_{j\varepsilon J} X_{ip}^{rq,t+n} \geq \underline{E} \quad , \tag{11b}$$

- constraints for minimum export from region r to other regions q;

$$\sum_{i\varepsilon I} \alpha_i Z_1^{t+n} \geq \underline{H}_1 \quad , \tag{11c}$$

- constraints for minimum final personal consumption;

$$\sum_{i\varepsilon I} \beta_i Z_2 \geq \underline{H}_2 \quad , \tag{11d}$$

- constraints for minimum volume of production for consumption by the non-productive subsystems;

$$\sum_{i\varepsilon I} A_{ij} X_{jp}^{t+n} \leq \bar{A} \quad , \tag{11e}$$

- constraints for maximum volume of material resources;

$$\sum_{i\varepsilon I} B_{ij} X_{jp}^{t+n} \leq \bar{B} \quad , \tag{11f}$$

- constraints for maximum volume of capital investments;

$$\sum_{i\varepsilon I} V_{mj} X_{jp}^{t+n} \leq \bar{L}_{mp} \quad , \tag{11g}$$

- constraints for maximum quantity of labor force by different types of qualification and by subregions of the region. In this case the quantity of labor resources is derived by formulate (1) and (3) without taking into account the size of migration processes and commuting patterns;

$$\sum_{i\varepsilon I} V_{mj} \gamma_i X_{jp}^{t+n} \leq \bar{V}_{jp} \quad , \tag{11h}$$

- constraint for maximum gross wage.

Stage 2: Optimization of Separate Subsystems

The optimization may be realized using local criteria and taking into account the constraints assigned by the regional balance (11). Generally speaking when the separate subsystem maximizes its final income, the volume of this income may be derived by means of summing up the relative columns of the regional balance and will consist of the following elements:

$$\underbrace{\sum_{i\varepsilon I} P_j X_{jp}^{t+n}}_{\text{revenue}} = \underbrace{\sum_{i\varepsilon I} A_{ij} P_i X_{jp}^{t+n}}_{\text{current material costs}} + \underbrace{\sum_{i\varepsilon I} V_{mj} \gamma_{mi} X_{jp}^{t+n}}_{\text{wage costs}} + \underbrace{\sigma \sum_{i\varepsilon I} B_{ij} P_i X_{jp}^{t+n}}_{\text{profit (income)}} \qquad (12)$$

where

$P_j$ = price of product j;

$\sigma$ = percent of profitability referring to the value of the installed productive funds.

Thus, the income of the separate subsystems will represent the difference between revenue and production costs and has to be maximized:

$$\max \left\{ \sum_{i\varepsilon I} \sum_{p\varepsilon P} [P_j^{t+n} - (A_{ij} X_{jp}^{t+n} + V_{mj} \gamma_{m_i}^{t+n})] \, X_{jp}^{t+n} \right\} . \qquad (13)$$

The result of the optimization of the separate subsystems will be new quantities of their elements in the framework of the assigned constraints which will differ from its quantity in regional input-output balance. As far as labor resources are concerned (viewed as productive resources) the difference obtained in the result of the optimization will be:

$$\sum_{i\varepsilon I} V_{mj} X_{jp}^{t+n} - \sum_{i\varepsilon I} \check{V}_{mj} \check{X}_{jp}^{t+n} = \check{L}_{mp}^{t+n} . \qquad (14)$$

This requires the new quantities of the subsystem elements to be included in the regional input-output balance (11) which will appear as follows:

$$\sum_{j\varepsilon J} X_{ip}^{t+n} + \sum_{q\neq r} X_{ip}^{qr,t+n} \pm \sum_{j\varepsilon J} \check{X}_{ip}^{t+n} = \sum_{j\varepsilon J} A_{ij}X_{jp}^{t+n} \qquad (15)$$

$$\sum_{j=J} B_{ij}X_{jp}^{t+n} + \alpha_i Z_1^{t+n} + \beta_i Z_2^{t+n} + \sum_{q\neq r} X_{ip}^{rq,t+n} \pm \sum_{q\neq r} \check{X}_{ip}^{rq,t+n} ,$$

where

$$\pm \sum_{j\varepsilon J} \check{X}_{ip}^{t+n} \quad - \ , \qquad (15a)$$

- balance of additional volume or reduction of volume of product i as a result of the subsystem optimization and of required labor resources;

$$\pm \sum_{q\neq r} \check{X}_{ip}^{rq,t+n} \quad - \ , \qquad (15b)$$

- balance of product i intended for export in the case of surplus or for import in the case of deficit in comparison with its quantity in the prospective regional input-output balance (11).

Stage 3: Strategic Type Models Solving for Development of the Region

The goal of the present paper is not to investigate the entire optimization process of the IRD system of models and to solve all its problems (this is the goal of the general concept), but we will expose here only the outline of one feasible model of a strategic type. This model is based on the alternative development of the major productive subsystems depending on their efficiency and caused by that development redistribution of the resources within the region (including the spatial relocation of labor resources). Hence, the optimization in the regional aspect is realized by means of the criteria of higher rank, compared with local criteria of the separate subsystems.

Feasible criteria of such a strategic type model may be the maximization of final personal consumption and the consumption intended for the non-productive subsystems by an assigned assortment structure:

$$\alpha_i Z_1^{t+n} + \beta_i Z_2^{t+n} \rightarrow \max \quad . \tag{16}$$

The constraints are taken from the regional input-output balance (15) as a result of separate subsystem model solving (13) without taking into account the constraints for the resources by subsystems of the region (including labor resources).

$$\sum_{j\varepsilon J} \check{X}_i^{qr,t+n} \leq \bar{\bar{I}} \quad , \tag{16a}$$

$$\sum_{j\varepsilon J} \check{X}_i^{qr,t+n} \geq \underline{\underline{E}} \quad , \tag{16b}$$

$$\sum_{i\varepsilon I} V_{nj} X_j^{t+n} \leq \bar{\bar{L}}_m \quad , \tag{16c}$$

and so on following the constraints of (11).

The result of the strategic model solving will be the relocation of labor resources among the subregions of the region the quantity of which will be:

$$\sum_{j\varepsilon J} \check{L}_{mp}^{r,t+n} + \sum_{q\neq r} \check{L}_{mp}^{qr,t+n} = V_{m1}\check{X}_{jp}^{I,t+n} + V_{m2}\check{X}_{jp}^{II,t+n} + V_{m3}\check{X}_{jp}^{III,t+n}$$

$$+ V_{m4}\check{X}_{jp}^{IV,t+n} + \sum_{q\neq r} \check{L}_{mp}^{rq,t+n} \quad . \tag{17}$$

The required quantity of migration flows originating from the above solution may be derived by the following way:

$$\check{M}_{ps}^{t+n} = K_p^{t+n} - N_p^{t+n} - \Big( \sum_{j\varepsilon J} \check{L}_{mp}^{r,t+n} + \sum_{q\neq r} \check{L}_{mp}^{qr,t+n} - \sum_{q\neq r} \check{L}_{mp}^{rq,t+n} \Big)$$

$$- \Delta m_{ps} \quad , \tag{18}$$

where

$M_{ps}$ = required size of migration flows from subregions p to s, of the region;

$K_p$ = population size derived by means of the Leslie model; model [1];

$N_p$ = population size in non-working age;

$\Delta m_{ps}$ = additional part of the population (families) which are expected to migrate because of their relation with the labor resources movement.

The section of the model in parentheses represents the size of labor resources [derived by formula (17) as a result of the optimization decision of strategic type models (16)].

It can definitely be claimed that the above allocation of labor resources by subregions is submitted to the requirements of the strategic character for the development of the region, but it does not directly reflect the propensity of the population to migrate between the subregion of the region and out of the region. Nevertheless, this is an interesting fact that the strategic decision provokes alterations in the conditions and in the factors for migration but in some cases some of these factors will objectively favor the migration movements, while others will restrict them. This requires the expected quantity of migration flows to be derived. This size should be real in the conditions consistent by the optimal decision of the strategic type models for the development of the region, taking into account the influence of the factors to the migration.

Stage 4: Defining the Expected Quantity of Migration Flows

The expected size of migration flows might be expressed in terms of Rogers' model [2] in which the migration rates $q^{t+n}$ are derived by La Bella's model (10) and at the conditions consistent by the strategic type models (16):

$$\{\underset{\sim}{M}_{ps}^{exp,t+n}\} = \underset{\sim}{G}_{ps} \{K_{ps}^{t}\} \quad , \tag{19}$$

where

$\{M_{ps}^{exp,t+n}\}$ = vector of the expected size of migration flows between subregions p and s for prospective year t+n.

*Deriving the expected size of migration flows makes it possible to compare them with the so-called required size of migration flows which are provoked by solving the strategic type models.* The difference between the required migration size and the expected migration size is represented:

$$\check{M}_{ps}^{t+n} \pm M_{ps}^{exp,t+n} = \Delta M_{ps}^{t+n} \quad . \tag{20}$$

The feature characteristics of the stages treated so far show that the difference (20) has to be reduced to 0 (zero) when it is positive [because the expected size of migration flows is undesirable with respect of the optimal decision (16)] or to be realized in the full size when it is negative [because these migration flows are needed with respect to the optimal decision]. The problem is, however, that the provoked additional size of the migration flows or the prevention of the undesirable size of these is connected with sensitive additional expenditures out of the expenditures considered in the optimal decision so far. *This requires the problem for the regulation of migration processes in a broad sense to be treated in conjunction with the final efficiency of the migration flows.*

Stage 5: Regulation of the Migration Processes

The migration processes regulation, in essence presents a new model of a strategic character, taking into account the efficiency and the expenditure additionally and directly provoked from the migration flows. In this case a criterion of higher rank has to be used which meets both the global requirements for the development of the region and the incentives of people who take decisions to migrate. But prior to answering the question of how to regulate the migration processes, it is necessary to prove which size of the migration flows is to be regulated in order to be effective.

The answer to the latter question is predetermined by accepted stages of the optimization process. From the optimization process, we can see that the part of required size of migration flows which is coverd by the expected size of migration flows is calculated by means of the strategic type model at stage 3 and hence we can claim that this size is effective. *To answer the question whether the difference between the required and expected size of migration flows is effective, it is necessary to make an assessment of the efficiency of this difference.*

The following more general formulation of migration efficiency may be adopted: a given additional size of migration flows is effective in the regional framework when the difference between the additional income and costs per capita provoked by this migration exceeds, or is equal to, the net income per capita calculated at the previous states of the optimization cycle:

$$\sum_{j \varepsilon J} \frac{\Delta Q_{ps}^{t+n} - \Delta C_{ps}^{t+n}}{\Delta M_{ps}^{t+n}} \geq \sum_{j \varepsilon J} \frac{V_{jp}^{t+n} + B_{ij} X_{jp}^{t+n}}{K_p^{t+n}} \quad , \tag{21}$$

where

$\Delta Q_{ps}$ = additional income from migration expressing the difference between income created in sub-region s and p of the region as a result of different labor productivity.

$$\Delta Q_{ps} = Q_s - Q_p \quad , \tag{22}$$

where

$\Delta C_{ps}$ = additional expenditures for migration which expresses:

$\Delta C_{ps1}$ = the expenditures for living space

$\Delta C_{ps2}$ = additional expenditures for municipal services

$\Delta C_{ps3}$ = additional expenditures for education

$\Delta C_{ps4}$ = addiitonal expenditures for the development of health care services and so on and additional expenditures (salary or other facilities) which will provoke the propensity to migrate = $C_{psn}$. Or generally:

$$\Delta C_{ps} = \Delta C_{ps1} + \ldots \Delta C_{psm} + \Delta C_{psn} \quad , \tag{23}$$

where

$V_{jp}$ = gross wage within the region;

$B_{ij}X_{jp}$ = realized profit within the region.

