POPULATION GROWTH AND DEMOCRACY: AN EXTREME VALUE ANALYZES IN ROMANIA'S CASE

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Abstract: *The paper analyzes empirically, in Romania's case, the relationships between population growth (dependent variable) and the dimensions of democracy (independent variables). The analysis is based on the construction of a linear "Extreme Value Model". In Romania's case, the probability of annual population growth to be more then 10.000 persons could be high, if the state is a dictatorial monarchy, the political regime durability is high and the abort is legal. In such conditions, the type of political regime and the abort restrictions are brought forward by the democratization intensity and political regime durability. In other words, the main results show that, in Romania's case, the probability of annual population growth to be more then 10.000 persons could be high, if the level of democratization intensity is low and the political regime durability is high.*

Key words: *population growth; democracy; factors; connections; extreme value analysis*

1. Introduction

The population growth represents the change in the level of population over the time. These modifications are caused by several factors, with different action intensity. During the last years, the conceptualization of the population growth was different, but in essence they reflect the same idea. In a minimal view, the main factors which have a direct impact on population growth consist in fertility, mortality and migration (Alho and Spencer, 1985). Moreover, for the authors, these three factors illustrate the major source of errors in forecasts of the total population in the United States. In a limitative sense, other opinions resume that the population growth goes hand in hand with economic development (Jackson, 1995).

The determinants of population growth, in other vision, could be: the availability of sparsely populated areas, the industrial revolution, the revolution in transport of food and goods, the medical revolution; and the green revolution (Mostert, Oosthuizen, Hofmeyr and Zyl, 1998). Some studies are focalized on the relationship between population growth and

political regime and include both directions of putative causation: how demographic change affects politics, and how political forces affect demographic patterns (Teitelbaum, 2005).

In an extended version, the population growth determinants have two directions: one, that groups the health demographic factors, such as child mortality, immunizations, nutrition, HIV/AIDS, access to healthcare and maternal mortality, and another one, that summarizes the socioeconomic demographic factors, such as economy, education, age composition, total fertility rate, orphans and child labor (Casper and Kitchen, 2008).

In our opinion, all these scientific acquisitions bring to the remark that population growth has in fact two main categories of determinants: one exogenous and another endogenous.

On the one hand, the exogenous determinants of the population growth have an indirect impact and include: the economic conditions, the health care system, the education, the political regime; the rule of laws, the culture; and so on. On the other hand, the endogenous factors of the population growth refer to the determinants, such as the fertility, the mortality and the migration, with a direct impact.

All of them have a significant impact on the population growth, but the field literature offers different points of view regarding "the sign" of this relationships.

2. Theoretical fundaments

Between exogenous determinant factors of population growth, the democracy, as political factor, has an important role, even if the field research offers few studies. No matter how, the impact of democracy on population growth could be focused both on intensity of democratization and political regime durability one.

According to the first coordinates - the intensity of democratization, the results reveal that the population growth is faster under dictatorship than under democracy (Handenius, 1997). In the same note, the population growth is faster under dictatorships in all but one income band, poor countries differ little regardless of regimes, and the rate of domestic population growth falls faster as income increases in wealthier democracies than in wealthier dictatorships (Przeworski, Alvarez and Cheibub, 2000).

Moreover, in connection with economic development, population grows faster under dictatorships and per capita incomes increase more rapidly under democracies (Przeworski, 2000). Another author shows that the degree of democracy or political freedom also has a dampening effect on population growth (Feng, 2005). Regarding the interaction between the population change with the democracy and the power status indicator variables, the effect of population growth is clearly evident for the democratic minor powers (Cranmer and Siverson, 2008).

On the contrary, other results show a positive effect of democracy on economic growth over time, with a significant mediating role for fertility (Roberts, 2006). More precisely, the growth of population is faster, as the level of democratization is increasing.

For the second coordinates - the political regime durability, the scientific acquisitions illustrate that the fertility decisions are determined by three fundamental political variables: political stability, political capacity and political freedom (Feng, Kugler and Zak, 1999). The same authors, in an empirical study in China's case, argue that political stability and government capacity are two crucial factors that shape family decisions regarding the number of children (Feng, Kugler and Zak, 2002). In the same note, political

stability also reduces birth rates; more precisely, population growth is faster as the intensity of political regime durability is higher (Feng, 2005).

