THE YEARBOOK OF THE „GH.ZANE" INSTITUTE OF ECONOMIC RESEARCH
VOL. 21, ISSUE 1, 5-15, 2012

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RELATION BETWEEN ECONOMIC DEVELOPMENT AND FERTILITY IN ROMANIA

Abstract

The economic, social and the demographic evolution of Romania is part of a larger picture that includes a number of Eastern European countries of the former communist bloc. Typical for them is not only economic and social transition process caused by the fall of communism, but also a process of demographic transition that is characterized by a negative natural growth, decreased fertility, demographic ageing. Studies have tried to highlight different explanatory theories for this decline, and the nature of the relationship between evolution of economic development and demographic evolution.

In this study we intend to analyze causality relationship *between economic growth and fertility in the last 22 years in Romania. The empirical study aims to study the existence of a long run relationship between the two phenomena, and using the Granger method to highlight the type of causality between economic growth and fertility. In addition, if we add the unemployment rate, we want to analyze the existence of cointegration relationships for all three variables, to test the hypothesis that the economic and social transition has an impact on fertility. The empirical results show a relationship between fertility and economic output and* between *unemployment and fertility also, and support the hypothesis of demographic developments in Romania in* accord with *the theory of demographic transition, which however takes into account the socio-*economic *context of a country in the transition process.*

Keywords: *fertility, economic growth, cointegration, causality*

1. Introduction

Demographic and economic changes after 1989 in communist countries are a topic of current research and common in the literature. These studies have tried to highlight different explanatory theories for negative demographic trends and the nature of the relationship between economic development and demographic trends, also. Thus, several studies have explained the demographic decline as a natural evolution of demographic transition phenomenon similar to West European states (Jóźwiak, Kotowska, 2008; Zakharov, 1997; Zakharov and Ivanova, 1996, Sobotka et all, 2003), in accord with the theory of demographic transition. Other studies have identified a connection more or less significant between economic development in post-communist states and accelerated demographic changes taking place here (Ranjan, 1999, Cornia and Paniccià, 1996, Sobotka, 2003, Billingsley, 2010).

According to the first category of research, since 1989, in former communist countries dominated the pattern of demographic transition phenomenon (Jóźwiak, Kotowska, 2008). This phenomenon is taking shape as the change from a traditional society with high fertility and mortality rates to an industrialised society in which fertility and mortality are stabilized at low levels (Coale, 1973). Notestein (1953) explain the demographic transition as a consequence of a modernisation process of society that consists in social and economic changes, promoted by the industrial revolution. Since then, the studies on demographic trends

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use as independent variables some of macro social factors in order to measure the degree of modernization of the society. In this context, the mortality and fertility transition are explained by factors such as education levels, urbanisation, productive structure, secularisation, etc. (Solsona i Pairó, 1997, p. 171).

In the context of last category of studies that attempt to identify the nature of the relationship between economic development and demographic trends, Sobotka (2003, p.452) stated that the radical social and economic transformations generated a strong impetus for the subsequent change in the demographic behavior of the populations in Central and Eastern European countries. In this sense, the debate between supporters of Malthusian theory and neoclassical theory shows the crucial link between fertility, mortality and economic growth

Some recent studies (e.g. Hondroyiannis şi Papapetrou, 2002 for Greece, Savaş, 2008, for Central Asian Economies) investigated the dynamic interaction between demographic changes and economic growth, in order to explain systematically the process of economic development and associated demographic changes. The use of specific analysis methods of correlations between economic and demographic variables, such as cointegration and causality, showed that fertility changes should be considered as endogenous for the infant mortality, employment and economic growth process (Hondroyiannis şi Papapetrou, 2002). In particular, infant mortality, labor market and economic growth are responsible for the variations in fertility rate.

In the case of ex-communist countries of Central and Eastern Europe, Billingsley (2010) found that GDP change was positively correlated with fertility rates at all age groups above 20, in a model with inflation, wage growth and employment. She also found, however, that GDP rise was positively linked to fertility postponement. A similar result was obtained within a larger model in the fertility rate analysis done on the case of Hungary (Aassve et al. 2006).