In the case when the effectiveness of the additional size of migration $\Delta M_{ps}$ is claimed, a problem for the regulation of this migration arises, i.e. it is necessary to create conditions which will transfer the expected migration size (19) into the required migration size (18) which is needed by the optimal decision (16).

The problem may be solved on the basis of La Bella's model (10) in which the additional value $\Delta C_{psn}$ has to be added with the aim of provoking the additional migration size $\Delta M_{ps}$. In this case La Bella's model for forecasting migration flows may be transformed in the model for migration regulation.

$$K_p^{t+n} \cdot q_{ps} + \Delta M_{ps}^{t+n} = f(a, \Delta R_{ps}, \Delta C_{ps}, \Delta h_{ps}^{R}, \Delta h_{ps}^{C}, r, L_{ps}, \gamma_{ps}, \Delta C_{psn}) \quad . \tag{24}$$

As shown, the additional value $\Delta C_{psn}$ which plays the role of regulator of the migration processes exists at the same time in formula (21) for the efficiency of the additional size of migration which ensures convergence between the efficiency of the migration and its regulation.

The interdependencies and the sequence of the stages of the proposed optimization cycle may be expressed in the block-scheme of Figure 3.

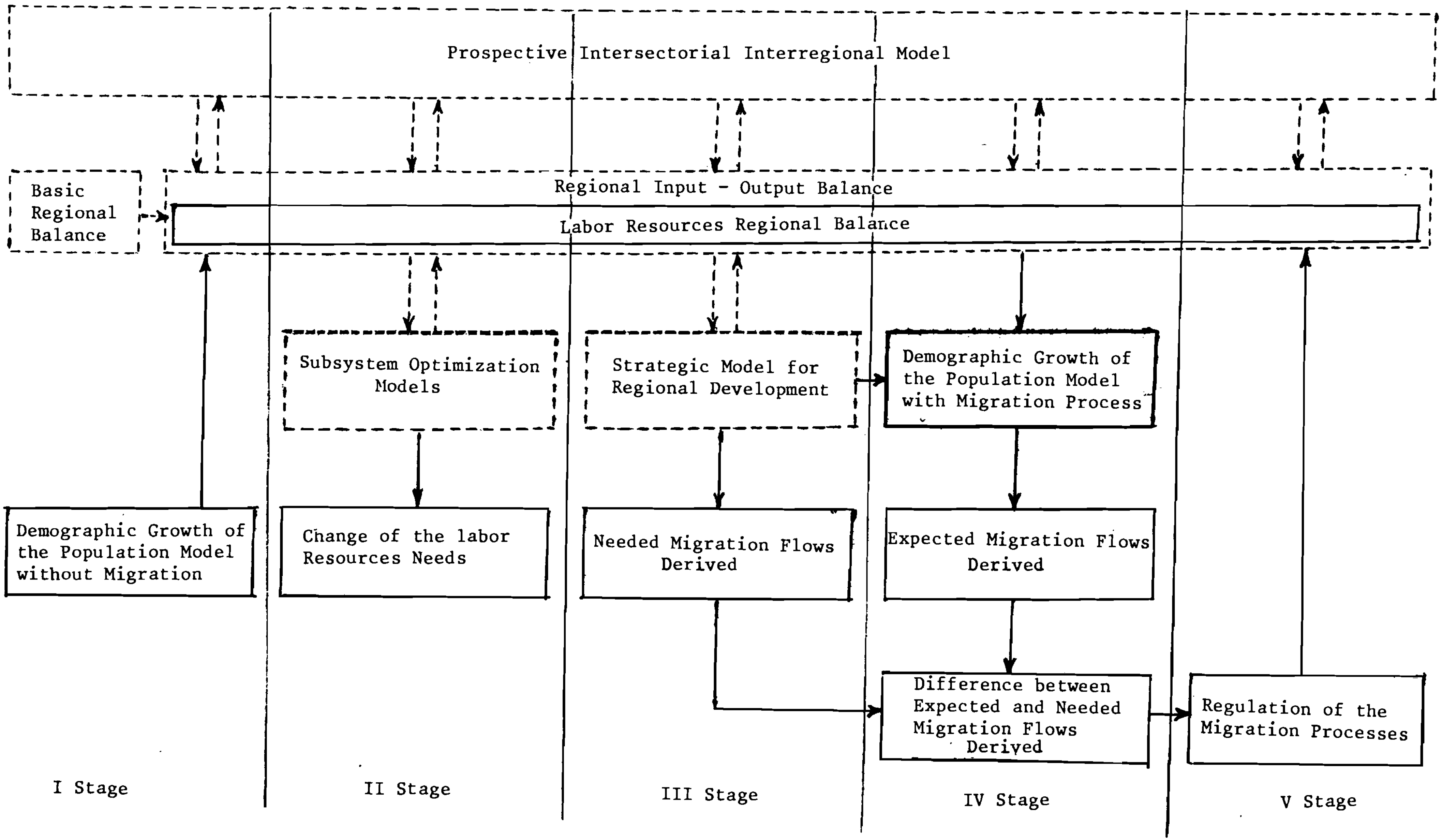
Prospective Intersectorial Interregional Model
Basic Regional Balance
Regional Input - Output Balance
Labor Resources Regional Balance
Subsystem Optimization Models
Strategic Model for Regional Development
Demographic Growth of the Population Model with Migration Process
Demographic Growth of the Population Model without Migration
Change of the labor Resources Needs
Needed Migration Flows Derived
Expected Migration Flows Derived
Difference between Expected and Needed Migration Flows Derived
Regulation of the Migration Processes
I Stage
II Stage
III Stage
IV Stage
V Stage

Figure 3

## IV. BASIC CONCLUSIONS AND REQUIREMENTS TO THE SYSTEM OF REGIONAL MODELS AND TO THE MIGRATION PROCESSES MODEL

1. The elaboration of the IRD system of models requires the investigation, on the one hand, of the factors which influence migration processes and on the other, the reverse influence of migration processes on the development of other subsystems of the region.
2. The migration processes modelling from the aspect of the factors which influence them and of the techniques for their regulation are adequate in centrally planned and market economies.
3. In the demographic population growth model including the migration processes (2) it is necessary to differentiate the population by main age groups and basic subregions of the population allocation must necessarily be introduced.
4. In the basic regional input-output balance (4) and the prospective regional input-output balance (11) the main sectors and activities have to be differentiated by subregions of the region and the consumption has to be differentiated by subregions of the region.
5. In the basic balace of labor resources (5) and in the prospective balance of labor resources (17) the allocation of labor resources has to be differentiated by subregions of the region by qualification types and by subsystems.
6. The differentiation of the conditions which reflect the factors for migration of the population (10) is necessary to be made by main subregions of the region and by concrete subregions outside the region, but not by average conditions for the country.
7. The dependence of migration flows with labor resources utilization and the participation of labor resources in other subsystem models requires the migration flows to be treated in a specific way at different stages of the

optimization cycle of the system of models for regional development. Therefore, it is impossible to apply only one model for defining migration flows. It is necessary to use, in sequence, different models concerning the migration processes, closely connected with other subsystem models with the region.

8. The interdependency between the models of the separate subsystems (in horizontal line) and the links with the regional balance and with the strategic type models (in vertical line) requires that the efficiency of migration processes and their regulation be also realized in horizontal and vertical lines. Hence, the full cycle of migration processes modelling may be treated as a hierarchical system of models of two levels.

9. The defining the needed size of migration flows (adequate to the optimal decisions of other subsystems) and the defining of the expected size of migration flows (adequate of the incentives of the population) is a key problem of the migration processes. The difference between the required and expected size of migration flows raises the problem for their regulation.

## References


[1] Albegov, M. et al. (1977), Models and Algorithms in Solving Tasks of Production Relocation, (Russian Edition), Moscow, U.S.S.R.

[2] Keyfitz, N. (1968), Introduction to the Mathematics of Population, Addison Wesley Edition.

[3] Kulikowski, R. (1978), "Regional Development Modelling - Labor, Investments and Allocation Policy Impact," Paper presented at the Notec Task Force Meeting I, International Institute for Applied Systems Analysis, Laxenburg, Austria, RM-78-40.

[4] Frick, P.A. and A. La Bella (1977), "Models of Spatial Population Dynamics in Italy," R-77-01, Istituto Automatica, Universita di Roma, Italy.

[5] La Bella, A. (1978), "A Possible Approach to the Analysis of Migration and Commuting Patterns in Bulgaria (Silistra Region)," International Institute for Applied Systems Analysis, Laxenburg, Austria (forthcoming).

[6] La Bella, A. et al. (1977), "Dynamic Modelling in Development Planning," Applied Mathematical Modelling, Vol. 1, December, Rome, Italy.

[7] Willekens, F. and A. Rogers (1976), "Computer Programs for Spatial Demographic Analysis," RM-76-58, International Institute for Applied Systems Analysis, Laxenburg, Austria.

# APPENDIX I

## TWO-REGIONAL LIFE TABLES AND POPULATION PROJECTION

## SILISTRA - REST OF BULGARIA

## TOTAL POPULATION, 1975

## LIST OF PARAMETERS

*******************

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NA | = | 18 | NY | = | 5 | NR | = | 2 |
| NZB | = | 1 | NZD | = | 1 | NZO | = | 1 |
| IPUNT | = | 2 | IOPTG | = | 3 | NGRO | = | 1 |
| INIT | = | 1975 | KA | = | 0 | KC | = | 0 |
| NU | = | 5 | L0 | = | 2 | NPAR1 | = | 1 |
| NPAR2 | = | 2 | NPAR3 | = | 2 | NPAR4 | = | 7 |
| NPAR5 | = | 2025 | NPAR6 | = | 1000 | NPAR7 | = | 0 |
| NPAR8 | = | 0 | | | | | | |

## OBSERVED POPULATION CHARACTERISTICS, 1975

==========================================

INPUT-DATA

**********

REGION SILISTRA

-----------------

| AGE | POPULATION | BIRTHS | DEATHS | MIGRATION FROM SILISTRA TO SILISTRA | R.OF.BUL |
|---|---|---|---|---|---|
| 0 | 14686. | 0. | 110. | 0. | 84. |
| 5 | 15096. | 0. | 4. | 0. | 77. |
| 10 | 14657. | 4. | 4. | 0. | 360. |
| 15 | 12182. | 509. | 6. | 0. | 437. |
| 20 | 13125. | 1461. | 14. | 0. | 178. |
| 25 | 13950. | 861. | 16. | 0. | 86. |
| 30 | 13784. | 277. | 17. | 0. | 55. |
| 35 | 11579. | 57. | 19. | 0. | 31. |
| 40 | 11842. | 16. | 30. | 0. | 21. |
| 45 | 11577. | 7. | 45. | 0. | 14. |
| 50 | 11590. | 0. | 82. | 0. | 10. |
| 55 | 6707. | 0. | 76. | 0. | 5. |
| 60 | 8815. | 0. | 160. | 0. | 5. |
| 65 | 7166. | 0. | 235. | 0. | 4. |
| 70 | 4998. | 0. | 259. | 0. | 3. |
| 75 | 2621. | 0. | 262. | 0. | 2. |
| 80 | 1193. | 0. | 191. | 0. | 1. |
| 85 | 859. | 0. | 189. | 0. | 1. |
| TOTAL | 176428. | 3192. | 1719. | 0. | 1374. |