Therefore, the researches on the causal relationship's sign between population growth and its democratic determinants are not conclusive; some of them claim the connections of the same sign and other of the contrary sign.

This scientific approach is intended to analyze, in Romania's case, the relationship between population growth and its democratic determinants. According to the mentioned premise, all the theoretical elements presented allow us to formulate a series of theoretical working assumptions, which consider two of the main characteristics of democracy: intensity of democratization and political regime durability.

The assumptions hypotheses are:

H_1: The population growth is faster as the intensity of democratization is smaller.

H_2: The population growth is faster as the political regime durability is higher.

In summary, the meanings of the hypothesis' work relations are:

Table 1. The sense („the sings") of the hypothesis' work relations

The trend of population growth	The main democratic factors of population growth	The trend of democratic factors of population growth
+	Intensity of democratization	-
+	Political regime durability	+

The fundamental assumption is that population growth represents a complex demographic phenomenon, determined by a couple of exogenous factors, especially political regime.

3. Methods and results

Starting with the theoretical argues shown, the paper analyzes empirically, in Romania's case, the relationships between the population growth (dependent variable) and its exogenous political factors (independent variables). The analysis is based on the construction of a linear "Extreme Value Model" and the data set is covering the period 1926-2007.The measures of democracy and its determinants are presented in Table 2.

Moreover, I entered two sets of dummy variables.

The first set, considers dummy variable - TG, which reflects the form of government (monarchy or republic). If the state is a monarchy, the dummy is 1, and if the state is a republic, dummy is 0 (in Romania, in the considered sample, the monarchic period covers the interval 1926-1947). In a monarchy, in a democratic approach, the most important function is to sustain the legitimacy of the state. More, under modern conditions, a constitutional monarchy serves not to limit democracy but to underpin and indeed to sustain it (Bogdanor, 1997).

The second set, considers dummy variable - A, which reflects the freedom of abortion. If abortion is legal, the dummy is 1, and if abortion is illegal, dummy is 0 (in Romania, in the considered sample, the abortion has been illegal in two periods: from 1923 to 1955; and from 1966 to 1990).

Table 2. The variables' description and its sources

Variable	Measure and description	Source
Population growth - PG	Population Growth represents the difference between the numbers of total population in a country for two consecutive years.	Statistical Yearbook of Romania, National Institute of Statistics, 1927 -2008
Level of democracy -DE	Index of Democratization illustrates the rank of democracy's level (intensity of democratization).	Vanhanen (2007)
Political regime durability - D	Political regime durability represents the number of years since the most recent regime change or the end of transition period defined by the lack of stable political institutions.	Madison (2003)
Form of government - TG	Dummy variables reflect the form of government (monarchy - 1 or republic - 0).	Dummy methodology
Freedom of abort - A	Dummy variables reflect freedom of abort (legal abort - 1 or illegal abort - 0).	Dummy methodology

Because some of the considered independent factors (DE and D) have different scales of measurement, for a comparative analysis, the levels of variables were normalized:

$$IF_{Normalized} = \frac{IF - IF_{Min.}}{IF_{Max.} - IF_{Min.}} \quad (1)$$

where *IF* represents the independent variables *DE* and *D*.

$$IF_{Normalized} \in [0,1] \quad (2)$$

In this case, DE and D become DEMO and DM, where 0 corresponds to the minimum intensity level of indicators and 1 indicates the maximum intensity level.

Population Growth (PG) has different absolute levels over the years:

$$PG = NP_t - NP_{t-1} \quad (3)$$

where *NP* illustrates the number of total population in a country in the year *t*.

In our extreme value approach, the Population Growth becomes "The Probability of Annual Population Growth to be more then 10.000 Persons" - P:

$$P = \begin{cases} 0, \ if \ PG < 10.000 \\ 1, \ if \ PG \geq 10.000 \end{cases} \quad (4)$$

Based on the theoretical assumptions made above and on the normalized illustrated variables, the sense of the relationship between "The Probability of Annual Population Growth to be more then 10.000 Persons" and its considered determinant factors as it follows:

Table 3. The expected sense („the sings") of the relations between P - DEMO, DM, TG and A

The Probability of Annual Population Growth to be more then 10.000 Persons	The main democratic factors of population growth	The trend of democratic factors of population growth
+	DEMO	-
+	DM	+
+	TG	+ or -
+	A	-

In extreme value estimation one hypothesis that the probability *p* of the occurrence of the event is determined by the function:

$$p_i = F(Z_i) = exp(Z_i - e^{Z_i}) \text{ for } -\infty < Z < \infty \quad (5)$$

where Z is a linear function of the explanatory variables.