In approaching fertility and economic growth, literature develops theories about unemployment implications; outlining the thesis that unemployment has different psychological influences on men and on women (Sobotka et al., 2010). Thus, for men, unemployment is perceived more acutely and is a factor of delay the birth of a child, considering that man is the main support of the family, while for women, unemployment is not necessarily regarded as a delay factor for shaping the family and that of giving birth to a child. Thus, the relationship between unemployment rate on the one hand, the formation of family and fertility rates, on the other hand, is seen in many studies (Sobotka et al., 2010) to be quite close.

In this paper, we propose to analyze the relationship between fertility and economic development for the post-communist Romania to evaluate some of the assumptions made in the literature. In terms of methodology, we use dynamic analysis methods based on cointegration and causality. In the following, the structure of the paper is as follows: in the next section we present some empirical evidence of economic development, fertility and unemployment, the third section presents a series of methodological considerations, the next chapter presents the results of time series analysis; the research ends with conclusions and references.

2. Evidences of the dynamics of fertility and economic development in Romania after 1990

After 1990, Romania recorded a negative population trend for which scientists have tried various explanations. One of these correlate the demographic decline with the characteristics of economic and social transition period, particularly population mobility, job uncertainty and a stable future etc. (Kohler and Kohler, 1999, Ranjan, 1999, Cornia and Paniccià, 1996, Sobotka, 2003, Billingsley, 2010).

In our opinion, as we shown in several works (Jemna, 2010, 2011, 2012), the hypothesis which remains valid after empirical analyzes is that after 1990 the demographic situation does not change radically from the previous period, but continues dynamics started in the past few decades. As shown by the graphs below (Figure 1 and 2), after 1990, Romania is at the end of a cycle which can be explained by demographic transition theory. Total fertility rate continued the downward trend of the past (the 80s were marked by attempts of the communist system to recover fertility, which is observed particularly in the first years of the decade) and stabilized after 1995, with low variations. The rate of population growth tends to decrease and then to stabilize, with negative values.

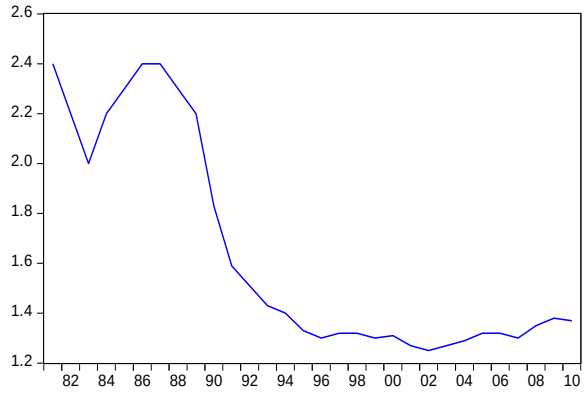

Figure 1. The evolution of total fertility rate (children per woman) during 1981-2010

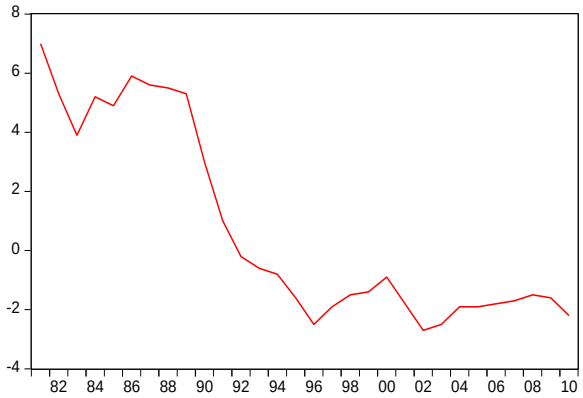

Figure 2. The evolution of natural increase (%) during 1981-2010

Source: Made by authors based on statistics data provided by the NIS

Demographic transition theory argues that the decrease of fertility rate is negatively correlated with economic growth. In the same time with demographic decline, real GDP per capita of Romania had a rapid growth, sign of increasing living standards of the country. At least at a visual analysis, we consider the hypothesis that between economic output and fertility is an inverse relationship. Also, in Figure 5 can be seen that growth rate has fluctuated since 1990, but upward, compared to the 80s as the end period of communism, in which there is a downward trend of economic development.