REGION R.OF.BUL

| AGE | POPULATION | BIRTHS | DEATHS | MIGRATION FROM R.OF.BUL TO SILISTRA | R.OF.BUL |
|---|---|---|---|---|---|
| 0 | 652871. | 0. | 3834. | 57. | 0. |
| 5 | 622846. | 0. | 316. | 38. | 0. |
| 10 | 612405. | 234. | 270. | 225. | 0. |
| 15 | 626311. | 23140. | 449. | 270. | 0. |
| 20 | 642213. | 63820. | 609. | 120. | 0. |
| 25 | 676309. | 37900. | 696. | 57. | 0. |
| 30 | 563856. | 11786. | 725. | 29. | 0. |
| 35 | 551814. | 3589. | 1006. | 19. | 0. |
| 40 | 622908. | 898. | 1626. | 7. | 0. |
| 45 | 621155. | 70. | 2663. | 5. | 0. |
| 50 | 633537. | 0. | 3981. | 3. | 0. |
| 55 | 364560. | 0. | 3650. | 3. | 0. |
| 60 | 440850. | 0. | 7678. | 3. | 0. |
| 65 | 384096. | 0. | 11335. | 1. | 0. |
| 70 | 277711. | 0. | 14248. | 1. | 0. |
| 75 | 166260. | 0. | 14353. | 1. | 0. |
| 80 | 73784. | 0. | 10461. | 1. | 0. |
| 85 | 47851. | 0. | 10353. | 1. | 0. |
| TOTAL | 8551337. | 141437. | 88255. | 841. | 0. |

PERCENTAGE DISTRIBUTION

REGION SILISTRA

| AGE | POPULATION | BIRTHS | DEATHS | MIGRATION FROM SILISTRA TO SILISTRA | R.OF.BUL |
|---|---|---|---|---|---|
| 0 | 6.3241 | 0.0000 | 6.3991 | 0.0000 | 6.1135 |
| 5 | 6.5565 | 0.0000 | 0.2327 | 0.0000 | 5.6041 |
| 10 | 8.3076 | 0.1253 | 0.2327 | 0.0000 | 26.2009 |
| 15 | 6.9048 | 15.9461 | 0.3490 | 0.0000 | 31.8049 |
| 20 | 7.4399 | 45.7707 | 0.8144 | 0.0000 | 12.9549 |
| 25 | 7.9069 | 26.9737 | 0.9308 | 0.0000 | 6.2591 |
| 30 | 7.8128 | 8.6779 | 0.9889 | 0.0000 | 4.0029 |
| 35 | 6.5630 | 1.7857 | 1.1053 | 0.0000 | 2.2562 |
| 40 | 6.7121 | 0.5013 | 1.7452 | 0.0000 | 1.5284 |
| 45 | 6.5619 | 0.2193 | 2.6178 | 0.0000 | 1.0189 |
| 50 | 6.5693 | 0.0000 | 4.7702 | 0.0000 | 0.7278 |
| 55 | 3.8016 | 0.0000 | 4.4212 | 0.0000 | 0.3639 |
| 60 | 4.9964 | 0.0000 | 9.3077 | 0.0000 | 0.3639 |
| 65 | 4.0617 | 0.0000 | 13.6707 | 0.0000 | 0.2911 |
| 70 | 2.8329 | 0.0000 | 15.0669 | 0.0000 | 0.2183 |
| 75 | 1.4856 | 0.0000 | 15.2414 | 0.0000 | 0.1456 |
| 80 | 0.6762 | 0.0000 | 11.1111 | 0.0000 | 0.0728 |
| 85 | 0.4869 | 0.0000 | 10.9948 | 0.0000 | 0.0728 |
| TOTAL | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 |
| M.AGE | 33.6030 | 24.3296 | 65.0422 | 0.0000 | 18.7409 |

REGION R.OF.BUL

---

| AGE | POPULATION | BIRTHS | DEATHS | MIGRATION FROM R.OF.BUL TO SILISTRA | R.OF.BUL |
|---|---|---|---|---|---|
| 0 | 7.6347 | 0.0000 | 4.3442 | 6.7776 | 0.0000 |
| 5 | 7.2836 | 0.0000 | 0.3561 | 4.5184 | 0.0000 |
| 10 | 7.1615 | 0.1654 | 0.3059 | 26.7539 | 0.0000 |
| 15 | 7.3241 | 16.3606 | 0.5088 | 32.1046 | 0.0000 |
| 20 | 7.5101 | 45.1226 | 0.6900 | 14.2687 | 0.0000 |
| 25 | 7.9008 | 26.7964 | 0.7886 | 6.7776 | 0.0000 |
| 30 | 6.5938 | 8.3330 | 0.6215 | 3.4483 | 0.0000 |
| 35 | 6.4530 | 2.5375 | 1.1399 | 2.2592 | 0.0000 |
| 40 | 7.2843 | 0.6349 | 1.8447 | 0.8323 | 0.0000 |
| 45 | 7.2638 | 0.0495 | 3.0174 | 0.5945 | 0.0000 |
| 50 | 7.0578 | 0.0000 | 4.5108 | 0.3567 | 0.0000 |
| 55 | 4.2632 | 0.0000 | 4.1357 | 0.3567 | 0.0000 |
| 60 | 5.1553 | 0.0000 | 8.6998 | 0.3567 | 0.0000 |
| 65 | 4.4916 | 0.0000 | 12.8435 | 0.1189 | 0.0000 |
| 70 | 3.2476 | 0.0000 | 16.1441 | 0.1189 | 0.0000 |
| 75 | 1.9443 | 0.0000 | 16.2631 | 0.1189 | 0.0000 |
| 80 | 0.8628 | 0.0000 | 11.8552 | 0.1189 | 0.0000 |
| 85 | 0.5596 | 0.0000 | 11.7308 | 0.1189 | 0.0000 |
| TOTAL | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 |
| M.AGE | 35.3611 | 24.5585 | 66.7512 | 18.2253 | 0.0000 |

OBSERVED RATES

***************

DEATH RATES

************

| AGE | SILISTRA | R.OF.BUL |
|---|---|---|
| 0 | 0.007490 | 0.005873 |
| 5 | 0.000265 | 0.000507 |
| 10 | 0.000273 | 0.000441 |
| 15 | 0.000493 | 0.000717 |
| 20 | 0.001067 | 0.000948 |
| 25 | 0.001147 | 0.001029 |
| 30 | 0.001233 | 0.001286 |
| 35 | 0.001641 | 0.001823 |
| 40 | 0.002533 | 0.002614 |
| 45 | 0.003887 | 0.004287 |
| 50 | 0.007075 | 0.006596 |
| 55 | 0.011331 | 0.010012 |
| 60 | 0.018151 | 0.017416 |
| 65 | 0.032794 | 0.029511 |
| 70 | 0.051821 | 0.051305 |
| 75 | 0.099962 | 0.086329 |
| 80 | 0.160101 | 0.141779 |
| 85 | 0.220023 | 0.216359 |
| GROSS | 0.621286 | 0.578832 |
| CRUDE | 0.009743 | 0.010321 |
| M.AGE | 78.5750 | 78.6961 |

## FERTILITY RATES

***************

| AGE | SILISTRA | R.OF.BUL |
|---|---|---|
| 0 | 0.000000 | 0.000000 |
| 5 | 0.000000 | 0.000000 |
| 10 | 0.000273 | 0.000382 |
| 15 | 0.041783 | 0.036947 |
| 20 | 0.111306 | 0.099375 |
| 25 | 0.061720 | 0.056039 |
| 30 | 0.020096 | 0.020902 |
| 35 | 0.004923 | 0.006504 |
| 40 | 0.001351 | 0.001442 |
| 45 | 0.000605 | 0.000113 |
| 50 | 0.000000 | 0.000000 |
| 55 | 0.000000 | 0.000000 |
| 60 | 0.000000 | 0.000000 |
| 65 | 0.000000 | 0.000000 |
| 70 | 0.000000 | 0.000000 |
| 75 | 0.000000 | 0.000000 |
| 80 | 0.000000 | 0.000000 |
| 85 | 0.000000 | 0.000000 |
| GROSS | 0.242056 | 0.221704 |
| CRUDE | 0.018092 | 0.016540 |
| M.AGE | 24.2099 | 24.4390 |

## OUTMIGRATION RATES

******************

| AGE | TOTAL | MIGRATION FROM SILISTRA TO SILISTRA | MIGRATION FROM SILISTRA TO R.OF.BUL |
|---|---|---|---|
| 0 | 0.005721 | 0.000000 | 0.005720 |
| 5 | 0.005101 | 0.000000 | 0.005101 |
| 10 | 0.024562 | 0.000000 | 0.024562 |
| 15 | 0.035873 | 0.000000 | 0.035873 |
| 20 | 0.013561 | 0.000000 | 0.013561 |
| 25 | 0.006165 | 0.000000 | 0.006165 |
| 30 | 0.003990 | 0.000000 | 0.003990 |
| 35 | 0.002677 | 0.000000 | 0.002677 |
| 40 | 0.001773 | 0.000000 | 0.001773 |
| 45 | 0.001209 | 0.000000 | 0.001209 |
| 50 | 0.000863 | 0.000000 | 0.000863 |
| 55 | 0.000745 | 0.000000 | 0.000745 |
| 60 | 0.000567 | 0.000000 | 0.000567 |
| 65 | 0.000558 | 0.000000 | 0.000558 |
| 70 | 0.000600 | 0.000000 | 0.000600 |
| 75 | 0.000763 | 0.000000 | 0.000763 |
| 80 | 0.000838 | 0.000000 | 0.000838 |
| 85 | 0.000000 | 0.000000 | 0.000000 |
| GROSS | 0.105566 | 0.000000 | 0.105566 |
| CRUDE | 0.007788 | 0.000000 | 0.007788 |
| M.AGE | 20.4421 | 0.0000 | 20.4421 |

MIGRATION FROM R.OF.BUL TO

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 0.000087 | 0.000087 | 0.000000 |
| 5 | 0.000061 | 0.000061 | 0.000000 |
| 10 | 0.000367 | 0.000367 | 0.000000 |
| 15 | 0.000431 | 0.000431 | 0.000000 |
| 20 | 0.000187 | 0.000187 | 0.000000 |
| 25 | 0.000084 | 0.000084 | 0.000000 |
| 30 | 0.000051 | 0.000051 | 0.000000 |
| 35 | 0.000034 | 0.000034 | 0.000000 |
| 40 | 0.000011 | 0.000011 | 0.000000 |
| 45 | 0.000008 | 0.000008 | 0.000000 |
| 50 | 0.000005 | 0.000005 | 0.000000 |
| 55 | 0.000008 | 0.000008 | 0.000000 |
| 60 | 0.000007 | 0.000007 | 0.000000 |
| 65 | 0.000003 | 0.000003 | 0.000000 |
| 70 | 0.000004 | 0.000004 | 0.000000 |
| 75 | 0.000006 | 0.000006 | 0.000000 |
| 80 | 0.000014 | 0.000014 | 0.000000 |
| 85 | 0.000000 | 0.000000 | 0.000000 |
| GROSS | 0.001369 | 0.001369 | 0.000000 |
| CRUDE | 0.000098 | 0.000098 | 0.000000 |
| M.AGE | 19.2403 | 19.2403 | 0.0000 |