The marginal effect of Z on the probability, which will be denoted *f*(Z), is given by the derivative of this function with respect to Z:

$$f(Z) = \frac{dp}{dZ} \quad (6)$$

In extreme value analysis the marginal effect of Z on the probability is not constant. It depends on the value of *f*(Z), which, in turn, depends on the values of each of the explanatory variables. To obtain a summary statistic for the marginal effect, the usual procedure is parallel to that used in extreme value analysis, based on the mean values of the explanatory variables.

In the considered case, Z is:

$$Z = \alpha + \beta_1 xDEMO_i + \beta_2 xDM_i + \beta_3 xTG_i + \beta_4 xA_i + \varepsilon \quad (7)$$

where α are the intercept term and *i* is the period of time (years 1926-2007).

From 82 included P observations, 26% are 0 (The Probability of Annual Population Growth to be more then 10.000 Persons is null) and 73% are 1 (The Probability of Annual Population Growth to be more then 10.000 Persons is positive):

Table 4. The P frequencies, in Romania, in the period 1926-2007

Dependent Variable: P				
Method: ML - Binary Extreme Value (Newton-Raphson)				
Date: 07/05/09 Time: 19:56				
Sample: 1926 2007				
Included observations: 82				
Frequencies for dependent variable				
			Cumulative	
Value	Count	Percent	Count	Percent
0	22	26.00	22	26.83
1	60	73.00	82	100.00

The econometric tests of the "Extreme Value Model" are:

Table 5. The econometric tests of the "Extreme Value Model P - DEMO, DM, TG and A"

Dependent Variable: P				
Method: ML - Binary Extreme Value (Newton-Raphson)				
Date: 07/09/09 Time: 01:28				
Sample: 1926 2007				
Included observations: 82				
Convergence achieved after 5 iterations				
GLM Robust Standard Errors & Covariance				
Variance factor estimate = 0.6996205118				
Covariance matrix computed using second derivatives				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
DEMO	-4.129881	1.330049	-3.105059	0.0019
DM	6.615952	1.531099	4.321049	0.0000
TG	0.919438	0.416760	2.206157	0.0274
A	0.893263	0.754669	1.183650	0.2366
Mean dependent var	0.731707	S.D. dependent var		0.445797
S.E. of regression	0.323706	Akaike info criterion		0.694619
Sum squared resid	8.173281	Schwarz criterion		0.812020
Log likelihood	-24.47939	Hannan-Quinn criter.		0.741754
Avg. log likelihood	-0.298529			
Obs with Dep=0	22	Total obs		82
Obs with Dep=1	60			

The tests of the model show that the absolute values of the standard errors corresponding to the coefficients of the function are lower than the values of the coefficients; witch sustains the correct estimation of these coefficients (a conclusion reinforced by the low values of the probabilities). For more accuracy, the model considers a robust covariance GLM and Newton-Raphson optimization algorithm.

Based on the model, the expectation-prediction values are:

Table 6. The expectation-prediction values of "Extreme Value Model P - DEMO, DM, TG and A"

Dependent Variable: P						
Method: ML - Binary Extreme Value (Newton-Raphson)						
Date: 07/09/09 Time: 01:33						
Sample: 1926 2007						
Included observations: 82						
Prediction Evaluation (success cutoff C = 0.5)						
	Estimated Equation			Constant Probability		
	Dep=0	Dep=1	Total	Dep=0	Dep=1	Total
P(Dep=1)<=C	18	7	25	0	0	0

