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MODELS WITH SIMULTANEOUS EQUATIONS FOR LOCAL DEVELOPMENT

A. Matei*
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Introduction

The procedures used by analysts in their effort to offer a clear vision as possible, the processes and phenomena that occur in an economic or administrative system, in order to increase efficiency and improve its performance, are included in the modeling process.

This type of process requires obtaining some very useful models, especially when it is not possible to carry out experiments to evaluate the system, its performance and to analyze behavioral changes that make its leadership difficult.

When it comes to local development, the literature shows multiple types of models aimed to surprise as faithful as possible the existing realities at the local communities level and highlighting the economic laws that approximate this reality. Relevant synthesis are presented from this perspective in Matei (2005), Constantin (2001), Matei and Anghelescu (2009), Matei, Anghelescu and Săvulescu (2009) etc.

Given the complexity of specific local development processes and phenomena, the authors focused on making use of statistical models with simultaneous equations.

In the literature there are some applications of models with simultaneous equations for social phenomena analysis, while for the parameters estimation are being used data sets resulting from statistical surveys. One example in this sense is Kaufmann (2002), Bai and Wei (2000), Kaufmann et al. (1999), Andrei, Matei and Oancea (2009), etc. For exemplification, the last cited paper defines a simultaneous equations model for studying issues related to corruption and public sector health services performance.

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I. Modeling local development systems specific aspects

Local development systemic approaches started both from more general concerns of social systemic but also from similar models used in administrative or economic theories or those relating to regional development, etc.

Among the relevant work supporting this approach we underline Chevalier (1986), Timsit (1986), Decleris (1992), Landry and Lemieux (1978), Buckley (1967) and Matei (2003, 2008).

This paper analysis perspective follows both general ideas mentioned in the previous works and also more modern approaches on cybernetic systems models, administrative and systemic models of local development[1].

In Matei (2008) the suitable systemic analysis of public administration is accompanied by feedback mechanisms based on fundamental public economic theories and findings. This approach draws also from European institutions preoccupations concerning the assessment and impact of local and regional development programs and projects.

I.1. Economic and social models

Management processes systemic approach requires a careful and thorough system investigation with the aim of its representation by models in order to achieve high efficiency in attaining system's objectives.

The model can be defined as *"an isomorphic representation of objective reality and represents a simplified rigorous and fundamental description in the sense of the represented system (phenomenon / process) logical structure that facilitates the discovery of links and laws that are very difficult to find other ways"*[2].

In Klein's, Welfe and Welfe's (2003) view, the model "*is a schematic simplification that removes non-essential issues in order to highlight the content, form and operation of a more complicated mechanism*"[3].

[1] Matei, A., (2008), *„Systemic Models of Local Development",* „International Journal of Public Administration in Central and Eastern Europe", No. 1, pp. 13 – 14, Available at SSRN:http://ssrn.com/abstract=1 311 811.
[2] Păun, M., (1997), *„Analiza sistemelor economice"* – Editura All Educational, Bucharest, p. 133
[3] Klein R, L., Welfe, A., Welfe, W., (2003), *„Principiile modelării macroeconometrice"*, Editura Economică, p.13

Therefore, the essence of modeling method is to replace the real studied process with a more easily reached model.

The models are found both in the economic and the social sphere. A social model consists of simplifying hypothesis, approximate but sharp relations, and a specific explanation of reality. Finally, *"this model does not represent reality but only a simplified picture of reality that man is able to understand"*[4].

A more closely picture of the administrative phenomena and acts outlines the administrative system model as "*a cybernetic-administrative model*"[5] according to which the public administration is seen as *"an evolutionary process from continuous requirements, attributes and relationships that allow optimal operation"* [6].

Given the features and complexity of phenomena and processes taking place in these systems, defining the model concept, located in the economic, social and administrative systems, raises new problems and stresses controversy. The essential elements that can not be ignored in the modeling process are:

- dual quantitative and qualitative essence of social-economic phenomena and processes that require the avoidance of unilateral economic approach;
- different development of socio-economic phenomena, both in space plan (from an administrative-territorial unit to another), and in time (from one period to another);
- economic and social phenomena and processes explanation is influenced by group interests, aspirations and choices, being determined by their conduct;
- mathematical formalization is not the only possible abstraction form, but a higher level of scientific abstraction that draws us most closely to certainty borders, since the hypothesis are appropriate and can be applied in practice.

Consequently, a model approximates the objective reality based on a conceptualization that comprises a core-theory, expressed by descriptive or mathematical representations and normative acts that reveal the phenomenon essence in accordance

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[4] Idem

[5] Matei, A., (2003), „*Analiza sistemelor administrației publice"*, Editura Economică, Bucharest, p.53

[6] Alexandru, I., (1999), „*Administrația publică. Teorii, realități, perspective"* – Editura Lumina Lex, Bucharest, p.47.

with a pattern of thought, namely observations and measurements derived from descriptions, facts ordering, data comparison, regularities set upon data processing, etc.

The literature presents an important number of economic development theories and models. This phenomenon is generated by the underdevelopment complexity problems, by countries efforts to overcome this situation, by the trends of economic and political emancipation of industrialized countries, and also by the bottlenecks that may arise in the development process of the concerned industrialized countries. In this regard, some theories focus on internal factors (endogenous) and others stress the importance of external factors (exogenous).

In this situation, an analysis of the two forms of development is need. *Exogenous development* strategies and policies aim, in particular, to resolve employment and supporting the new business problems, while *endogenous development* incorporates, in its broadest sense, factors that may contribute to local economic development: material resources, including those offered by environment, transport and telecommunications infrastructure, etc. To promote local development means to coordinate these factors and put them in the service of local community members.

For this reason *"it must be distinguished between the spontaneous development and stimulated development by public authorities based on the endogenous potential, as well as between endogenous and self-development"*[7].

We must also bear in mind that endogenous development policies are not limited to the secondary sector and could extend to the primary one, but also to the tertiary, depending on the specific analyzed area or localities. However, in relation to this differentiation, solving local development problems can be achieved simultaneously focusing endogenous and exogenous factors.

I.2. Model options. Data sources problem

In relation to the many theories and models that seek to highlight the local development process, it is difficult to choose a particular model, especially, as the Romanian society knows extensive changes due to transition to a market economy. The

[7] Constantin, D.L., (2000), „*Introducere în teoria şi practica dezvoltării regionale*" - Ed. Economică, Bucharest, p. 100

study of economic and social processes in the counties or municipalities (communes, towns, cities) is affected by the existence of some constraints.

In this case, one of the most important restrictions to overcome is to provide data needed to estimate the selected parameters.

Referring to models with simultaneous equations, one major problem relates to defining the list of instrumental variables used in estimating parameters involved in the model. We mention that the literature does not offer a consistent approach in choosing the list of variables.

If at national, regional or even at county level, there are certain chronological series on the territorial-administrative units (commune, town, city), they are restricted or entirely absent. Thus, data collection action for this type of model was rather difficult. Therefore, in these conditions, we chose to use an econometric analysis by addressing the data simultaneously in time and space, an action that allows increasing the number of observations used in the model.

Another limitation encountered in studying the processes of local development lies in the lack of local separate compartments to collect the necessary data to periodically adjust the local development strategy. Following these restrictions to ensure consistency and good specification, the constructed econometric model is a relatively small model sizes.

Given these circumstances and taking into account the fact that statistical data series are of relatively small scale for local authorities at communes, cities and some municipalities level and, as such, do not allow us to build a model of social-economic development, we considered necessary and appropriate to build an econometric model specific to Braila city.