TOTAL POPULATION SYSTEM
************************

| AGE | POPULATION | | BIRTHS | | DEATHS | |
|---|---|---|---|---|---|---|
| | ABSOLUTE | PERCENT | ABSOLUTE | PERCENT | ABSOLUTE | PERCENT |
| 0 | 667557. | 7.6487 | 0. | 0.0000 | 3944. | 4.3835 |
| 5 | 637942. | 7,3093 | 0. | 0.0000 | 320. | 0.3557 |
| 10 | 627062. | 7,1847 | 238. | 0.1646 | 274. | 0.3045 |
| 15 | 638493. | 7.3157 | 23649. | 16.3515 | 455. | 0.5057 |
| 20 | 655339. | 7.5087 | 65281. | 45.1369 | 623. | 0.6924 |
| 25 | 690259. | 7.9088 | 38761. | 26.8003 | 712. | 0.7913 |
| 30 | 577640. | 6.6184 | 12063. | 8.3407 | 742. | 0.8247 |
| 35 | 563393. | 6.4552 | 3646. | 2,5209 | 1025. | 1.1392 |
| 40 | 634750. | 7.2728 | 914. | 0.6320 | 1658. | 1.8428 |
| 45 | 632732. | 7.2496 | 77. | 0.0532 | 2708. | 3.0098 |
| 50 | 615127. | 7.0479 | 0. | 0.0000 | 4063. | 4.5157 |
| 55 | 371267. | 4.2539 | 0. | 0.0000 | 3726. | 4.1412 |
| 60 | 449665. | 5.1521 | 0. | 0.0000 | 7838. | 8.7114 |
| 65 | 391262. | 4.4830 | 0. | 0.0000 | 11570. | 12.8593 |
| 70 | 282709. | 3.2392 | 0. | 0.0000 | 14507. | 16.1235 |
| 75 | 168881. | 1.9350 | 0. | 0.0000 | 14615. | 16.2436 |
| 80 | 74977. | 0.8591 | 0. | 0.0000 | 10652. | 11.8390 |
| 85 | 48710. | 0.5581 | 0. | 0.0000 | 10542. | 11.7167 |
| TOTAL | 8727765. | 100.0000 | 144629. | 100.0000 | 89974. | 100.0000 |
| CRUDE | | | | | | |
| M.AGE | | 35.3256 | | 24.3579 | | 66.7185 |

| MIGRATION | | OBSERVED RATES | | |
|---|---|---|---|---|
| ABSOLUTE | PERCENT | BIRTH | DEATH | MIGRATION |
| 141. | 6,3657 | 0,000000 | 0,005908 | 0,000211 |
| 115. | 5,1919 | 0,000000 | 0,000502 | 0,000180 |
| 585. | 26,4108 | 0,000380 | 0,000437 | 0,000933 |
| 707. | 31,9187 | 0,037039 | 0,000713 | 0,001107 |
| 298. | 13,4537 | 0,099614 | 0,000951 | 0,000455 |
| 143. | 6,4560 | 0,056154 | 0,001031 | 0,000207 |
| 84. | 3,7923 | 0,020883 | 0,001285 | 0,000145 |
| 50. | 2,2573 | 0,006472 | 0,001819 | 0,000089 |
| 28. | 1,2641 | 0,001440 | 0,002612 | 0,000044 |
| 19. | 0,8578 | 0,000122 | 0,004280 | 0,000030 |
| 13. | 0,5869 | 0,000000 | 0,006605 | 0,000021 |
| 8. | 0,3612 | 0,000000 | 0,010036 | 0,000022 |
| 8. | 0,3612 | 0,000000 | 0,017431 | 0,000018 |
| 5. | 0,2257 | 0,000000 | 0,029571 | 0,000013 |
| 4. | 0,1806 | 0,000000 | 0,051314 | 0,000014 |
| 3. | 0,1354 | 0,000000 | 0,086540 | 0,000018 |
| 2. | 0,0903 | 0,000000 | 0,142070 | 0,000027 |
| 2. | 0,0903 | 0,000000 | 0,216424 | 0,000041 |
| 2215. | 100,0000 | 0,222103 | 0,579528 | 0,003575 |
| | | 0,016571 | 0,010309 | 0,000254 |
| | 18,5451 | 24,4339 | 78,6930 | 20,3429 |

MULTIREGIONAL LIFE TABLE OPTION 3

PROBABILITIES OF DYING AND MIGRATING

REGION SILISTRA

| AGE | DEATH | MIGRATION FROM SILISTRA TO SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 0.036654 | 0.936068 | 0.027278 |
| 5 | 0.001339 | 0.973531 | 0.025130 |
| 10 | 0.001412 | 0.883186 | 0.115402 |
| 15 | 0.002551 | 0.833489 | 0.163959 |
| 20 | 0.005299 | 0.929472 | 0.065228 |
| 25 | 0.005710 | 0.964103 | 0.030187 |
| 30 | 0.006150 | 0.974222 | 0.019628 |
| 35 | 0.008177 | 0.978641 | 0.013182 |
| 40 | 0.012589 | 0.978696 | 0.008715 |
| 45 | 0.019254 | 0.974839 | 0.005907 |
| 50 | 0.034756 | 0.961083 | 0.004161 |
| 55 | 0.055085 | 0.941385 | 0.003530 |
| 60 | 0.086811 | 0.910593 | 0.002596 |
| 65 | 0.151526 | 0.846075 | 0.002399 |
| 70 | 0.229384 | 0.768265 | 0.002352 |
| 75 | 0.399810 | 0.597684 | 0.002507 |
| 80 | 0.571613 | 0.426181 | 0.002206 |
| 85 | 1.000000 | 0.000000 | 0.000000 |

REGION R.OF.BUL

| AGE | DEATH | MIGRATION FROM R.OF.BUL TO SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 0.028940 | 0.000416 | 0.970644 |
| 5 | 0.002533 | 0.000301 | 0.997166 |
| 10 | 0.002201 | 0.001726 | 0.996072 |
| 15 | 0.003577 | 0.001970 | 0.994453 |
| 20 | 0.004731 | 0.000899 | 0.994371 |
| 25 | 0.005133 | 0.000413 | 0.994455 |
| 30 | 0.006438 | 0.000253 | 0.993339 |
| 35 | 0.009070 | 0.000170 | 0.990757 |
| 40 | 0.012963 | 0.000055 | 0.986962 |
| 45 | 0.021208 | 0.000039 | 0.978752 |
| 50 | 0.032446 | 0.000024 | 0.967530 |
| 55 | 0.048858 | 0.000039 | 0.951123 |
| 60 | 0.083448 | 0.000031 | 0.916520 |
| 65 | 0.137416 | 0.000011 | 0.862573 |
| 70 | 0.227363 | 0.000014 | 0.772622 |
| 75 | 0.355022 | 0.000020 | 0.644958 |
| 80 | 0.523384 | 0.000036 | 0.476581 |
| 85 | 1.000000 | 0.000000 | 0.000000 |

EXPECTED NUMBER OF SURVIVORS AT EXACT AGE X IN EACH REGION

| AGE | AGGREGATED | AGE | INITIAL REGION OF COHORT SILISTRA: TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|---|---|
| 0 | 200000. | 0 | 100000. | 100000. | 0. |
| 5 | 193441. | 5 | 96335. | 93607. | 2728. |
| 10 | 193062. | 10 | 96202. | 91130. | 5072. |
| 15 | 192709. | 15 | 96062. | 80493. | 15569. |
| 20 | 192103. | 20 | 95801. | 67121. | 28680. |
| 25 | 191156. | 25 | 95310. | 62413. | 32897. |
| 30 | 190138. | 30 | 94785. | 60186. | 34599. |
| 35 | 188936. | 35 | 94193. | 58643. | 35550. |
| 40 | 187274. | 40 | 93391. | 57397. | 35994. |
| 45 | 184866. | 45 | 92201. | 56176. | 36025. |
| 50 | 181056. | 50 | 90355. | 54764. | 35591. |
| 55 | 175054. | 55 | 87297. | 52634. | 34664. |
| 60 | 166173. | 60 | 82705. | 49550. | 33155. |
| 65 | 152138. | 65 | 75637. | 45121. | 30516. |
| 70 | 130589. | 70 | 64606. | 38176. | 26431. |
| 75 | 100820. | 75 | 49840. | 29330. | 20511. |
| 80 | 63702. | 80 | 30832. | 17530. | 13302. |
| 85 | 29508. | 85 | 13850. | 7472. | 6378. |

| AGE | INITIAL REGION OF COHORT R.OF.BUL: TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 100000. | 0. | 100000. |
| 5 | 97106. | 42. | 97064. |
| 10 | 96860. | 70. | 96790. |
| 15 | 96647. | 229. | 96418. |
| 20 | 96301. | 381. | 95921. |
| 25 | 95846. | 440. | 95406. |
| 30 | 95354. | 464. | 94890. |
| 35 | 94743. | 476. | 94267. |
| 40 | 93883. | 481. | 93402. |
| 45 | 92665. | 476. | 92188. |
| 50 | 90700. | 468. | 90232. |
| 55 | 87756. | 452. | 87304. |
| 60 | 83468. | 429. | 83039. |
| 65 | 76501. | 393. | 76108. |
| 70 | 65983. | 333. | 65650. |
| 75 | 50980. | 257. | 50723. |
| 80 | 32870. | 155. | 32715. |
| 85 | 15659. | 67. | 15592. |