P(Dep=1)>C	4	53	57	22	60	82
Total	22	60	82	22	60	82
Correct	18	53	71	0	60	60
% Correct	81.82	88.33	86.59	0.00	100.00	73.17
% Incorrect	18.18	11.67	13.41	100.00	0.00	26.83
Total Gain*	81.82	-11.67	13.41			
Percent Gain**	81.82	NA	50.00			
	Estimated Equation			Constant Probability		
	Dep=0	Dep=1	Total	Dep=0	Dep=1	Total
E(# of Dep=0)	17.00	10.20	27.20	5.90	16.10	22.00
E(# of Dep=1)	5.00	49.80	54.80	16.10	43.90	60.00
Total	22.00	60.00	82.00	22.00	60.00	82.00
Correct	17.00	49.80	66.80	5.90	43.90	49.80
% Correct	77.26	83.00	81.46	26.83	73.17	60.74
% Incorrect	22.74	17.00	18.54	73.17	26.83	39.26
Total Gain*	50.43	9.83	20.72			
Percent Gain**	68.92	36.64	52.78			
*Change in "% Correct" from default (constant probability) specification						
**Percent of incorrect (default) prediction corrected by equation						

The estimated model correctly predicts 86.59% of the observations (81.82% of the Dep=0 and 88.33% of the Dep=1 observations). Among the 22 individuals with y=0, the expected number of y=0 observations in the estimated model is 17. Moreover, among the 60 observations with y=1, the expected number of y=1 observations is 49.8. These numbers represent roughly a 20.72% improvement over the constant probability model.

The correlogram of standardized residuals is presented in Table 7.

Table 7. Correlogram of standardized residuals

Date: 07/09/09 Time: 01:40						
Sample: 1926 2007						
Included observations: 82						
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |*.	. |*.	1	0.124	0.124	1.3117	0.252
. |**	. |**	2	0.323	0.312	10.280	0.006
. | .	.*| .	3	-0.047	-0.128	10.473	0.015
. |*.	. | .	4	0.138	0.063	12.150	0.016
.*| .	.*| .	5	-0.108	-0.088	13.197	0.022
. | .	. | .	6	-0.001	-0.052	13.197	0.040
.*| .	. | .	7	-0.089	-0.005	13.926	0.053
.*| .	.*| .	8	-0.068	-0.077	14.350	0.073
. | .	. | .	9	-0.033	0.036	14.456	0.107
. | .	. | .	10	-0.010	0.023	14.464	0.153
. | .	. | .	11	0.005	-0.004	14.467	0.208
. | .	. | .	12	-0.036	-0.038	14.595	0.264

The tests show that there are some "low" autocorrelations and partial correlations of standardized residuals for inferior lags (especially for lag 2). The fact is explicable because all of five data series are not provided by the same source. However, we consider that this impediment does not affect the quality and stability of the model.

Moreover, the high value of Andrews Goodness-of-Fit Test and low level of Hosmer-Lemeshow Goodness-of-Fit Test does not suggest the caution in interpreting of the results (Table 8).

Table 8. Andrews and Hosmer-Lemeshow Goodness-of-Fit Tests

Dependent Variable: P								
Method: ML - Binary Extreme Value (Newton-Raphson)								
Date: 07/09/09 Time: 21:03								
Sample: 1926 2007								
Included observations: 82								
Andrews and Hosmer-Lemeshow Goodness-of-Fit Tests								
Grouping based upon predicted risk (randomize ties)								
	Quantile of Risk			Dep=0		Dep=1	Total	H-L
	Low	High	Actual	Expect	Actual	Expect	Obs	Value
1	9.E-12	0.0021	8	7.99706	0	0.00294	8	0.00294
2	0.0518	0.2211	5	6.96587	3	1.03413	8	4.29193
3	0.2227	0.3430	4	5.72435	4	2.27565	8	1.82602
4	0.4054	0.6712	2	3.23729	6	4.76271	8	0.79432
5	0.6712	0.8947	3	1.99572	6	7.00428	9	0.64936
6	0.9072	0.9447	0	0.56318	8	7.43682	8	0.60583
7	0.9465	0.9643	0	0.35371	8	7.64629	8	0.37007
8	0.9661	0.9764	0	0.22560	8	7.77440	8	0.23214
9	0.9795	0.9932	0	0.10186	8	7.89814	8	0.10318
10	0.9941	0.9984	0	0.03041	9	8.96959	9	0.03052
		Total	22	27.1951	60	54.8049	82	8.90631
H-L Statistic:			8.9063			Prob. Chi-Sq(8)		0.3503
Andrews Statistic:			53.2346			Prob. Chi-Sq(10)		0.0000

In conclusion, the model may be considered representative and stabile to describe, in Romania's case, the connection between P and DEMO, DM, TG & A.