Regarding to unemployment variable, the literature argues that this variable has a negative influence on fertility. Indeed, after 1990 there is a sudden increase in this indicator, followed by irregular fluctuations specific to the social and economic transition.

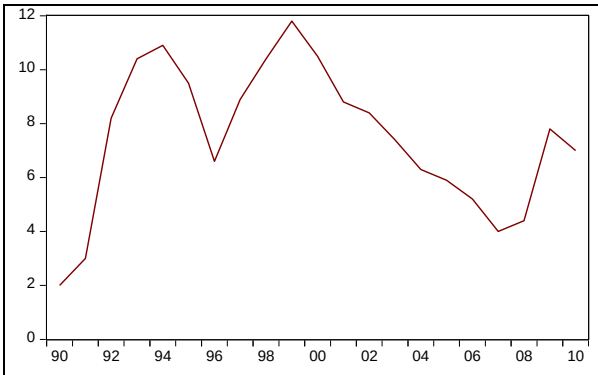

Figure 3. Dynamics of unemployment (%) during 1990-2010

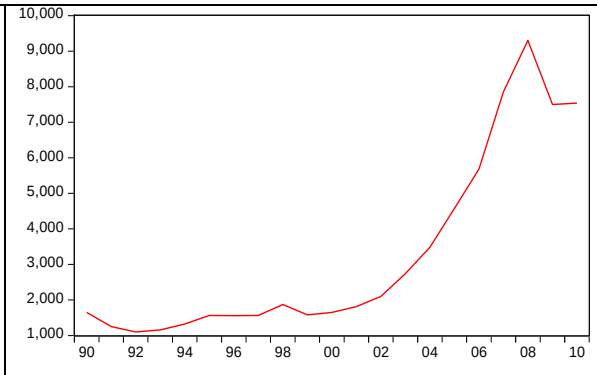

Figure 4. The dynamics of real GDP / capita ($) in period 1990-2010

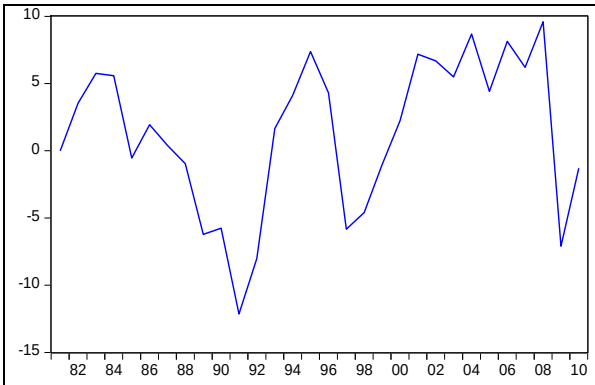

Figure 5. Evolution of economic growth rates (%) of Romania during 1981-2010

Source: Made by authors based on statistics data provided by the NIS and the World Bank

3. Data and method

The empirical study was performed on two levels. In the former, we analyzed the relationship between economic growth rate and total fertility rate during 1981 to 2010. On the second level, we considered three variables: total fertility rate, economic development and unemployment for the period 1990 to 2010. Their choice was mainly due to the assumptions made in the literature on demographic and economic growth trends in countries of Central and Eastern Europe, and the limits due to availability of statistical data.

In the case of fertility and unemployment rate, data are offered by the National Institute of Statistics (NIS). For variable that expresses the degree of economic development we used two variables: real GDP per capita, expressed in dollars, and the growth rate of GDP (%). For both variables, data are provided by the World Bank. An important limit of the study is related to the availability of statistical data. For economic development, the World Bank data are available for the period 1990 - 2010 for real GDP per capita and for the period 1981 - 2010 for the variable rate of GDP growth. In the case of unemployment variable, data are available only after 1990.