NUMBER OF YEARS LIVED IN EACH REGION BY THE INITIAL UNIT COHORT
*************************************************************

| AGE | AGGREGATED | AGE | INITIAL REGION OF COHORT SILISTRA | | |
|---|---|---|---|---|---|
| | | | TOTAL | SILISTRA | R.OF.BUL |
| 0 | 4.918008 | 0 | 4.908365 | 4.840170 | 0.068195 |
| 5 | 4.831289 | 5 | 4.813423 | 4.618417 | 0.195006 |
| 10 | 4.822149 | 10 | 4.806621 | 4.290583 | 0.516038 |
| 15 | 4.810154 | 15 | 4.796598 | 3.690361 | 1.106237 |
| 20 | 4.790733 | 20 | 4.777787 | 3.238349 | 1.539438 |
| 25 | 4.766176 | 25 | 4.752372 | 3.064975 | 1.687397 |
| 30 | 4.738424 | 30 | 4.724446 | 2.970736 | 1.753709 |
| 35 | 4.702622 | 35 | 4.689596 | 2.901004 | 1.788592 |
| 40 | 4.651748 | 40 | 4.639797 | 2.839321 | 1.800476 |
| 45 | 4.574016 | 45 | 4.563910 | 2.773501 | 1.790409 |
| 50 | 4.451366 | 50 | 4.441315 | 2.684940 | 1.756375 |
| 55 | 4.265329 | 55 | 4.250056 | 2.554586 | 1.695469 |
| 60 | 3.978881 | 60 | 3.958545 | 2.366766 | 1.591779 |
| 65 | 3.534090 | 65 | 3.506081 | 2.082417 | 1.423664 |
| 70 | 2.892622 | 70 | 2.861165 | 1.687636 | 1.173529 |
| 75 | 2.056527 | 75 | 2.016809 | 1.171494 | 0.845315 |
| 80 | 1.165127 | 80 | 1.117047 | 0.625043 | 0.492004 |
| 85 | 0.679029 | 85 | 0.634373 | 0.339578 | 0.294795 |

| AGE | INITIAL REGION OF COHORT R.OF.BUL | | |
|---|---|---|---|
| | TOTAL | SILISTRA | R.OF.BUL |
| 0 | 4.927651 | 0.001041 | 4.926610 |
| 5 | 4.849154 | 0.002784 | 4.846370 |
| 10 | 4.837677 | 0.007459 | 4.830217 |
| 15 | 4.823710 | 0.015230 | 4.808480 |
| 20 | 4.803679 | 0.020512 | 4.783167 |
| 25 | 4.779980 | 0.022586 | 4.757394 |
| 30 | 4.752402 | 0.023477 | 4.728925 |
| 35 | 4.715647 | 0.023924 | 4.691723 |
| 40 | 4.663698 | 0.023942 | 4.639756 |
| 45 | 4.584123 | 0.023606 | 4.560517 |
| 50 | 4.461416 | 0.022996 | 4.438421 |
| 55 | 4.280602 | 0.022017 | 4.258584 |
| 60 | 3.999217 | 0.020546 | 3.978671 |
| 65 | 3.562100 | 0.018161 | 3.543938 |
| 70 | 2.924079 | 0.014762 | 2.909317 |
| 75 | 2.096244 | 0.010293 | 2.085951 |
| 80 | 1.213207 | 0.005543 | 1.207664 |
| 85 | 0.723686 | 0.003049 | 0.720637 |

# SURVIVORSHIP PROPORTIONS

***************************

## REGION SILISTRA

****************

| | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 0.980609 | 0.954180 | 0.026429 |
| 5 | 0.998627 | 0.928973 | 0.069654 |
| 10 | 0.998011 | 0.859888 | 0.138124 |
| 15 | 0.996148 | 0.877070 | 0.119078 |
| 20 | 0.994496 | 0.946146 | 0.048350 |
| 25 | 0.994064 | 0.969069 | 0.024995 |
| 30 | 0.992836 | 0.976402 | 0.016434 |
| 35 | 0.989628 | 0.978668 | 0.010960 |
| 40 | 0.984096 | 0.976788 | 0.007308 |
| 45 | 0.973077 | 0.968049 | 0.005029 |
| 50 | 0.955264 | 0.951430 | 0.003834 |
| 55 | 0.929499 | 0.926454 | 0.003045 |
| 60 | 0.882307 | 0.879843 | 0.002464 |
| 65 | 0.812728 | 0.810414 | 0.002315 |
| 70 | 0.696475 | 0.694152 | 0.002323 |
| 75 | 0.535759 | 0.533525 | 0.002234 |
| 80 | 0.545201 | 0.543263 | 0.001937 |

## REGION R.OF.BUL

****************

| | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 0.984071 | 0.000363 | 0.983707 |
| 5 | 0.997633 | 0.001006 | 0.996627 |
| 10 | 0.997112 | 0.001825 | 0.995286 |
| 15 | 0.995847 | 0.001488 | 0.994359 |
| 20 | 0.995069 | 0.000665 | 0.994404 |
| 25 | 0.994231 | 0.000334 | 0.993897 |
| 30 | 0.992263 | 0.000212 | 0.992052 |
| 35 | 0.988980 | 0.000113 | 0.988868 |
| 40 | 0.982931 | 0.000047 | 0.982884 |
| 45 | 0.973233 | 0.000032 | 0.973202 |
| 50 | 0.959493 | 0.000031 | 0.959462 |
| 55 | 0.934290 | 0.000035 | 0.934255 |
| 60 | 0.890743 | 0.000021 | 0.890722 |
| 65 | 0.820928 | 0.000012 | 0.820916 |
| 70 | 0.716994 | 0.000016 | 0.716978 |
| 75 | 0.578965 | 0.000025 | 0.578940 |
| 80 | 0.596742 | 0.000031 | 0.596711 |

TOTAL NUMBER OF YEARS TO BE LIVED -T-
****************************************

| AGE | INITIAL REGION OF COHORT SILISTRA | | |
|---|---|---|---|
| *** | ************************************ | | |
| | TOTAL | SILISTRA | R.OF.BUL |
| 0 | 70.258316 | 48.739883 | 21.518429 |
| 5 | 65.349945 | 43.899712 | 21.450233 |
| 10 | 60.536522 | 39.281292 | 21.255228 |
| 15 | 55.729897 | 34.990707 | 20.739189 |
| 20 | 50.933300 | 31.300348 | 19.632952 |
| 25 | 46.155516 | 28.062000 | 18.093515 |
| 30 | 41.403141 | 24.997025 | 16.406116 |
| 35 | 36.678696 | 22.026287 | 14.652407 |
| 40 | 31.989100 | 19.125284 | 12.863814 |
| 45 | 27.349302 | 16.285963 | 11.063338 |
| 50 | 22.785393 | 13.512462 | 9.272930 |
| 55 | 18.344076 | 10.827521 | 7.516555 |
| 60 | 14.094020 | 8.272934 | 5.821086 |
| 65 | 10.135475 | 5.906168 | 4.229307 |
| 70 | 6.629394 | 3.823751 | 2.805642 |
| 75 | 3.768229 | 2.136115 | 1.632114 |
| 80 | 1.751419 | 0.964621 | 0.786799 |
| 85 | 0.634373 | 0.339578 | 0.294795 |

| AGE | INITIAL REGION OF COHORT R.OF.BUL | | |
|---|---|---|---|
| *** | ************************************ | | |
| | TOTAL | SILISTRA | R.OF.BUL |
| 0 | 70.998268 | 0.281928 | 70.716339 |
| 5 | 66.070618 | 0.280887 | 65.789734 |
| 10 | 61.221470 | 0.278104 | 60.943367 |
| 15 | 56.383793 | 0.270644 | 56.113148 |
| 20 | 51.560081 | 0.255414 | 51.304668 |
| 25 | 46.756405 | 0.234902 | 46.521503 |
| 30 | 41.976425 | 0.212316 | 41.764111 |
| 35 | 37.224022 | 0.188839 | 37.035183 |
| 40 | 32.508369 | 0.164915 | 32.343456 |
| 45 | 27.844671 | 0.140973 | 27.703699 |
| 50 | 23.260550 | 0.117367 | 23.143183 |
| 55 | 18.799135 | 0.094371 | 18.704763 |
| 60 | 14.518535 | 0.072354 | 14.446180 |
| 65 | 10.519317 | 0.051808 | 10.467509 |
| 70 | 6.957216 | 0.033646 | 6.923570 |
| 75 | 4.033137 | 0.018884 | 4.014253 |
| 80 | 1.936893 | 0.008592 | 1.928301 |
| 85 | 0.723686 | 0.003049 | 0.720637 |

# EXPECTATIONS OF LIFE

| AGE | AGGREGATED | AGE | INITIAL REGION OF COHORT SILISTRA TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|---|---|
| 0 | 70.628296 | 0 | 70.258316 | 48.739883 | 21.518429 |
| 5 | 67.938042 | 5 | 67.836418 | 45.570034 | 22.266384 |
| 10 | 63.066170 | 10 | 62.926254 | 40.831955 | 22.094297 |
| 15 | 58.177090 | 15 | 58.014210 | 36.424942 | 21.589268 |
| 20 | 53.352894 | 20 | 53.165493 | 32.672112 | 20.493382 |
| 25 | 48.604855 | 25 | 48.426704 | 29.442856 | 18.983849 |
| 30 | 43.851540 | 30 | 43.681179 | 26.372383 | 17.308796 |
| 35 | 39.114796 | 35 | 38.939945 | 23.384212 | 15.555731 |
| 40 | 34.439640 | 40 | 34.252918 | 20.478750 | 13.774166 |
| 45 | 29.855782 | 45 | 29.662693 | 17.663542 | 11.999151 |
| 50 | 25.431517 | 50 | 25.217527 | 14.954795 | 10.262733 |
| 55 | 21.217657 | 55 | 21.013353 | 12.403051 | 8.610302 |
| 60 | 17.217756 | 60 | 17.041315 | 10.002943 | 7.038372 |
| 65 | 13.575375 | 65 | 13.400188 | 7.808590 | 5.591598 |
| 70 | 10.402576 | 70 | 10.261197 | 5.918530 | 4.342667 |
| 75 | 7.735906 | 75 | 7.560626 | 4.285930 | 3.274696 |
| 80 | 5.786576 | 80 | 5.680488 | 3.128614 | 2.551873 |
| 85 | 4.601019 | 85 | 4.580421 | 2.451886 | 2.128535 |

| AGE | INITIAL REGION OF COHORT R.OF.BUL TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 70.998268 | 0.281928 | 70.716339 |
| 5 | 68.039658 | 0.289258 | 67.750397 |
| 10 | 63.206078 | 0.287119 | 62.918961 |
| 15 | 58.339970 | 0.280034 | 58.059937 |
| 20 | 53.540287 | 0.265224 | 53.275063 |
| 25 | 48.782997 | 0.245083 | 48.537914 |
| 30 | 44.021900 | 0.222662 | 43.799240 |
| 35 | 39.289646 | 0.199318 | 39.090328 |
| 40 | 34.626362 | 0.175659 | 34.450703 |
| 45 | 30.048870 | 0.152132 | 29.896738 |
| 50 | 25.645508 | 0.129401 | 25.516108 |
| 55 | 21.421961 | 0.107538 | 21.314423 |
| 60 | 17.394197 | 0.086685 | 17.307512 |
| 65 | 13.750562 | 0.067721 | 13.682840 |
| 70 | 10.543956 | 0.050992 | 10.492964 |
| 75 | 7.911184 | 0.037043 | 7.874142 |
| 80 | 5.892663 | 0.026138 | 5.866524 |
| 85 | 4.621616 | 0.019469 | 4.602147 |

THE DISCRETE MODEL OF MULTIREGIONAL DEMOGRAPHIC,GROWTH
*************************************************************
*************************************************************