I.2.1. Overall structure of the model

The structure comprises the following components:

- model variables
- model parameters
- model equations
- data sets (primary information).

a) Model variables and parameters

The proposed model includes statistic interdependent variables. The types of variables used in this model are:

- *endogenous variables*, also called *result variable* or *resulted effect*, are those variables whose values are determined by one or more exogenous variables. Endogenous variables are obtained by solving the model, and on this basis, they are also called *dependent*;
- *independent variables*, also called *factor variables* or *influencing factors* are those variables whose status and evolution depend on the studied external system factors. These are always *explanatory variables*, meaning their value is predetermined, known in advance, or is determined by entering primary data. We must note that not any explanatory variable in the model is exogenous.
- In turn, exogenous variables, may be:
  - *predetermined* or explanatory - variables whose values are known a priori and are used to explain the status and the evolution of endogenous variables;
  - *delayed variables* - variables that can be emphasized by retrospective, or, in other words, existing variables evolution is dependent of similar variables in past periods;
- *residual variables*, also called *errors* that occur in the model as the sum of all unknown influences;

The proposed model also comprises its *parameters*, called the *regression coefficients*, real and unknown quantities, which appear in the model in different expressions along with variables. Parameters are the process subject of statistical estimation and testing.

The model focuses primarily to quantify factors determination influence of some economic, social, demographic and spatial-urbanity indicators at Braila city level. Also, it underlines at this level the conditioning variables related to: business development (total number of companies), public transportation (number of bus trips, number of tram trips), development of public affairs (running costs of the local budget, capital expenditures for public utility services), gross domestic product (demography, population density, the average life span), social comfort (the amount of heat distributed in the city, the number of existing houses), etc.

The model includes in its structure, 36 variables, 20 of which are exogenous, and 16 are endogenous. All variables are calculated at local level (municipality). The symbols used and their significance, are presented in Tab. I.1.

Tab. I.1. – *The variables symbols used in the model and their meanings:*

Symbol	Meaning	Variables Type
AG_ECON	Total number of companies	exogenous
WATER	The amount of total distributed water (thousand c.m)	exogenous
a_1, a_2, ..., a_n	Econometric determined coefficients	endogenous
BUS_TRIP	Number of trips related to a bus/minibus (per 1000 inhabitants)	exogenous
TRIP_BUS	Number of bus trips	endogenous
TRAM_TRIP	Number of trips related to a tram (per 1000 inhabitants)	exogenous
TRIP_TRAM	Number of tram trips	exogenous
CURRENT_EXPEND	Current expenditure of local budget (thousand lei)	exogenous
EXPEND_SUP	Capital expenditure for public services (thousand lei)	exogenous
DECED	Deaths	endogenous
DENSITY	Population density (inhabitants per/km^2)	endogenous
AVERAGE LIFE SPAN	The average life span	exogenous
EN_TERM	The amount of heat distributed (Gcal.)	exogenous
GAS	The volume of natural gas distributed (thousands c.m.)	endogenous
HOUSES	Number of existing housing	exogenous
BIRTHS	Number of live births	exogenous
NR_TRMV	The number of trams in stock	exogenous
NR_BUS	The number of bus/minibuses in stock	exogenous
BEDS	Number of beds in hospitals	exogenous
PENSIONERS	Number of pensioners in the city	exogenous
GDP	Gross domestic product (million lei)	endogenous
GDP_LOC	Gross domestic product per capita (lei RON)	exogenous
DEPART_DOM	Local resident departures	endogenous
POP_ACTIV	Active population of the city	exogenous
POP_MUN	The total population of the city	endogenous
R_DECED	Death rate (per 1000 inhabitants)	endogenous
R_BIRTH	Birth rate (per 1000 inhabitants)	endogenous
R_BED	Rates number of hospital beds (per 1000 inhabitants)	endogenous
R_PENS	Pensioners Rates (per 1000 inhabitants)	endogenous
R_DEPART	Local resident departure rate (per 1000 inhabitants)	endogenous
R_EMPLOYEES	Rates of employees (per 1000 inhabitants)	endogenous
R_ARRIVALS	Rates settling residence in the village (1000 inhabitants)	endogenous
EMPLOYEES_ADM	Number of employees in public administration	endogenous
EMPLOYEES	Number of employees (per 1000 inhabitants)	endogenous
UNEMPLOYED	The total number of unemployed	exogenous
ARRIVALS_DOM	Arrivals residing in the locality	exogenous
OWN_REVENUE	Own revenues of local budget (thousand lei)	

I.2.2.-Model equations and identities

Model equations are designed to connect between endogenous and explanatory variables. The types of equations used in the model are:

- behavioral equations;
- definition equations;
- balance sheet or equilibrium equation;

Identifying equations represented a model specific stage because it includes multiple equations for analyzing socio-economic activities in Braila town, from 2001 to 2005.

The model consists of 17 equations, and of these, 9 are *behavioral* equations and 8 are *definition* or *equilibrium* equations. The chosen model is structured in blocks of equations, each containing specific equations.

The *first block* consists of eight equations, of which two equations are behavioral (R_EMPLOYEES and AVERAGE LIFE SPAN) and six equations of equilibrium (R_BIRTH, R_DEPART, R_ARRIVALS, R_PENS, R_DECED and R_BED) and seek to analyze the local demographic variables.

Structured form of block equation is as follows:

R_EMPLOYEES = a_{11} + a_{12}*R_BIRTH + a_{13}*R_DEPART + a_{14}*R_ARRIVALS

AVERAGE LIFE SPAN = a_{21} + a_{22}*R_PENS + a_{23}*R_DECED + a_{24}*R_BED

R_BIRTH = BIRTHS/1000 * POP_MUN

R_DEPART = DEPART_DOM/1000 * POP_MUN

R_ARRIVALS = ARRIVALS_DOM/1000 * POP_MUN

R_PENS = PENSIONERS/1000 * POP_MUN

R_DECED = DECED/1000 * POP_MUN

R_BED = BEDS/1000 * POP_MUN

The *second block* includes six equations, of which 4 are behavior equations (EMPLOYEES, SOMERI, POP_ACTIV and EMPLOYEES_ADM) and two are equations of equilibrium (TRAM_TRIP and BUS_TRIP) and analyze local labor market.

The structure of the equations system that highlights local labor market, is as follows:

EMPLOYEES = a_{31} + a_{32}*TRAM_TRIP + a_{33}*BUS_TRIP
UNEMPLOYED= a_{41} + a_{42}*RATA_PLECARI + a_{43}*RATA_SOSIRI + a_{44}*GDP_LOC

POP_ACTIV = a_{51} + a_{52}*POP_MUN + a_{53}*GDP
EMPLOYEES_ADM = a_{61} + a_{62}*OWN_REVENUE + a_{63}*CURRENT_EXPEND + a_{64}*EXPEND_SUP
TRAM_TRIP = (TRIP_TRAM/NR_TRMV*1000)/POP_MUN
BUS_TRIP = (TRIP_BUS/NR_BUS*1000)/POP_MUN

The *last block* consists of three equations, all behavioral, and reveals the utilities provision, housing issues in relation to the number of traders, the unemployed and the local GDP.