4. Conclusions

The method for identifying the effect of the DEMO, DM, TG and A on the P consists in calculating the marginal effect at the mean value of the explanatory variables. The next table shows the marginal effects, calculated by multiplying *f(Z)* with the estimated coefficients of the extreme value regression.

Table 9. The marginal effects of the "Extreme Value Model P - DEMO, DM, TG and A"

Variable	Mean	β	Mean × β	f(Z)	β x f(Z)
DEMO	0.197461	-4.12988	-0.81549	0.041775	-0.03407
DM	0.320826	6.615952	2.12257	0.041775	0.088671
TG	0.268293	0.919438	0.24668	0.041775	0.010305
A	0.341463	0.893263	0.30502	0.041775	0.012742
Total			1.5537578		

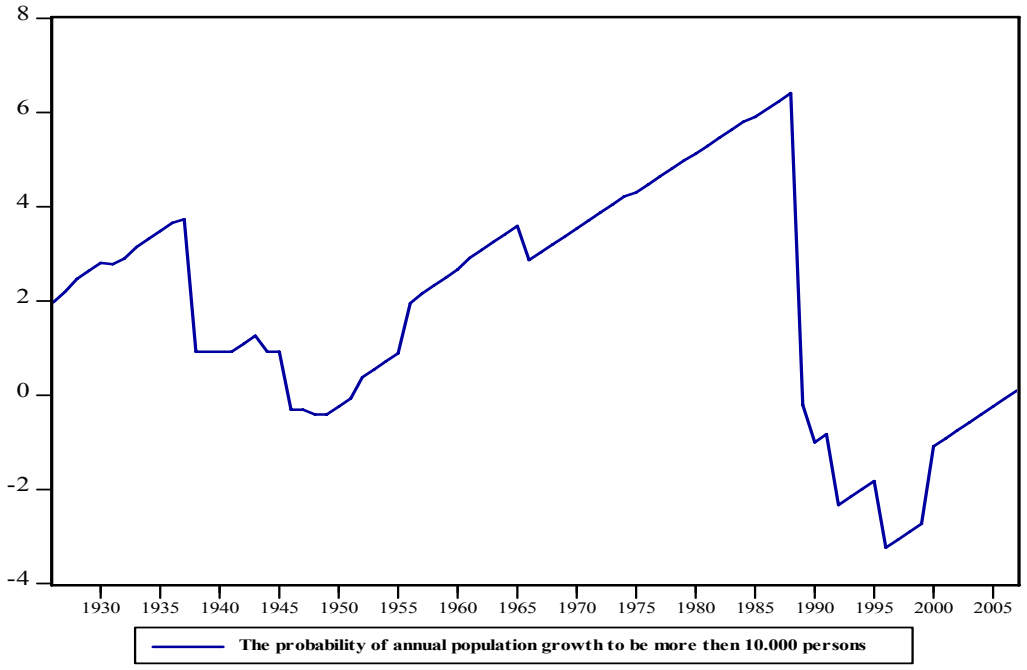
Starting from the marginal effects measured on the "extreme value model" built, we can identify the following remarks in Romania's case:

- an one-point increase in the *DEMO,* decreases with 3.40% the probability of annual population growth to be more then 10.000 persons;
- an one-point increase in the *DM,* increases with 8.86% the probability of annual population growth to be more then 10.000 persons;
- an one-point increase in the *TG,* increases with 1.03% the probability of annual population growth to be more then 10.000 persons;
- an one-point increase in the *A,* increases with 1.27% the probability of annual population growth to be more then 10.000 persons.

We can observe that the results confirm all the assumption hypotheses, except the freedom of abortion. In such conditions, the model disaffirms only the acquisitions of Roberts (2006), regarding the connection between population growth and democratization.

For the analyzed period, in Romania's case, a decrease in the level of democratization, an augmentation of political regime durability, with a freedom of abortion, on a monarchical base, increases the probability of annual population growth to be more then 10.000 persons. On the contrary, an augmentation in the level of democratization, a decrease of political regime durability, without the freedom of abortion, on a republican base, decreases the probability of annual population growth to be more then 10.000 persons.