MULTIREGIONAL PROJECTION MATRIX
*******************************

REGION SILISTRA
*****************

| AGE | FIRST ROW SILISTRA | FIRST ROW R.OF.BUL |
|---|---|---|
| 0 | 0.000000 | 0.000000 |
| 5 | 0.000614 | 0.000074 |
| 10 | 0.087614 | 0.013805 |
| 15 | 0.337380 | 0.033903 |
| 20 | 0.410696 | 0.012461 |
| 25 | 0.196498 | 0.004056 |
| 30 | 0.060266 | 0.001112 |
| 35 | 0.015113 | 0.000252 |
| 40 | 0.004699 | 0.000068 |
| 45 | 0.001463 | 0.000021 |
| 50 | 0.000004 | 0.000000 |
| 55 | 0.000000 | 0.000000 |
| 60 | 0.000000 | 0.000000 |
| 65 | 0.000000 | 0.000000 |
| 70 | 0.000000 | 0.000000 |
| 75 | 0.000000 | 0.000000 |
| 80 | 0.000000 | 0.000000 |

| AGE | SURVIVORSHIP PROPORTIONS SILISTRA | SURVIVORSHIP PROPORTIONS R.OF.BUL |
|---|---|---|
| 0 | 0.954180 | 0.026429 |
| 5 | 0.928973 | 0.069654 |
| 10 | 0.859888 | 0.138124 |
| 15 | 0.877070 | 0.119078 |
| 20 | 0.946146 | 0.048350 |
| 25 | 0.969069 | 0.024995 |
| 30 | 0.976402 | 0.016434 |
| 35 | 0.978668 | 0.010960 |
| 40 | 0.976789 | 0.007308 |
| 45 | 0.968049 | 0.005029 |
| 50 | 0.951430 | 0.003834 |
| 55 | 0.926454 | 0.003045 |
| 60 | 0.879843 | 0.002464 |
| 65 | 0.810414 | 0.002315 |
| 70 | 0.694152 | 0.002323 |
| 75 | 0.533525 | 0.002234 |
| 80 | 0.543263 | 0.001937 |

REGION R.OF.BUL
*****************

| AGE | FIRST ROW SILISTRA | R.OF.BUL |
|---|---|---|
| 0 | 0.000000 | 0.000000 |
| 5 | 0.000001 | 0.000938 |
| 10 | 0.000204 | 0.091525 |
| 15 | 0.000471 | 0.334426 |
| 20 | 0.000180 | 0.382063 |
| 25 | 0.000056 | 0.189218 |
| 30 | 0.000017 | 0.067383 |
| 35 | 0.000004 | 0.019533 |
| 40 | 0.000001 | 0.003824 |
| 45 | 0.000000 | 0.000278 |
| 50 | 0.000000 | 0.000000 |
| 55 | 0.000000 | 0.000000 |
| 60 | 0.000000 | 0.000000 |
| 65 | 0.000000 | 0.000000 |
| 70 | 0.000000 | 0.000000 |
| 75 | 0.000000 | 0.000000 |
| 80 | 0.000000 | 0.000000 |

| AGE | SURVIVORSHIP PROPORTIONS SILISTRA | R.OF.BUL |
|---|---|---|
| 0 | 0.000363 | 0.983707 |
| 5 | 0.001006 | 0.996627 |
| 10 | 0.001825 | 0.995286 |
| 15 | 0.001488 | 0.994359 |
| 20 | 0.000665 | 0.994404 |
| 25 | 0.000334 | 0.993897 |
| 30 | 0.000212 | 0.992052 |
| 35 | 0.000113 | 0.988868 |
| 40 | 0.000047 | 0.982884 |
| 45 | 0.000032 | 0.973202 |
| 50 | 0.000031 | 0.959462 |
| 55 | 0.000035 | 0.934255 |
| 60 | 0.000021 | 0.890722 |
| 65 | 0.000012 | 0.820916 |
| 70 | 0.000016 | 0.716978 |
| 75 | 0.000025 | 0.578940 |
| 80 | 0.000031 | 0.596711 |

# MULTIREGIONAL POPULATION PROJECTION

## YEAR 1975

### POPULATION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 667557. | 14686. | 652871. |
| 5 | 637942. | 15096. | 622846. |
| 10 | 627062. | 14657. | 612405. |
| 15 | 638493. | 12182. | 626311. |
| 20 | 655339. | 13126. | 642213. |
| 25 | 690259. | 13950. | 676309. |
| 30 | 577640. | 13784. | 563856. |
| 35 | 563393. | 11579. | 551814. |
| 40 | 634750. | 11842. | 622908. |
| 45 | 632732. | 11577. | 621155. |
| 50 | 615127. | 11590. | 603537. |
| 55 | 371267. | 6707. | 364560. |
| 60 | 449665. | 8815. | 440850. |
| 65 | 391262. | 7166. | 384096. |
| 70 | 282709. | 4998. | 277711. |
| 75 | 168881. | 2621. | 166260. |
| 80 | 74977. | 1193. | 73784. |
| 85 | 48710. | 859. | 47851. |
| TOT | 8727765. | 176428. | 8551337. |

### PERCENTAGE DISTRIBUTION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 7.6487 | 8.3241 | 7.6347 |
| 5 | 7.3093 | 8.5565 | 7.2836 |
| 10 | 7.1847 | 8.3076 | 7.1615 |
| 15 | 7.3157 | 6.9048 | 7.3241 |
| 20 | 7.5087 | 7.4399 | 7.5101 |
| 25 | 7.9088 | 7.9069 | 7.9088 |
| 30 | 6.6184 | 7.8128 | 6.5938 |
| 35 | 6.4552 | 6.5630 | 6.4530 |
| 40 | 7.2728 | 6.7121 | 7.2843 |
| 45 | 7.2496 | 6.5619 | 7.2638 |
| 50 | 7.0479 | 6.5693 | 7.0578 |
| 55 | 4.2539 | 3.8016 | 4.2632 |
| 60 | 5.1521 | 4.9964 | 5.1553 |
| 65 | 4.4830 | 4.0617 | 4.4916 |
| 70 | 3.2392 | 2.8329 | 3.2476 |
| 75 | 1.9350 | 1.4856 | 1.9443 |
| 80 | 0.8591 | 0.6762 | 0.8628 |
| 85 | 0.5581 | 0.4869 | 0.5596 |
| TOTAL | 100.0000 | 100.0000 | 100.0000 |
| M.AGE | 35.3256 | 33.6030 | 35.3611 |
| SHA | 100.0000 | 2.0215 | 97.9785 |

YEAR 1980

POPULATION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 706809. | 15200. | 691608. |
| 5 | 656873. | 14250. | 642622. |
| 10 | 636447. | 14650. | 621797. |
| 15 | 625264. | 13721. | 611543. |
| 20 | 635845. | 11616. | 624228. |
| 25 | 652100. | 12846. | 639254. |
| 30 | 686275. | 13744. | 672530. |
| 35 | 573179. | 13578. | 559601. |
| 40 | 557192. | 11394. | 545798. |
| 45 | 623929. | 11597. | 612333. |
| 50 | 615794. | 11227. | 604567. |
| 55 | 590161. | 11046. | 579115. |
| 60 | 346839. | 6226. | 340612. |
| 65 | 400461. | 7765. | 392696. |
| 70 | 321139. | 5812. | 315327. |
| 75 | 202598. | 3474. | 199124. |
| 80 | 97663. | 1402. | 96260. |
| 85 | 44680. | 650. | 44030. |
| TOT | 8973247. | 180200. | 8793047. |

PERCENTAGE DISTRIBUTION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 7.8768 | 8.4353 | 7.8654 |
| 5 | 7.3203 | 7.9081 | 7.3083 |
| 10 | 7.0927 | 8.1299 | 7.0715 |
| 15 | 6.9681 | 7.6144 | 6.9548 |
| 20 | 7.0860 | 6.4463 | 7.0991 |
| 25 | 7.2672 | 7.1287 | 7.2700 |
| 30 | 7.6480 | 7.6273 | 7.6484 |
| 35 | 6.3876 | 7.5350 | 6.3641 |
| 40 | 6.2095 | 6.3230 | 6.2072 |
| 45 | 6.9532 | 6.4354 | 6.9638 |
| 50 | 6.8626 | 6.2301 | 6.8755 |
| 55 | 6.5769 | 6.1298 | 6.5861 |
| 60 | 3.8653 | 3.4553 | 3.8737 |
| 65 | 4.4628 | 4.3091 | 4.4660 |
| 70 | 3.5789 | 3.2254 | 3.5861 |
| 75 | 2.2578 | 1.9277 | 2.2646 |
| 80 | 1.0884 | 0.7783 | 1.0947 |
| 85 | 0.4979 | 0.3609 | 0.5007 |
| TOTAL | 100.0000 | 100.0000 | 100.0000 |
| M.AGE | 35.7584 | 34.2661 | 35.7890 |
| SHA | 100.0000 | 2.0082 | 97.9918 |
| LAM | 1.028127 | 1.021382 | 1.028266 |

YEAR 1985

POPULATION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 695770. | 14899. | 680872. |
| 5 | 695497. | 14755. | 680742. |
| 10 | 655332. | 13884. | 641447. |
| 15 | 634622. | 13732. | 620889. |
| 20 | 622671. | 12944. | 609727. |
| 25 | 632703. | 11406. | 621297. |
| 30 | 648336. | 12662. | 635674. |
| 35 | 680973. | 13563. | 667411. |
| 40 | 566871. | 13351. | 553520. |
| 45 | 547695. | 11155. | 536539. |
| 50 | 607227. | 11245. | 595982. |
| 55 | 590803. | 10700. | 580102. |
| 60 | 551329. | 10254. | 541075. |
| 65 | 308892. | 5485. | 303406. |
| 70 | 328686. | 6298. | 322389. |
| 75 | 230136. | 4039. | 226096. |
| 80 | 117147. | 1858. | 115289. |
| 85 | 58207. | 765. | 57442. |
| TOT | 9172895. | 182997. | 8989898. |

PERCENTAGE DISTRIBUTION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 7.5851 | 8.1415 | 7.5737 |
| 5 | 7.5821 | 8.0631 | 7.5723 |
| 10 | 7.1442 | 7.5872 | 7.1352 |
| 15 | 6.9184 | 7.5041 | 6.9065 |
| 20 | 6.7882 | 7.0735 | 6.7824 |
| 25 | 6.8975 | 6.2326 | 6.9111 |
| 30 | 7.0680 | 6.9193 | 7.0710 |
| 35 | 7.4238 | 7.4113 | 7.4240 |
| 40 | 6.1799 | 7.2960 | 6.1571 |
| 45 | 5.9708 | 6.0960 | 5.9682 |
| 50 | 6.6198 | 6.1451 | 6.6295 |
| 55 | 6.4407 | 5.8472 | 6.4528 |
| 60 | 6.0104 | 5.6032 | 6.0187 |
| 65 | 3.3674 | 2.9976 | 3.3750 |
| 70 | 3.5832 | 3.4415 | 3.5861 |
| 75 | 2.5089 | 2.2074 | 2.5150 |
| 80 | 1.2771 | 1.0155 | 1.2824 |
| 85 | 0.6346 | 0.4180 | 0.6390 |
| TOTAL | 100.0000 | 100.0000 | 100.0000 |
| M.AGE | 36.1892 | 34.9228 | 36.2149 |
| SHA | 100.0000 | 1.9950 | 98.0050 |
| LAM | 1.022249 | 1.015522 | 1.022387 |

YEAR 1990

POPULATION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 691570. | 15046. | 676524. |
| 5 | 684636. | 14464. | 670172. |
| 10 | 693865. | 14392. | 679474. |
| 15 | 653451. | 13110. | 640341. |
| 20 | 631990. | 12968. | 619022. |
| 25 | 619593. | 12652. | 606941. |
| 30 | 629051. | 11260. | 617791. |
| 35 | 643327. | 12498. | 630829. |
| 40 | 673478. | 13348. | 660130. |
| 45 | 557211. | 13068. | 544143. |
| 50 | 533033. | 10816. | 522217. |
| 55 | 582583. | 10718. | 571865. |
| 60 | 551930. | 9934. | 541996. |
| 65 | 491005. | 9033. | 481972. |
| 70 | 253533. | 4449. | 249084. |
| 75 | 235537. | 4377. | 231160. |
| 80 | 133066. | 2161. | 130905. |
| 85 | 69811. | 1013. | 68798. |
| TOT | 9328669. | 185306. | 9143363. |