Equations that compose this block have the following form:
HOUSES = a_{71} + a_{72}*AG_ECON + a_{73}*GDP_LOC + a_{74}*UNEMPLOYED
DENSITY = a_{81} + a_{82}*EN_TERM + a_{83}*GAS + a_{84}*WATER
GDP_LOC = a_{91} + a_{92}*HOUSES + a_{93}*OWN_REVENUE

I.2.3. Model validity

The model is solved by the two-stage least squares method (MCMMP-2)[8]. The chosen alternative is frequently applied in practice[9], both because of the outcome quality and because it is less laborious (implying lower processing costs) compared to other alternatives. MCMMP-2 application is necessary because in the model appear circularities. However, the method advantage also consists in mitigating the autocorrelation phenomenon of residues.

According to the chosen method, the first phase (stage) implies the ordinary method of least squares (classical) for each equations model, achieving thereby estimated parameters vectors a_1, a_2, a_3 …….a_g. The estimations thus obtained are introduced into the reduced area equations to obtain the adjusted values for each of the endogenous variables related to exogenous variables evolution.

[8] Pecican, St.E, (2005) – *Econometria pentru … economişti- Econometrie – teorie şi aplicaţii* – Second edition, Editura Economică, Bucharest, p. 322
[9] Andrei, T., Bourbonnais, R., (2008), *Econometrie*, Editura Economică, pp. 305 – 312.

In the second stage, statistical values of the endogenous variables model are replaced with values adjusted in first phase independent of the disturbance and the method of least squares is applied to estimate parameters of each equation.

Solving the model was possible using the software package EViews. The coefficients values of model equations, based on a specific Braila town statistical data, in the period 2001 - 2005, together with significance tests are shown in Tab. I.2.

Tab. I.2.- *The coefficients values of equations model*

	Coefficient	Standard deviation	t-Statistic	Probability	R-squared (R^2)
a_{11}	391.0415	196.6041	1.988979	0.2966	0.654709
a_{12}	-8.736079	16.16709	-0.540362	0.6846	
a_{13}	4.263381	4.436007	0.961085	0.5126	
a_{14}	-11.83660	10.45436	-1.132216	0.4606	
a_{21}	56.25880	0.169200	332.4998	0.0019	0.999902
a_{22}	-0.004946	0.000546	-9.061887	0.0700	
a_{23}	0.889994	0.014420	61.71799	0.0103	
a_{24}	0.654579	0.007936	82.48737	0.0077	
a_{31}	312.1570	28.34757	11.01177	0.0081	0.775478
a_{32}	0.042654	0.016279	2.620193	0.1200	
a_{33}	-0.114599	0.052645	-2.176816	0.1614	
a_{41}	9551.164	7533.859	1.267765	0.4252	0.973272
a_{42}	-1539.797	898.5682	-1.713611	0.3363	
a_{43}	2793.408	1561.229	1.789237	0.3245	
a_{44}	-0.237357	0.534305	-0.444235	0.7339	
a_{51}	-87217.24	26385.32	-3.305521	0.0806	0.984094
a_{52}	0.975084	0.112235	8.687916	0.0130	
a_{53}	2.583090	0.597837	4.320726	0.0496	
a_{61}	1456.040	20.30109	71.72223	0.0089	0.995836
a_{62}	0.026195	0.002630	9.958481	0.0637	
a_{63}	-0.007440	0.001024	-7.268484	0.0870	
a_{64}	-0.072579	0.005831	-12.44689	0.0510	
a_{71}	77131.90	150.1683	513.6365	0.0012	0.999026
a_{72}	-0.013680	0.011382	-1.201987	0.4418	
a_{73}	0.129590	0.013152	9.853228	0.0644	
a_{74}	0.024047	0.006952	3.459180	0.1792	
a_{81}	-1749.727	991.9967	-1.763843	0.3283	0.988181
a_{82}	-0.008661	0.002004	-4.322721	0.1447	
a_{83}	0.000274	0.001478	0.185297	0.8834	
a_{84}	0.812144	0.092067	8.821225	0.0719	
a_{91}	-610918.7	152578.2	-4.003971	0.0571	0.993762
a_{92}	7.870874	1.965725	4.004056	0.0571	
a_{93}	0.046978	0.026952	1.743022	0.2235	

The analysis of the errors in the above table indicates that they provide information characterizing the performance model in the sense that the probability that the coefficient value is insignificant is almost zero, whatever coefficient is selected.

Moreover, there were also been taken in the analysis the calculated statistical tests for econometric relations validation.

R^2 test highlights the extent to which factorial variables have the variation of the result variable. The maximum value of this indicator is 1, and achieving this value means the existence of functional dependencies.

The verification of disturbances' independence related to its value was made by Durbin-Watson test. The presence of errors' autocorrelation of is that the estimation of parameters to be inefficient and significance tests of the estimator is not valid. The absence of errors autocorrelation test status is indicated by Durbin-Watson around the 2.5 value, with a calculated deviation, plus or minus, depending on the number of statistical observations and the number of explanatory variables in each equation of the model. If we consider that the Durbin-Watson test value is found between the two limits with a 95% probability, the residues in the model equations do not show the phenomenon of order I autocorrelation. The data to be presented underline that all equations defined in the model complies with this condition.

This indicates that none of the equations presents the autocorrelation of errors phenomenon, so the estimated values of model parameters are calculated correctly. Therefore, the estimators are effective.

As such, the proposed model raises the spatial autocorrelation problem since the relatively short series do not permit applying such tests.

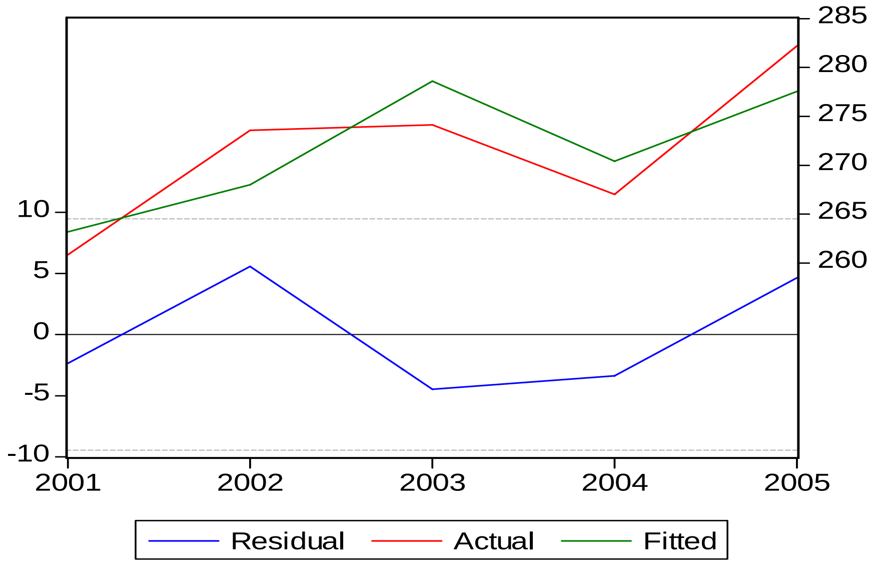
II. Model variables interpretation and dynamic

The computation and dynamics in the period under review, is as follows:

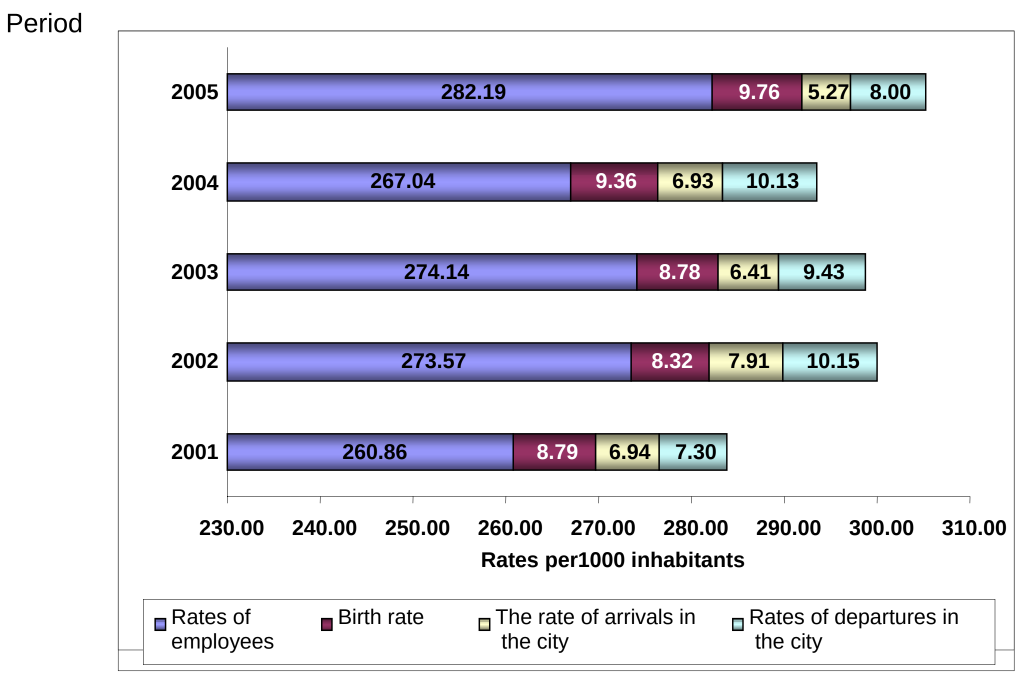
1. Estimation Equation:
R_EMPLOYEES = a_{11} + a_{12}*R_BIRTH + a_{13}*R_DEPART + a_{14}*R_ARRIVALS

R-squared	0.654709	Mean dependent var	271.5569
Adjusted R-squared	-0.381166	S.D. dependent var	8.041777
S.E. of regression	9.450938	Akaike info criterion	7.320667
Sum squared resid	89.32022	Schwarz criterion	7.008217
Log likelihood	-14.30167	F-statistic	0.632035
Durbin-Watson stat	2.559047	Prob(F-statistic)	0.702555

Graphical representation of the calculated measured values and residual values for this model equation is as follows:



However, the dynamic evolution of these parameters is as follows:

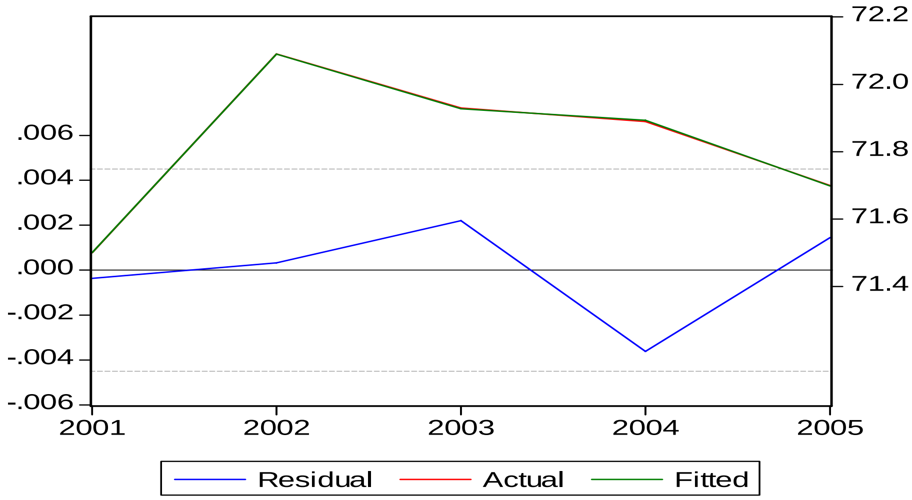


2. Estimation Equation:

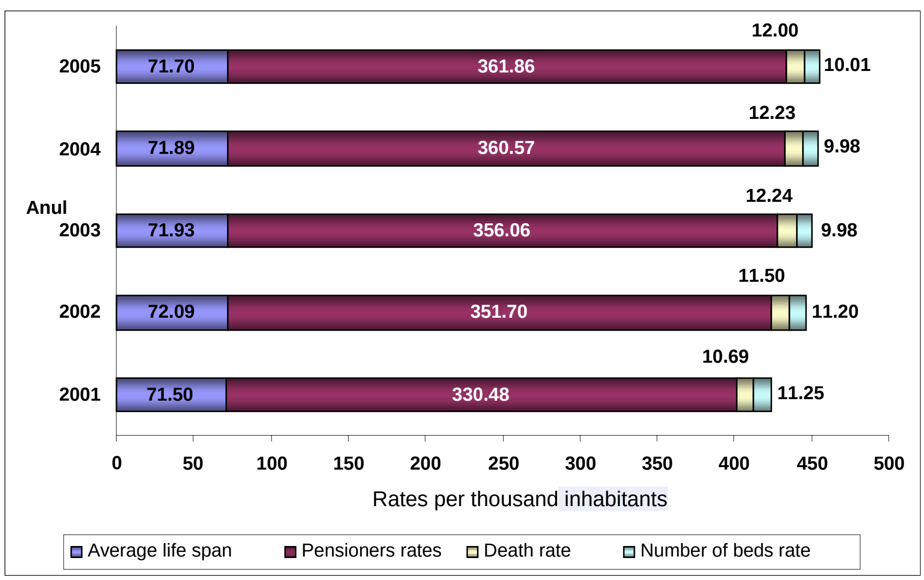
AVERAGE LIFE SPAN = $a_{21} + a_{22}$*R_PENS + a_{23}*R_DECED + a_{24}*R_BED

R-squared	0.999902	Mean dependent var	71.82200
Adjusted R-squared	0.999608	S.D. dependent var	0.227310
S.E. of regression	0.004502	Akaike info criterion	-7.978042
Sum squared resid	2.03E-05	Schwarz criterion	-8.290492
Log likelihood	23.94511	F-statistic	3398.834
Durbin-Watson stat	3.133220	Prob(F-statistic)	0.012608

Graphical representation of the calculated measured values and residual values for this equation is:



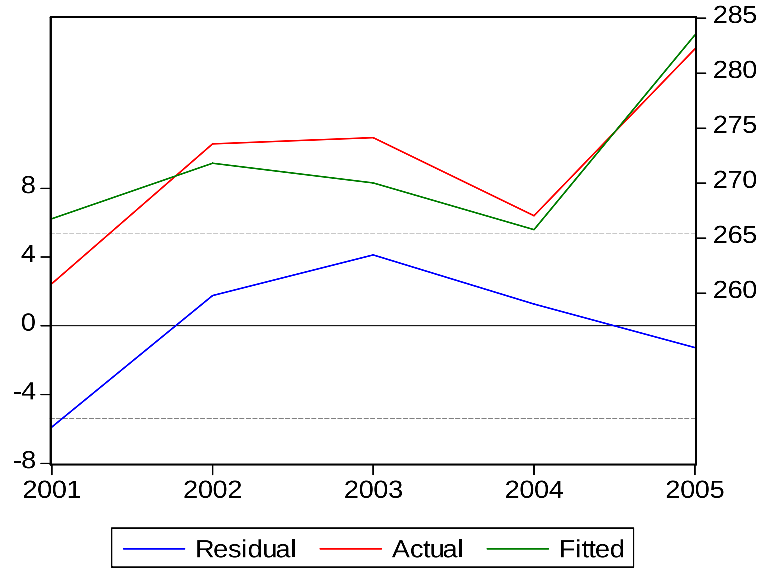
As far as the dynamic evolution of these parameters is concerned, the situation is as follows:



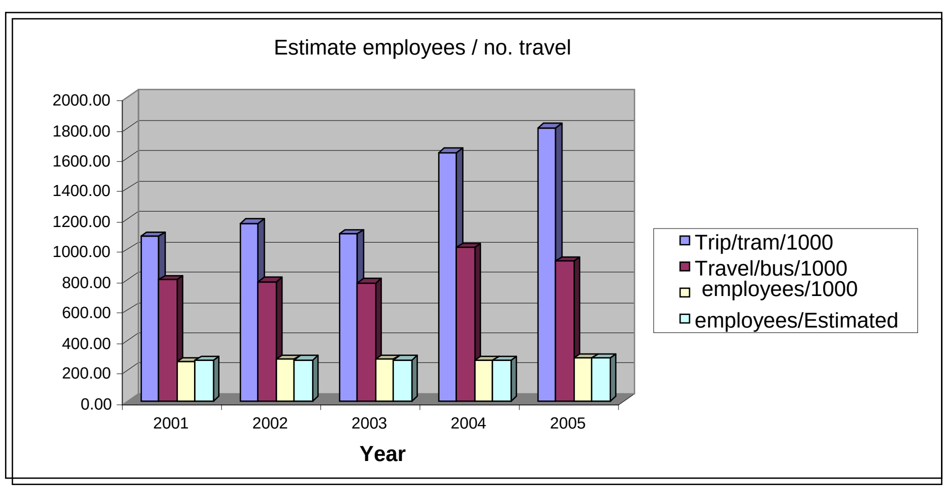
3. Estimation Equation:
EMPLOYEES = a_{31} + a_{32}*TRAM_TRIP + a_{33}*BUS_TRIP

R-squared	0.775478	Mean dependent var	271.5569
Adjusted R-squared	0.550955	S.D. dependent var	8.041777
S.E. of regression	5.388860	Akaike info criterion	6.490254
Sum squared resid	58.07962	Schwarz criterion	6.255917
Log likelihood	-13.22563	F-statistic	3.453898
Durbin-Watson stat	1.356345	Prob(F-statistic)	0.224522

Graphical representation of the calculated measured values and residual values for this equation is:



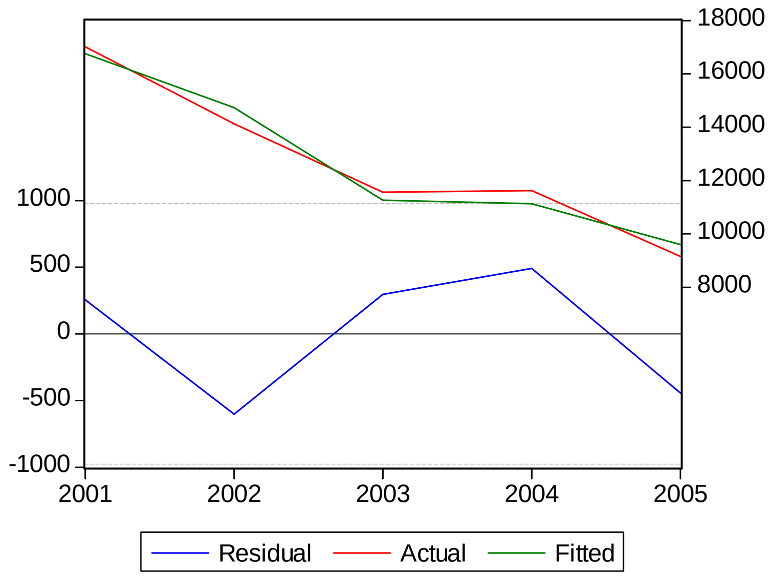
Also, the dynamic evolution of these parameters is as follows:



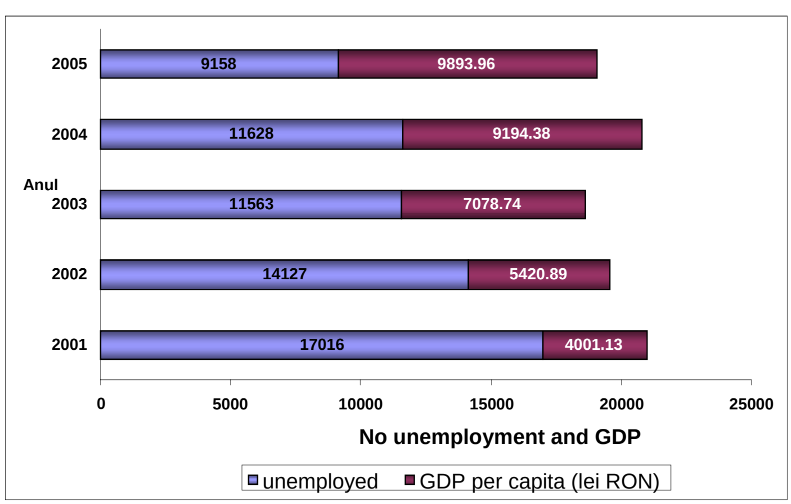
4. Estimation Equation:
UNEMPLOYED= a_{41} + a_{42}*RATA_PLECARI + a_{43}*RATA_SOSIRI + a_{44}*GDP_LOC

R-squared	0.973272	Mean dependent var	12698.40
Adjusted R-squared	0.893089	S.D. dependent var	2985.460
S.E. of regression	976.1632	Akaike info criterion	16.59570
Sum squared resid	952894.7	Schwarz criterion	16.28325
Log likelihood	-37.48925	F-statistic	12.13810
Durbin-Watson stat	2.573804	Prob(F-statistic)	0.207226

Graphical representation of the calculated measured values and residual values for this equation is:



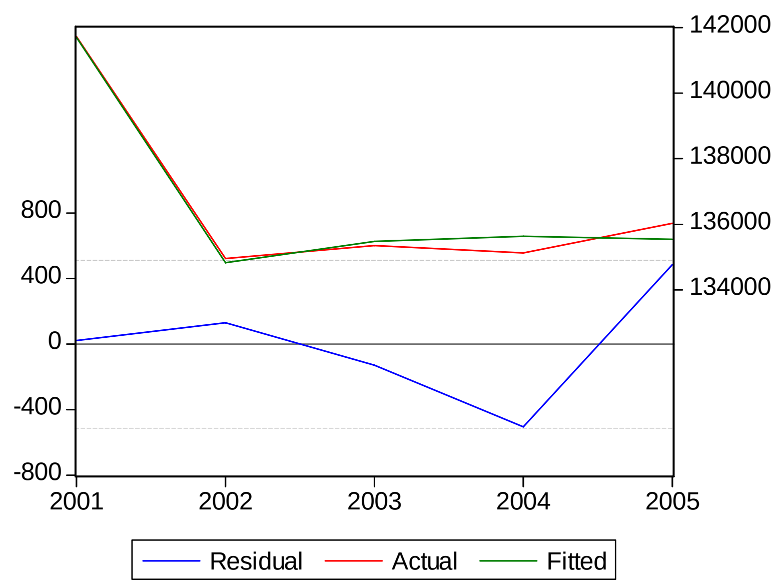
However, the dynamic evolution of these parameters has the following form:



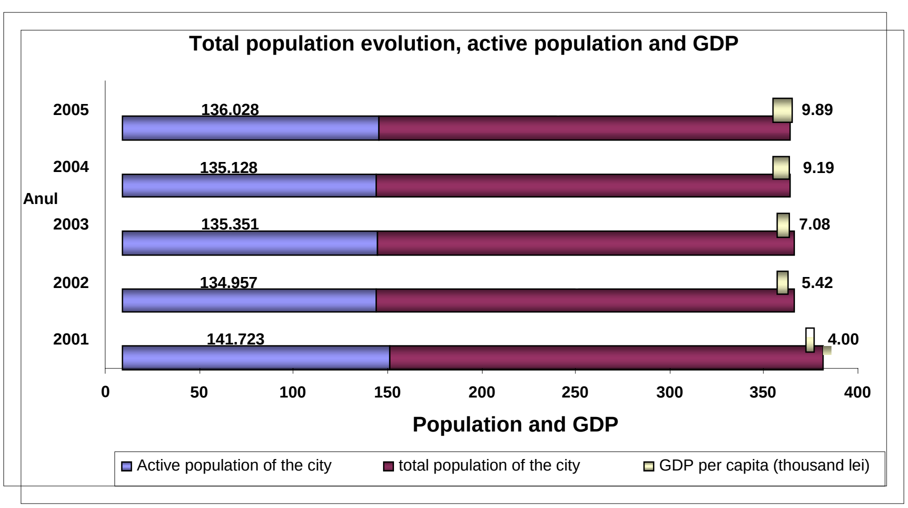
5. Estimation Equation:
POP_ACTIV = a_{51} + a_{52}*POP_MUN + a_{53}*GDP

R-squared	0.984094	Mean dependent var	136637.4
Adjusted R-squared	0.968187	S.D. dependent var	2871.914
S.E. of regression	512.2384	Akaike info criterion	15.59917
Sum squared resid	524776.3	Schwarz criterion	15.36483
Log likelihood	-35.99792	F-statistic	61.86784
Durbin-Watson stat	2.289873	Prob(F-statistic)	0.015906

Graphical representation of the calculated measured values and residual values for this equation is:



On the dynamic evolution of these parameters, the situation is as follows:

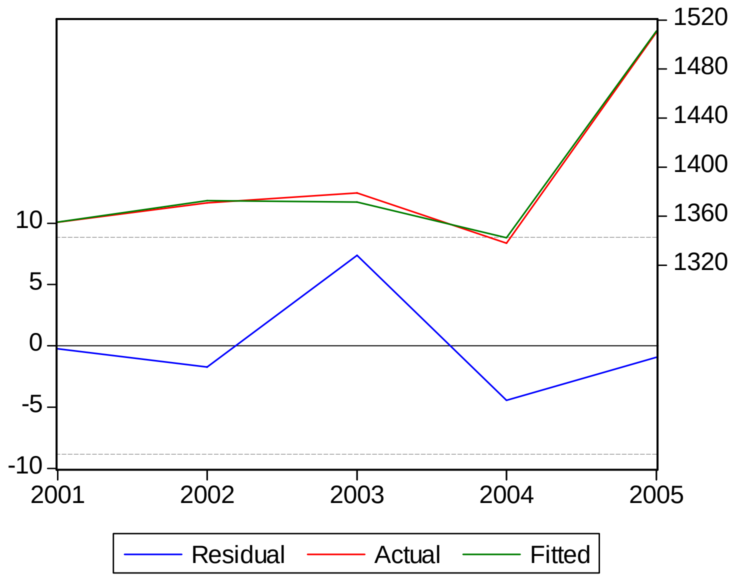


6. Estimation Equation:

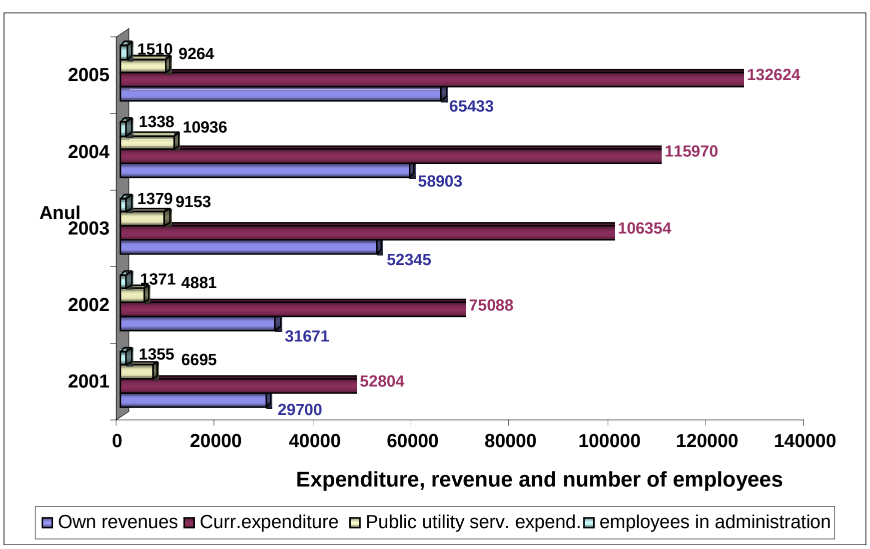
$EMPLOYEES\_ADM = a_{61} + a_{62}*OWN\_REVENUE + a_{63}*CURRENT\_EXPEND + a_{64}*EXPEND\_SUP$

R-squared	0.995836	Mean dependent var	1390.600
Adjusted R-squared	0.983345	S.D. dependent var	68.57332
S.E. of regression	8.849792	Akaike info criterion	7.189227
Sum squared resid	78.31883	Schwarz criterion	6.876777
Log likelihood	-13.97307	F-statistic	79.72064
Durbin-Watson stat	3.036388	Prob(F-statistic)	0.082102

Graphical representation of the calculated measured values and residual values for this equation is:



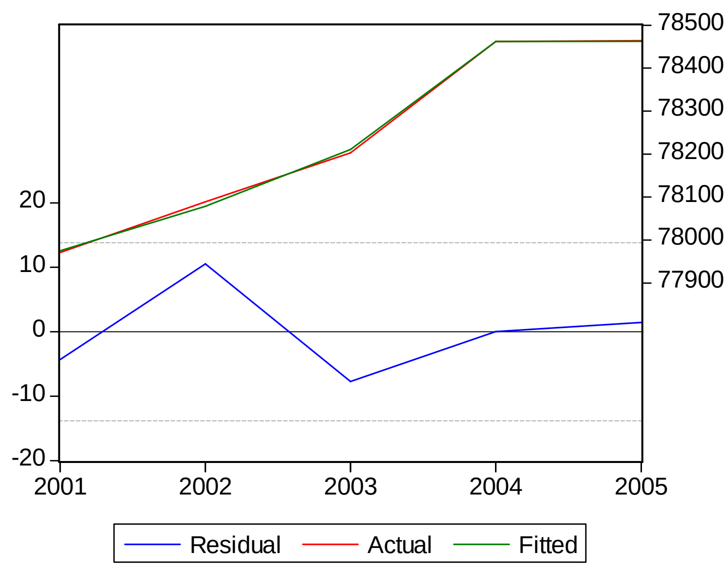
The dynamic evolution of these parameters is as follows:



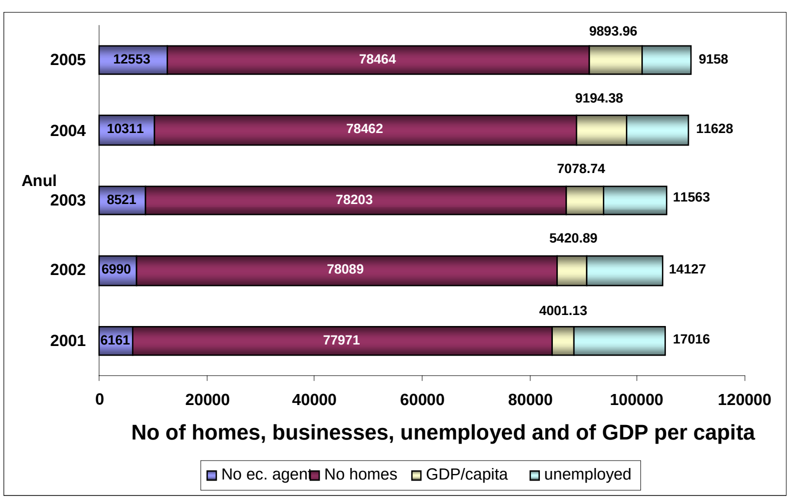
7. Estimation Equation:
HOUSES = $a_{71} + a_{72}$*AG_ECON + a_{73}*GDP_LOC + a_{74}*SOMERI

R-squared	0.999026	Mean dependent var	78237.80
Adjusted R-squared	0.996103	S.D. dependent var	221.3407
S.E. of regression	13.81740	Akaike info criterion	8.080296
Sum squared resid	190.9205	Schwarz criterion	7.767847
Log likelihood	-16.20074	F-statistic	341.8104
Durbin-Watson stat	3.219927	Prob(F-statistic)	0.039735

Graphical representation of the calculated measured values and residual values for this equation is:



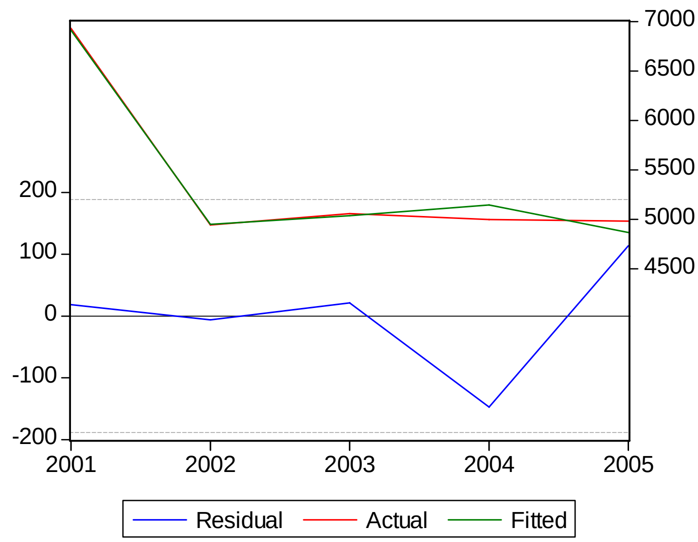
The dynamic evolution of these parameters is as follows:



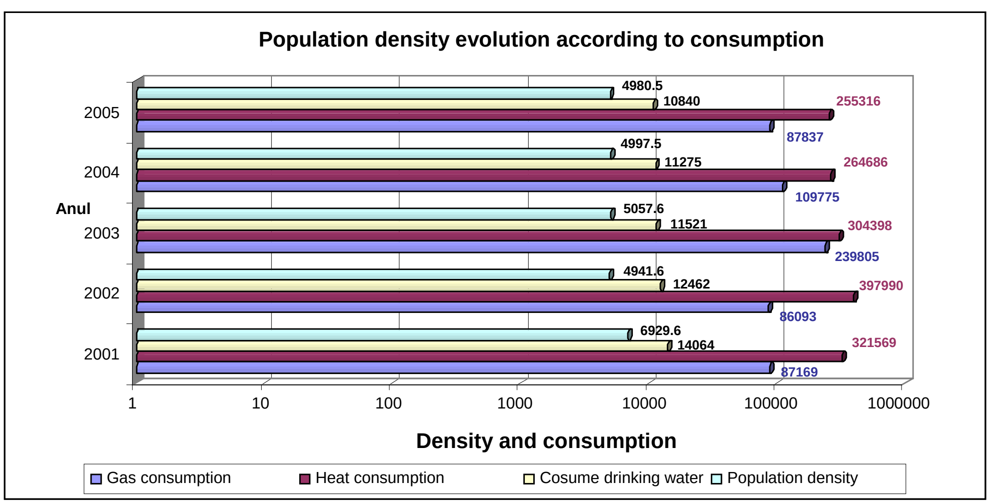
8. Estimation Equation:
$DENSITY = a_{81} + a_{82}*EN\_TERM + a_{83}*GAS + a_{84}*WATER$

R-squared	0.988181	Mean dependent var	5381.360
Adjusted R-squared	0.952725	S.D. dependent var	866.5007
S.E. of regression	188.4025	Akaike info criterion	13.30560
Sum squared resid	35495.52	Schwarz criterion	12.99315
Log likelihood	-29.26400	F-statistic	27.87017
Durbin-Watson stat	2.760990	Prob(F-statistic)	0.138147

Graphical representation of the calculated measured values and residual values for this equation is:



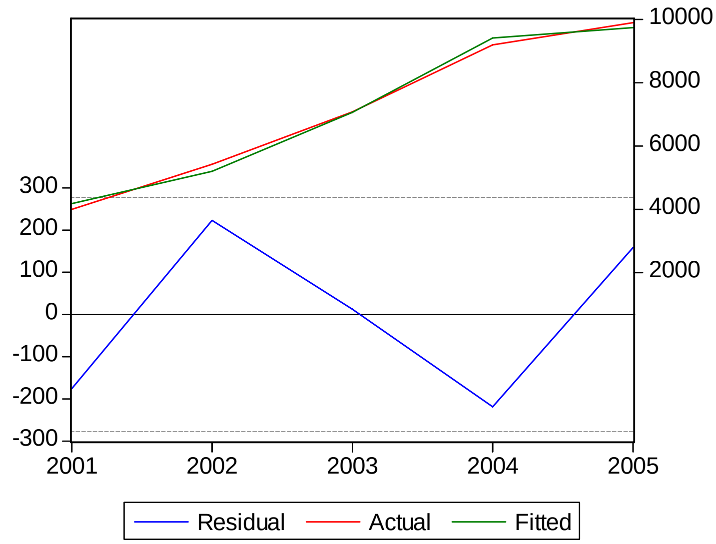
The dynamic evolution of these parameters is as follows:



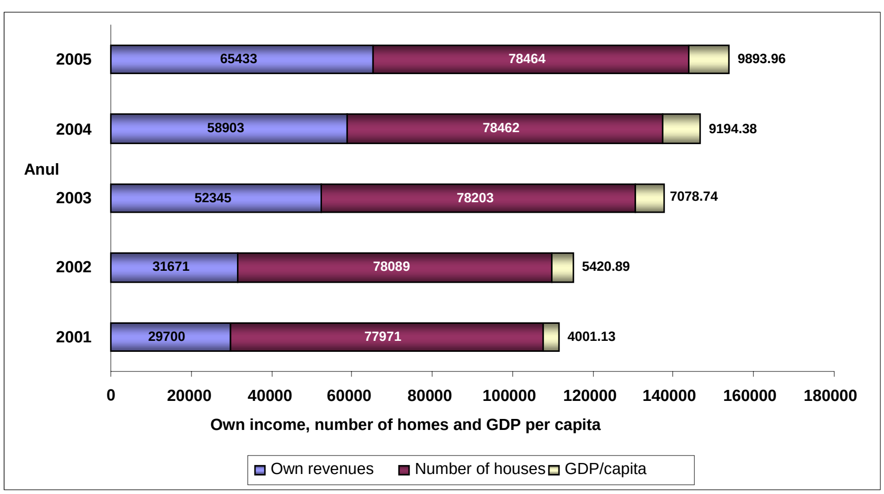
9. Estimation Equation:
GDP_LOC = a_{91} + a_{92}*HOUSES + a_{93}*OWN_REVENUE

R-squared	0.993762	Mean dependent var	7117.819
Adjusted R-squared	0.987523	S.D. dependent var	2480.620
S.E. of regression	277.0851	Akaike info criterion	14.37024
Sum squared resid	153552.4	Schwarz criterion	14.13590
Log likelihood	-32.92559	F-statistic	159.2964
Durbin-Watson stat	2.596121	Prob(F-statistic)	0.006238

Graphical representation of the calculated measured values and residual values for this equation is:



The dynamic evolution of these parameters is as follows:



III. Results and conclusions

The model used, fails to make an eloquent picture of trends and important factors correlations for the development of the town Braila, Romania.

Testing parameters was carried out in stages, and finally they validate the built model.

However, the results are consistent with the theory and economic practice of the specific analyzed domain. The model obtained by replacing the coefficients with parameters estimators is convergent after several iterations and has the following form:

R_EMPLOYEES = 391.0415 -8.736079*R_BIRTH+ 4.263381*R_DEPART -11.83660*R_ARRIVALS

AVERAGE LIFE SPAN = 56.25880 -0.004946*R_PENS + 0.889994*R_DECED + 0.654579*R_BED

R_BIRTH = BIRTHS/1000 * POP_MUN

R_DEPART = DEPART_DOM/1000 * POP_MUN

R_ARRIVALS = ARRIVALS_DOM/1000 * POP_MUN

R_PENS = PENSIONERS/1000 * POP_MUN

R_DECED = DECED/1000 * POP_MUN

R_BED = BEDS/1000 * POP_MUN

EMPLOYEES = 312.1570 + 0.042654*TRAM_TRIP -0.114599*BUS_TRIP

UNEMPLOYED= 9551.164 -1539.797*RATA_PLECARI + 2793.408*RATA_SOSIRI - 0.237357*GDP_LOC

POP_ACTIV = -87217.24 + 0.975084*POP_MUN + 2.583090*GDP

EMPLOYEES_ADM = 1456.040 + 0.026195*OWN_REVENUE -0.007440*CURRENT_EXPEND -0.072579*EXPEND_SUP

TRAM_TRIP = (TRIP_TRAM/NR_TRMV*1000)/POP_MUN

BUS_TRIP = (TRIP_BUS/NR_BUS*1000)/POP_MUN

HOUSES = 77131.90 -0.013680*AG_ECON + 0.129590*GDP_LOC + 0.024047*UNEMPLOYED

DENSITY = -1749.727 -0.008661*EN_TERM + 0.000274*GAS + 0.812144*WATER

GDP_LOC = -610918.7 + 7.870874*HOUSES + 0.046978*OWN_REVENUE

As far as the relations between the presented model variables are concerned, we find that their specification can be supported both by theoretical arguments and also by practical arguments. The estimation benefits are based primarily on the fact that they allow both the assessment of their influence and also their intensity.

The results of endogenous model variables are detailed in Tab. III.1.

Tab. III.1. The measured/calculated values dynamic of the local development model variables

INDICATORS	PERIOD					
	2001		2002		2003	
	Measured value	Calculated value	Measured value	Calculated value	Measured value	Calculated Value
R_EMPLOYEES	260,856	263,203	273,570	268,010	274,135	278,609
AVERAGE LIFE SPAN	71,5000	71,5004	72,0900	72,0897	71,9300	71,9278
EMPLOYEES	260,856	266,750	273,570	271,809	274,135	270,008
SOMERI	17016,0	16759,8	14127,0	14728,3	11563,0	11266,0
POP_ACTIV	141723	141702	134957	134827	135351	135481
EMPLOYEES_ADM	1355,00	1355,25	1371,00	1372,74	1379,00	1371,62
HOUSES	77971,0	77975,3	78089,0	78078,5	78203,0	78210,7
DENSITY	6929,60	6911,07	4941,60	4947,85	5057,60	5036,32
GDP_LOC	4001,13	4176,48	5420,89	5197,83	7078,74	7066,33

INDICATORS	PERIOD			
	2004		2005	
	Measured value	Calculated value	Measured value	Calculated value
R_EMPLOYEES	267,036	270,410	282,188	277,552
AVERAGE LIFE SPAN	71,8900	71,8936	71,7000	71,6985
EMPLOYEES	267,036	265,766	282,188	283,452
SOMERI	11628,00	11136,90	9158,00	9601,07
POP_ACTIV	135128	135634	136028	135544
EMPLOYEES_ADM	1338,00	1342,45	1510,00	1510,95
HOUSES	78462,0	78462,0	78464,0	78462,5
DENSITY	4997,50	5144,85	4980,50	4866,71
GDP_LOC	9194,38	9412,97	9893,96	9735,48

Analyzing the Tab. III.1 data shows that statistical differences between statistical recorded values and estimated values by the model are insignificant. The outcome shows that the model is correctly specified.

However, it is noted that the used assessment method, namely the least squares method, minimizes the sums of deviation squares made for each series separately.

The previous calculations analysis point out that without adequate statistics, the model can not be extended to cover in detail the correlations needed locally. However, looking through a number of econometric methods for local statistical indicators, it can cause some correlations and mutual or univocal determination between variables.

Favorable obtained results in determining the indicators recommend this type of model to support hypothesis of the macroeconomic model.

Since the length of available statistical series available to calculate macroeconomic indicators is quite short, this issue becomes particularly important at this time.

The model uses a number of variables that reveal a pattern of *local development*, but it can also be used to *predict social-economic phenomena* at administrative territorial units' level. However, to highlight this, require estimations of the amount of exogenous variables in the model, indicating that some of these indicators are relatively stable over the short and medium periods of time (locality area, degree of urbanization, etc.), and some have a higher inertia in the evolution of short-term. For some demographic indicators such as population and natural growth, there are specific methods for forecasting. But the most difficult thing in forecasting is the economic exogenous indicators estimation. Therefore, for underlining the forecasts we consider it necessary to follow two paths:

1.-filling the model in with other behavioral and functional equations, economically and socially significant, situation that requires a broad base of local statistics, especially from the district's residence; this measure needs to be implemented in the near future;

2.- integrating the specific Braila city model in a wider pattern in which there is a permanent information exchange.

We believe that by placing both concepts in the field of scientific research, they can be of real help to local authorities at this level in the local development strategies foundation. Obviously, in this situation it remains necessary to ensure appropriate data structures and to development local sector studies to substantiate the hypothesis (exogenous variables) in these models.

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