For the study of the causality relationship between the degree of economic development, fertility and unemployment, the statistical method involves three steps. First, we study stationarity or nonstationarity of time series used. For this purpose, we use the *Augmented Dickey-Fuller Test*, which is called the unit root test. In the case of the nonstationarity, statistical series will be transformed with the difference operator and obtain an integrated series. For the next step, it is important that both variables have the same level of integration.

In step two, we study long run relationship between the two variables using the cointegration test. For the study of bivariate relations for the three variables we use *Single Ecuation Cointegration Test* or *Engle – Granger test* to evaluate the relationships for the pairs of variables. If we analyze all three variables, is required a multivariate test, as Johansen Cointegration Test. Because the Engle - Granger test is criticized in the literature as one no robust, we use the method of *Philips – Ouliaris* to compare results. Also, for the case in which we use the variations of all three variables, find a long run relationship that involve causality can be made using the *Vector Error Correction Model* method, which is based on VAR method and applied for the study of cointegration. In the third step is studied causality between variables using *Granger Causality Test* method.

4. Empirical results

In this chapter we present the results of empirical analysis carried out in Romania for the three variables: fertility, economic output, and unemployment. Results are presented according to the methodology proposed in the former chapter: stationarity and variables integration analysis, cointegration and causality analysis.

a. Stationarity of data series

Applying *Augmented Dickey-Fuller test* we obtained the results in Table 1, confirming that the variables used are non-stationary (unit root assumption is accepted, because the calculated probability is over 0.05).

Applying the same test for the variables transformed by first-order differential operator, we obtained results in Table 1, which confirms that the studied variables are integrated of order I. The table shows the results for the both periods of analysis. Since all variables are integrated of order I, we can move to step two of the empirical study to investigate the existence of long-term relationships between variables.

Table 1

Augmented Dickey-Fuller test results for the unit root hypothesis

Variables	t-Statistic	Prob.
GDP	-0.9989	0.9170
Fert	-2.6269	0.1051
Unempl	-2.4738	0.1362
Critical value (5%)	*-3.0206*	
GDP_rate	-2.684562	0.0888
Fert	-1.282778	0.6232
Critical value (5%)	*-2.9677*	

Variables	t-Statistic	Prob.
D(GDP)	-3.0811	0.0453
D(Fert)	-5.7576	0.0002
D(Unempl)	-3.0377	0.0493
Critical value (5%)	*-3.0299*	
D(GDP_rate)	-5.923612	0.0000
D(Fert)	-3.163354	0.0332
Critical value (5%)	*-2.9718*	

Source: Developed by authors

b. Cointegration

The idea of cointegration was introduced in 1981 by Granger. This method allows the study of the existence of long run relationships between variables. Study the existence of a long run relationship between economic outcome and fertility, on the one hand, and economic development, fertility and unemployment, on the other hand, can be achieved using the method of *Engle – Granger cointegration test* (applicable for the long time series), the *Philips – Ouliaris* method (which is more robust) or *Johansen* method (which allows an analysis for more than two variables).

For the first test, which examines only bivariate relationships, the results are presented in Table 2.

Table 2

The results of the cointegration test using *Engle – Granger* method

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
FERT	-1.383645	0.8059	-3.378108	0.8446
REAL_GDP	-1.682884	0.6897	16.91764	1.0000
FERT	-3.563444	0.0502	-7.828988	0.4288
UNEMPL	-1.936645	0.5706	-6.530560	0.5490
FERT	-1.454761	0.7810	-3.549553	0.8347
GDP_RATE	-2.772259	0.2042	-12.66129	0.1596

*MacKinnon (1996) p-values.

Source: Developed by authors

Results from the table above surprising and not surprising at the same time. On the one hand, statistical tests suggest that we can not reject the null hypothesis of no cointegration for the two of the pairs of variables studied; we can say that we have no reason to believe that between these variables would be a relationship to long term. In the case of fertility and unemployment there is such a relationship and its direction remains to be determined. On the other hand, for the short data series, the test used is not very robust, and the analysis requires a more advanced method.

Indeed, using *Philips – Ouliaris method*, more robust results are obtained which differ from those obtained by the *Engle – Granger* method. These results are presented in Table 3 and confirms the existence of a cointegrating relationship between fertility and real GDP per capita, with a probability of 0.95 and a relationship between fertility and unemployment, with a probability of 0.9.