PERCENTAGE DISTRIBUTION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 7.4134 | 8.1195 | 7.3991 |
| 5 | 7.3390 | 7.8052 | 7.3296 |
| 10 | 7.4380 | 7.7665 | 7.4313 |
| 15 | 7.0048 | 7.0747 | 7.0033 |
| 20 | 6.7747 | 6.9982 | 6.7702 |
| 25 | 6.6418 | 6.8278 | 6.6380 |
| 30 | 6.7432 | 6.0766 | 6.7567 |
| 35 | 6.8962 | 6.7445 | 6.8993 |
| 40 | 7.2194 | 7.2034 | 7.2198 |
| 45 | 5.9731 | 7.0520 | 5.9512 |
| 50 | 5.7139 | 5.8368 | 5.7114 |
| 55 | 6.2451 | 5.7838 | 6.2544 |
| 60 | 5.9165 | 5.3606 | 5.9278 |
| 65 | 5.2634 | 4.8747 | 5.2713 |
| 70 | 2.7178 | 2.4010 | 2.7242 |
| 75 | 2.5249 | 2.3619 | 2.5282 |
| 80 | 1.4264 | 1.1660 | 1.4317 |
| 85 | 0.7483 | 0.5467 | 0.7524 |
| TOTAL | 100.0000 | 100.0000 | 100.0000 |
| M.AGE | 36.5254 | 35.4071 | 36.5480 |
| SHA | 100.0000 | 1.9864 | 98.0136 |
| LAM | 1.016982 | 1.012615 | 1.017071 |

## YEAR 1995

### POPULATION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 700868. | 15055. | 685814. |
| 5 | 680501. | 14602. | 665899. |
| 10 | 683029. | 14110. | 668919. |
| 15 | 691874. | 13615. | 678259. |
| 20 | 650741. | 12451. | 638290. |
| 25 | 628866. | 12681. | 616185. |
| 30 | 616017. | 12464. | 603553. |
| 35 | 624190. | 11125. | 613065. |
| 40 | 636246. | 12302. | 623944. |
| 45 | 661998. | 13070. | 648928. |
| 50 | 542294. | 12667. | 529627. |
| 55 | 511396. | 10307. | 501089. |
| 60 | 544250. | 9949. | 534300. |
| 65 | 491543. | 8751. | 482792. |
| 70 | 403006. | 7326. | 395680. |
| 75 | 181690. | 3092. | 178598. |
| 80 | 136179. | 2341. | 133838. |
| 85 | 79295. | 1178. | 78117. |
| TOT | 9463985. | 187088. | 9276897. |

### PERCENTAGE DISTRIBUTION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 7.4056 | 8.0467 | 7.3927 |
| 5 | 7.1904 | 7.8051 | 7.1780 |
| 10 | 7.2171 | 7.5420 | 7.2106 |
| 15 | 7.3106 | 7.2776 | 7.3113 |
| 20 | 6.8760 | 6.6551 | 6.8804 |
| 25 | 6.6448 | 6.7781 | 6.6421 |
| 30 | 6.5091 | 6.6620 | 6.5060 |
| 35 | 6.5954 | 5.9466 | 6.6085 |
| 40 | 6.7228 | 6.5757 | 6.7258 |
| 45 | 6.9949 | 6.9859 | 6.9951 |
| 50 | 5.7301 | 6.7708 | 5.7091 |
| 55 | 5.4036 | 5.5091 | 5.4015 |
| 60 | 5.7507 | 5.3181 | 5.7595 |
| 65 | 5.1938 | 4.6777 | 5.2042 |
| 70 | 4.2583 | 3.9160 | 4.2652 |
| 75 | 1.9198 | 1.6529 | 1.9252 |
| 80 | 1.4389 | 1.2512 | 1.4427 |
| 85 | 0.8379 | 0.6296 | 0.8421 |
| TOTAL | 100.0000 | 100.0000 | 100.0000 |
| M.AGE | 36.7596 | 35.7792 | 36.7794 |
| SHA | 100.0000 | 1.9768 | 98.0232 |
| LAM | 1.014505 | 1.009619 | 1.014604 |

## YEAR 2000

### POPULATION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 720287. | 15060. | 705227. |
| 5 | 689652. | 14614. | 675038. |
| 10 | 678905. | 14235. | 664670. |
| 15 | 681069. | 13354. | 667715. |
| 20 | 689004. | 12951. | 676054. |
| 25 | 647525. | 12205. | 635320. |
| 30 | 625236. | 12495. | 612741. |
| 35 | 611258. | 12297. | 598961. |
| 40 | 617319. | 10957. | 606362. |
| 45 | 625400. | 12046. | 613354. |
| 50 | 644276. | 12673. | 631604. |
| 55 | 520274. | 12069. | 508205. |
| 60 | 477742. | 9566. | 468176. |
| 65 | 484702. | 8765. | 475937. |
| 70 | 403450. | 7098. | 396352. |
| 75 | 288803. | 5092. | 283711. |
| 80 | 105059. | 1654. | 103404. |
| 85 | 81143. | 1276. | 79867. |
| TOT | 9591105. | 188407. | 9402698. |

### PERCENTAGE DISTRIBUTION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 7.5100 | 7.9934 | 7.5003 |
| 5 | 7.1905 | 7.7566 | 7.1792 |
| 10 | 7.0785 | 7.5553 | 7.0689 |
| 15 | 7.1010 | 7.0879 | 7.1013 |
| 20 | 7.1838 | 6.8739 | 7.1900 |
| 25 | 6.7513 | 6.4778 | 6.7568 |
| 30 | 6.5189 | 6.6317 | 6.5167 |
| 35 | 6.3732 | 6.5271 | 6.3701 |
| 40 | 6.4364 | 5.8157 | 6.4488 |
| 45 | 6.5206 | 6.3938 | 6.5232 |
| 50 | 6.7174 | 6.7262 | 6.7173 |
| 55 | 5.4245 | 6.4056 | 5.4049 |
| 60 | 4.9811 | 5.0775 | 4.9792 |
| 65 | 5.0537 | 4.6523 | 5.0617 |
| 70 | 4.2065 | 3.7675 | 4.2153 |
| 75 | 3.0112 | 2.7026 | 3.0173 |
| 80 | 1.0954 | 0.8780 | 1.0997 |
| 85 | 0.8460 | 0.6771 | 0.8494 |
| TOTAL | 100.0000 | 100.0000 | 100.0000 |
| M.AGE | 36.8653 | 36.0771 | 36.8821 |
| SHA | 100.0000 | 1.9644 | 98.0356 |
| LAM | 1.013432 | 1.007047 | 1.013561 |

YEAR 2005

POPULATION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 734742. | 15108. | 719634. |
| 5 | 708762. | 14626. | 694135. |
| 10 | 688034. | 14255. | 673779. |
| 15 | 676957. | 13454. | 663503. |
| 20 | 678244. | 12706. | 665538. |
| 25 | 685599. | 12703. | 672897. |
| 30 | 643787. | 12039. | 631748. |
| 35 | 620406. | 12329. | 608076. |
| 40 | 604530. | 12103. | 592428. |
| 45 | 606795. | 10731. | 596064. |
| 50 | 608658. | 11681. | 596978. |
| 55 | 618125. | 12077. | 606048. |
| 60 | 486029. | 11199. | 474830. |
| 65 | 425465. | 8427. | 417038. |
| 70 | 397834. | 7109. | 390725. |
| 75 | 289126. | 4933. | 284192. |
| 80 | 166987. | 2724. | 164263. |
| 85 | 62608. | 902. | 61706. |
| TOT | 9702689. | 189106. | 9513583. |

PERCENTAGE DISTRIBUTION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 7.5726 | 7.9894 | 7.5643 |
| 5 | 7.3048 | 7.7344 | 7.2963 |
| 10 | 7.0912 | 7.5380 | 7.0823 |
| 15 | 6.9770 | 7.1143 | 6.9743 |
| 20 | 6.9903 | 6.7189 | 6.9957 |
| 25 | 7.0661 | 6.7172 | 7.0730 |
| 30 | 6.6351 | 6.3664 | 6.6405 |
| 35 | 6.3942 | 6.5199 | 6.3917 |
| 40 | 6.2305 | 6.3999 | 6.2272 |
| 45 | 6.2539 | 5.6748 | 6.2654 |
| 50 | 6.2731 | 6.1768 | 6.2750 |
| 55 | 6.3707 | 6.3863 | 6.3703 |
| 60 | 5.0092 | 5.9220 | 4.9911 |
| 65 | 4.3850 | 4.4561 | 4.3836 |
| 70 | 4.1002 | 3.7594 | 4.1070 |
| 75 | 2.9799 | 2.6088 | 2.9872 |
| 80 | 1.7210 | 1.4403 | 1.7266 |
| 85 | 0.6453 | 0.4769 | 0.6486 |
| TOTAL | 100.0000 | 100.0000 | 100.0000 |
| M.AGE | 36.8470 | 36.2327 | 36.8592 |
| SHA | 100.0000 | 1.9490 | 98.0510 |
| LAM | 1.011634 | 1.003710 | 1.011793 |

YEAR 2010

POPULATION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 738690. | 15118. | 723572. |
| 5 | 722986. | 14678. | 708308. |
| 10 | 707098. | 14285. | 692813. |
| 15 | 686059. | 13487. | 672572. |
| 20 | 674149. | 12787. | 661362. |
| 25 | 674892. | 12464. | 662429. |
| 30 | 681642. | 12535. | 669108. |
| 35 | 638814. | 11889. | 626925. |
| 40 | 613577. | 12135. | 601442. |
| 45 | 594226. | 11850. | 582376. |
| 50 | 590552. | 10407. | 580144. |
| 55 | 583954. | 11132. | 572822. |
| 60 | 577450. | 11210. | 566240. |
| 65 | 432832. | 9863. | 422969. |
| 70 | 349207. | 6834. | 342373. |
| 75 | 285099. | 4941. | 280158. |
| 80 | 167180. | 2639. | 164541. |
| 85 | 99507. | 1485. | 98023. |
| TOT | 9817916. | 189739. | 9628177. |

PERCENTAGE DISTRIBUTION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 7.5239 | 7.9677 | 7.5152 |
| 5 | 7.3639 | 7.7357 | 7.3566 |
| 10 | 7.2021 | 7.5290 | 7.1957 |
| 15 | 6.9878 | 7.1083 | 6.9855 |
| 20 | 6.8665 | 6.7392 | 6.8690 |
| 25 | 6.8741 | 6.5694 | 6.8801 |
| 30 | 6.9428 | 6.6062 | 6.9495 |
| 35 | 6.5066 | 6.2660 | 6.5114 |
| 40 | 6.2496 | 6.3956 | 6.2467 |
| 45 | 6.0525 | 6.2453 | 6.0487 |
| 50 | 6.0150 | 5.4851 | 6.0255 |
| 55 | 5.9478 | 5.8671 | 5.9494 |
| 60 | 5.8816 | 5.9080 | 5.8811 |
| 65 | 4.4086 | 5.1983 | 4.3930 |
| 70 | 3.5568 | 3.6020 | 3.5559 |
| 75 | 2.9039 | 2.6042 | 2.9098 |
| 80 | 1.7028 | 1.3909 | 1.7090 |
| 85 | 1.0135 | 0.7825 | 1.0181 |
| TOTAL | 100.0000 | 100.0000 | 100.0000 |
| M.AGE | 36.8768 | 36.3851 | 36.8865 |
| SHA | 100.0000 | 1.9326 | 98.0674 |
| LAM | 1.011876 | 1.003347 | 1.012045 |