Among the four determinant factors (DEMO, DM, TG and A), the most important one is the political regime durability, followed by the level of democratization. These two factors are followed, in order, by the freedom of abortion and the form of government (monarchy or republic).The forecast of the probability of annual population growth to be more then 10.000 persons, in the period 1926-2007, in Romania, is illustrated in the following graphic:



Graphic 1. The forecast of the probability of annual population growth to be more then 10.000 persons, in Romania, in the period 1926-2007

Based on the obtained forecast probability, we can observe four principal intervals of analysis.

The first three intervals have some „strong positive shocks" (the probability of annual population growth to be more then 10.000 persons is high): from 1939 to 1940 - the dictatorship of King Carol II; from 1940 to 1944 - the National Legionary State, in which power was taken by dictator Ion Antonescu; and from 1965 to 1989 - the communist dictatorship of Ceausescu Nicolae. Also, the positive effect on the probability is sustained by political factors, even if the abort has been illegal in two relative large periods: from 1923 to 1955; and from 1966 to 1990.

The last interval, from 1990 to 2007, implies a "strong negative shock" (the probability of annual population growth to be more then 10.000 persons is very low), especially beginning with 1992, the year of the first free democratic elections.

According to the democratic factors strictly, in Romania's case, the probability of annual population growth to be more then 10.000 persons can be high, if the state is a dictatorial monarchy, the political regime durability is high and the abortion is legal. In such conditions, the type of political regime and the abortion restrictions are brought forward by the democratization intensity and political regime durability. In other words, the main results show that, in Romania's case, the probability of annual population growth to be more then 10.000 persons can be high, if the level of democratization intensity is low and the political regime durability is major.

References

1. Alho, J. and Spencer, B. **Uncertain Population Forecasting,** Journal of the American Statistical Association, Vol. 80, No. 390, 1985, pp.310-312
2. Bogdanor, V. **The Monarchy and the Constitution,** Oxford University Press, 1997, p.64
3. Casper, L. and Kitchen, P. **Demographic Factors, Encyclopedia of Infant and Early Childhood Development,** Elsevier Inc., 2008, pp. 345-356
4. Cranmer, S. and Siverson, R. **Demography, Democracy and Disputes: The Search for the Elusive Relationship Between Population Growth and International Conflict,** The Journal of Politics, No.70, Cambridge University Press , 2008, pp. 794-806
5. Feng, Y. **Democracy, governance and economic performance,** MIT Press, 2005, p. 278 and p. 298
6. Feng, Y., Kugler, J. and Zak, P. **Population Growth, Urbanisation and the Role of Government in China: A Political Economic Model of Demographic Change,** Urban Studies, Vol. 39, No. 12, 2002, p. 1
7. Feng, Y., Kugler, J. and Zak, P. **The path to prosperity: a political model of demographic change,** Claremont Colleges Working Papers in Economics, 1999, p. 1
8. Handenius, A. **Democracy's victory and crisis,** Cambridge University Press, 1997, p. 172
9. Jackson, W. **Population growth. A comparison of evolutionary views,** International Journal of Social Economics, Vol. 22, No. 6, 1995, p. 3
10. Maddison, A. **Historical Statistics for the World Economy: 1-2003 AD,** Horizontal file, Copyright Angus Maddison, 2009
11. Mostert, W., Oosthuizen, J., Hofmeyr, B. and Zyl, J. **Demography: Textbook for the South African Student,** Human Sciences Research Council Press, 1998, p. 13
12. Przeworski, A., Alvarez, M. and Cheibub, J.A. **Democracy and development,** Cambridge University Press, 2000, p. 224
13. Przeworski, A. **Democracy and Economic Development, Political Science and the Public Interest,** Ohio State University Press, 2000, p. 1

14. Roberts, W. **Political Regimes as Demographic Regimes: Unpacking the Democracy - Economic Growth Relationship,** Paper presented at the Annual Meeting of the American Sociological Association, Montreal Convention Center, Montreal, Quebec, Canada, 2006, p. 1
15. Teitelbaum, M. **Political Demography, Handbooks of Sociology and Social Research,** Springer Publisher, 2005, p. 719
16. Vanhanen, T. **Introduction: Measures of Democratization,** Finnish Social Science Data Archive, 2007, pp. 20-21
17. * * * **World Economic Outlook Database,** International Monetary Fund, April 2009
18. * * * **Statistical Yearbook of Romania,** National Institute of Statistics, 1927-2008

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