Table 3

The results of cointegration test using *Philips – Ouliaris* method

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
FERT	-4.173550	0.0190	-10.55034	0.2291
REAL_GDP	-0.586247	0.9572	-1.480224	0.9547
FERT	-3.293695	0.0951	-9.428766	0.3018
UNEMPL	-2.447433	0.3342	-11.35636	0.1854

Source: Developed by authors

If we analyze the variation of all three variables, the cointegration study can be made by *Johansen cointegration test* method. Johansen proposed a multivariate analysis method based on estimation with the help of maximum likelihood method. The results of this test are presented in Table 4.

The first part of the table represents a test of cointegrating rank between variables. We test the null hypothesis of the existence of a number of *r* cointegrating relations against *k* alternatives such relationship, where *r = 0, 1, ..., k-1*. The second part of the table gives the calculated values of test for maximum eigen values, in which case is testing the null hypothesis of the existence of a number of *r* cointegrating relations against the *r+1* alternative such a relationship. In the last part of the table presents results of integrating equations for relations that have been identified by the tests.

Table 4

Results of cointegration test between fertility, economic development and unemployment

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.692091	41.09090	29.79707	0.0017
At most 1 *	0.604461	18.70981	15.49471	0.0158
At most 2	0.055615	1.087197	3.841466	0.2971

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.692091	22.38109	21.13162	0.0332
At most 1 *	0.604461	17.62261	14.26460	0.0142
At most 2	0.055615	1.087197	3.841466	0.2971

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

FERT	REAL_GDP	UNEMPL
-14.09023	-0.000276	-0.699051
26.48441	-0.000405	-0.195793
-8.427849	-0.000580	-0.233517

Unrestricted Adjustment Coefficients (alpha):

D(FERT)	0.012810	-0.012982	-0.002163
D(REAL_GDP)	186.5388	-92.63099	163.7281
D(UNEMPL)	0.796830	0.579149	-0.254031

1 Cointegrating Equation(s): Log likelihood -129.8354

Normalized cointegrating coefficients (standard error in parentheses)

FERT	REAL_GDP	UNEMPL
1.000000	1.96E-05	0.049612
	(9.6E-06)	(0.00926)

Adjustment coefficients (standard error in parentheses)

D(FERT)	-0.180494
	(0.07863)
D(REAL_GDP)	-2628.375
	(2693.75)
D(UNEMPL)	-11.22753
	(5.32257)

2 Cointegrating Equation(s): Log likelihood -121.0241

Normalized cointegrating coefficients (standard error in parentheses)		
FERT	REAL_GDP	UNEMPL
1.000000	0.000000	0.017604
		(0.00343)
0.000000	1.000000	1636.092
		(205.885)
Adjustment coefficients (standard error in parentheses)		
D(FERT)	-0.524321	1.72E-06
	(0.13111)	(2.1E-06)
D(REAL_GDP)	-5081.652	-0.013941
	(5686.93)	(0.09281)
D(UNEMPL)	4.110903	-0.000454
	(10.3372)	(0.00017)

Source: Developed by authors

As shown in the table above for both sections (*Trace* and *Maxim Eigenvalue*) tests indicate two cointegration relationships. Equations for the two relationships are shown in the last part of the table. These equations support the hypothesis of an inverse relationship between fertility, on the one hand, and GDP per capita and unemployment, on the other. Also that the second equation supports the hypothesis of an inverse relationship between fertility and unemployment.

The existence of cointegration relationship justifies the estimation of a *Vector Error Correction* model type, which allows the analysis of variables trend, long run and short run. Method allows us to highlight the cointegration relationship, with both types of variation.

We consider in this case only multiple relationship between fertility and the two factors: GDP per capita and unemployment. Results are presented in Table 5. In the first part of the table are presented the coefficients expressing the long run relationships that are significant, and in the second part the short run, of which only the lag in fertility is significant.