YEAR 2015

POPULATION

| AGE | TOTAL | SILISTRA | R. OF. BUL |
|---|---|---|---|
| 0 | 742853. | 15151. | 727702. |
| 5 | 726871. | 14688. | 712183. |
| 10 | 721289. | 14347. | 706941. |
| 15 | 705069. | 13548. | 691520. |
| 20 | 683214. | 12830. | 670384. |
| 25 | 670817. | 12538. | 658280. |
| 30 | 670997. | 12300. | 658697. |
| 35 | 676376. | 12380. | 663995. |
| 40 | 631782. | 11706. | 620076. |
| 45 | 603118. | 11882. | 591237. |
| 50 | 578318. | 11489. | 566829. |
| 55 | 566586. | 9920. | 556666. |
| 60 | 545529. | 10333. | 535196. |
| 65 | 514265. | 9875. | 504390. |
| 70 | 355243. | 7998. | 347245. |
| 75 | 250239. | 4749. | 245490. |
| 80 | 164849. | 2643. | 162206. |
| 85 | 99628. | 1439. | 98189. |
| TOT | 9907044. | 189818. | 9717226. |

PERCENTAGE DISTRIBUTION

| AGE | TOTAL | SILISTRA | R. OF. BUL |
|---|---|---|---|
| 0 | 7.4982 | 7.9818 | 7.4888 |
| 5 | 7.3369 | 7.7380 | 7.3291 |
| 10 | 7.2806 | 7.5585 | 7.2751 |
| 15 | 7.1168 | 7.1376 | 7.1164 |
| 20 | 6.8962 | 6.7591 | 6.8989 |
| 25 | 6.7711 | 6.6051 | 6.7744 |
| 30 | 6.7729 | 6.4797 | 6.7787 |
| 35 | 6.8272 | 6.5223 | 6.8332 |
| 40 | 6.3771 | 6.1669 | 6.3812 |
| 45 | 6.0878 | 6.2595 | 6.0844 |
| 50 | 5.8374 | 6.0529 | 5.8332 |
| 55 | 5.7190 | 5.2261 | 5.7287 |
| 60 | 5.5065 | 5.4438 | 5.5077 |
| 65 | 5.1909 | 5.2022 | 5.1907 |
| 70 | 3.5858 | 4.2137 | 3.5735 |
| 75 | 2.5259 | 2.5021 | 2.5263 |
| 80 | 1.6640 | 1.3925 | 1.6693 |
| 85 | 1.0056 | 0.7580 | 1.0105 |
| TOTAL | 100.0000 | 100.0000 | 100.0000 |
| M.AGE | 36.7787 | 36.3598 | 36.7869 |
| SHA | 100.0000 | 1.9160 | 98.0840 |
| LAM | 1.009078 | 1.000416 | 1.009249 |

YEAR 2020

POPULATION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 753311. | 15214. | 738098. |
| 5 | 730968. | 14721. | 716247. |
| 10 | 725165. | 14361. | 710804. |
| 15 | 719218. | 13627. | 705591. |
| 20 | 702144. | 12912. | 689232. |
| 25 | 679837. | 12584. | 667253. |
| 30 | 666945. | 12370. | 654576. |
| 35 | 665813. | 12149. | 653664. |
| 40 | 668930. | 12191. | 656739. |
| 45 | 621012. | 11464. | 609548. |
| 50 | 586973. | 11521. | 575452. |
| 55 | 554844. | 10949. | 543895. |
| 60 | 529308. | 9210. | 520098. |
| 65 | 485839. | 9103. | 476736. |
| 70 | 422094. | 8009. | 414085. |
| 75 | 254543. | 5558. | 248986. |
| 80 | 144674. | 2540. | 142134. |
| 85 | 98236. | 1441. | 96795. |
| TOT | 10009855. | 189923. | 9819932. |

PERCENTAGE DISTRIBUTION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 7.5257 | 8.0104 | 7.5163 |
| 5 | 7.3025 | 7.7511 | 7.2938 |
| 10 | 7.2445 | 7.5615 | 7.2384 |
| 15 | 7.1851 | 7.1752 | 7.1853 |
| 20 | 7.0145 | 6.7984 | 7.0187 |
| 25 | 6.7917 | 6.6261 | 6.7949 |
| 30 | 6.6629 | 6.5131 | 6.6658 |
| 35 | 6.6516 | 6.3968 | 6.6565 |
| 40 | 6.6827 | 6.4190 | 6.6878 |
| 45 | 6.2040 | 6.0359 | 6.2073 |
| 50 | 5.8639 | 6.0660 | 5.8600 |
| 55 | 5.5430 | 5.7650 | 5.5387 |
| 60 | 5.2879 | 4.8493 | 5.2964 |
| 65 | 4.8536 | 4.7930 | 4.8548 |
| 70 | 4.2168 | 4.2169 | 4.2168 |
| 75 | 2.5429 | 2.9262 | 2.5355 |
| 80 | 1.4453 | 1.3374 | 1.4474 |
| 85 | 0.9814 | 0.7587 | 0.9857 |
| TOTAL | 100.0000 | 100.0000 | 100.0000 |
| M.AGE | 36.7175 | 36.3028 | 36.7256 |
| SHA | 100.0000 | 1.8974 | 98.1026 |
| LAM | 1.010378 | 1.000555 | 1.010569 |

YEAR 2025

POPULATION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 767028. | 15298. | 751730. |
| 5 | 741259. | 14785. | 726474. |
| 10 | 729252. | 14396. | 714856. |
| 15 | 723083. | 13646. | 709437. |
| 20 | 716235. | 13002. | 703233. |
| 25 | 698674. | 12674. | 686000. |
| 30 | 675913. | 12418. | 663495. |
| 35 | 661792. | 12217. | 649576. |
| 40 | 658484. | 11963. | 646520. |
| 45 | 657527. | 11939. | 645588. |
| 50 | 604387. | 11117. | 593271. |
| 55 | 563148. | 10979. | 552169. |
| 60 | 518332. | 10163. | 508170. |
| 65 | 471400. | 8114. | 463285. |
| 70 | 398764. | 7383. | 391381. |
| 75 | 302474. | 5566. | 296908. |
| 80 | 147131. | 2971. | 144160. |
| 85 | 86202. | 1384. | 84818. |
| TOT | 10121085. | 190015. | 9931070. |

PERCENTAGE DISTRIBUTION

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 7.5785 | 8.0509 | 7.5695 |
| 5 | 7.3239 | 7.7808 | 7.3152 |
| 10 | 7.2053 | 7.5761 | 7.1982 |
| 15 | 7.1443 | 7.1816 | 7.1436 |
| 20 | 7.0767 | 6.8426 | 7.0811 |
| 25 | 6.9032 | 6.6702 | 6.9076 |
| 30 | 6.6783 | 6.5354 | 6.6810 |
| 35 | 6.5388 | 6.4292 | 6.5408 |
| 40 | 6.5061 | 6.2960 | 6.5101 |
| 45 | 6.4966 | 6.2833 | 6.5007 |
| 50 | 5.9716 | 5.8503 | 5.9739 |
| 55 | 5.5641 | 5.7780 | 5.5600 |
| 60 | 5.1213 | 5.3484 | 5.1170 |
| 65 | 4.6576 | 4.2703 | 4.6650 |
| 70 | 3.9399 | 3.8855 | 3.9410 |
| 75 | 2.9886 | 2.9292 | 2.9897 |
| 80 | 1.4537 | 1.5637 | 1.4516 |
| 85 | 0.8517 | 0.7285 | 0.8541 |
| TOTAL | 100.0000 | 100.0000 | 100.0000 |
| M.AGE | 36.6500 | 36.1914 | 36.6588 |
| SHA | 100.0000 | 1.8774 | 98.1226 |
| LAM | 1.011112 | 1.000487 | 1.011318 |

TOLERANCE LEVEL FOR EIGENVALUE 0.1000E-06
NUMBER OF ITERATIONS TO REACH STABILITY 173

1 STABLE EQUIVALENT TO ORIGINAL POPULATION
*****************************************

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 674705. | 11707. | 662998. |
| 5 | 655517. | 11267. | 644250. |
| 10 | 645702. | 10974. | 634728. |
| 15 | 635701. | 10461. | 625240. |
| 20 | 625054. | 9977. | 615077. |
| 25 | 614097. | 9724. | 604373. |
| 30 | 602828. | 9504. | 593325. |
| 35 | 590602. | 9286. | 581316. |
| 40 | 576709. | 9038. | 567672. |
| 45 | 559704. | 8743. | 550962. |
| 50 | 537829. | 8373. | 529456. |
| 55 | 509480. | 7882. | 501598. |
| 60 | 469942. | 7227. | 462715. |
| 65 | 413241. | 6288. | 406953. |
| 70 | 334898. | 5036. | 329862. |
| 75 | 236980. | 3457. | 233523. |
| 80 | 135320. | 1827. | 133493. |
| 85 | 79636. | 984. | 78652. |
| TOT | 8897948. | 141755. | 8756192. |

PERCENTAGE DISTRIBUTION
- - - - - - - - - - - - - -

| AGE | TOTAL | SILISTRA | R.OF.BUL |
|---|---|---|---|
| 0 | 7.5827 | 8.2586 | 7.5718 |
| 5 | 7.3671 | 7.9483 | 7.3577 |
| 10 | 7.2568 | 7.7416 | 7.2489 |
| 15 | 7.1444 | 7.3796 | 7.1405 |
| 20 | 7.0247 | 7.0385 | 7.0245 |
| 25 | 6.9016 | 6.8598 | 6.9022 |
| 30 | 6.7749 | 6.7042 | 6.7761 |
| 35 | 6.6375 | 6.5507 | 6.6389 |
| 40 | 6.4814 | 6.3754 | 6.4831 |
| 45 | 6.2903 | 6.1674 | 6.2923 |
| 50 | 6.0444 | 5.9069 | 6.0466 |
| 55 | 5.7258 | 5.5604 | 5.7285 |
| 60 | 5.2815 | 5.0984 | 5.2844 |
| 65 | 4.6442 | 4.4359 | 4.6476 |
| 70 | 3.7638 | 3.5529 | 3.7672 |
| 75 | 2.6633 | 2.4387 | 2.6669 |
| 80 | 1.5208 | 1.2887 | 1.5246 |
| 85 | 0.8950 | 0.6941 | 0.8982 |
| TOTAL | 100.0000 | 100.0000 | 100.0000 |
| M.AGE | 36.5433 | 35.4216 | 36.5615 |
| SHA | 100.0000 | 1.5931 | 98.4069 |
| LAM | 1.012814 | 1.012814 | 1.012814 |