Table 5

Results of *Vector Error Correction Estimates*

Cointegrating Eq:	CointEq1		
FERT(-1)	1.000000		
REAL_GDP(-1)	1.96E-05		
	(9.6E-06)		
	[2.04437]		
UNEMPL(-1)	0.049612		
	(0.00926)		
	[5.35508]		
C	-1.794213		
Error Correction:	**D(FERT)**	**D(REAL_GDP)**	**D(UNEMPL)**
CointEq1	-0.180494	-2628.375	-11.22753
	(0.07863)	(2693.75)	(5.32257)
	[-2.29556]	[-0.97573]	[-2.10942]
D(FERT(-1))	0.307134	175.7077	-14.68842
	(0.09215)	(3157.00)	(6.23790)
	[3.33301]	[0.05566]	[-2.35471]

D(REAL_GDP(-1))	1.56E-06	0.100562	0.000224
	(8.9E-06)	(0.30351)	(0.00060)
	[0.17620]	[0.33133]	[0.37368]
D(UNEMPL(-1))	0.000322	8.820957	0.695290
	(0.00401)	(137.447)	(0.27158)
	[0.08031]	[0.06418]	[2.56015]
C	-0.004884	301.3010	-0.418590
	(0.00692)	(237.077)	(0.46844)
	[-0.70572]	[1.27090]	[-0.89358]

Source: Developed by authors

According the results above, the estimated equation which express the relationship between fertility and its factors is:

D(FERT) = -0,180*(FERT(-1) + 1.956427448e-05*REAL_GDP(-1) + 0.0496124784881*UNEMPL(-1) - 1.79421308316) + 0,307*D(FERT(-1)) + 1,56e-06*D(REAL_GDP(-1)) + 0,00032*D(UNEMPL(-1)) -0,0048.

c. Causality

For two variables Y_t and X_t, for which we can build variables with a certain lag (Y_{t-1}, X_{t-1} etc.), X_t determine the Y_t in Granger sense if and only if $M(Y_t / Y_{t-1}, X_{t-1}) \neq M(Y_t / Y_{t-1})$, that means the past values of X_t are necessary for the prediction of Y_t.

Once we have highlighted the existence of long run relationship between fertility and other two variables, GDP per capita and unemployment, we test the directions of these relationships. In particular, we are interested to observe unidirectional causality for fertility, ie to see what the variables that influence fertility variation are. Using the classical method of Granger, we test relations between the three variables analyzed. Results are presented in Table6.

Table 6

Results of *Pairwise Granger Causality test*

Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
REAL_GDP does not Granger Cause FERT	19	4.77350	0.0263
FERT does not Granger Cause REAL_GDP		0.48321	0.6267
UNEMPL does not Granger Cause FERT	19	7.23352	0.0070
FERT does not Granger Cause UNEMPL		1.37090	0.2859
UNEMPL does not Granger Cause REAL_GDP	19	0.20738	0.8152
REAL_GDP does not Granger Cause UNEMPL		1.96776	0.1766

Source: Developed by authors

The result of the tests listed above is the clear position of endogenous of fertility variable in relation to economic result and with unemployment. This result supports the hypothesis stated in the paper of the influence of economic growth on fertility, as results from the theory of demographic transition. Also, socio-economic conditions after 1990, measured with the help of unemployment variable have an influence on fertility.

5. Conclusions

Negative demographic evolution of Romania still remains an open subject for academic studies. The various hypotheses, with or without a theory support developed are tested using empirical studies, based on time series or cross-section data. In this study we used a few time series analysis tools to analyze the existence of a causal relationship between fertility, economic development and unemployment.

Cointegration time series study reveals long run relationships between fertility, real GDP per capita and unemployment. Also, the study of causality supports endogenous variable position of fertility for the period analyzed. Relationship of fertility as dependent variable and real per capita GDP and unemployment, as independent variables was modeled using the Vector Error Correction Model method. The results support the hypothesis of a negative influence of economic development and unemployment on fertility. In these circumstances, Romania attempts to redress fertility can be achieved by building policies to encourage births to be sustained from economic growth and reducing unemployment.

Acknowledgement

This paper received financial support through the project "Postdoctoral Research in Economics: training program for elite researchers - SPODE" co-financed by European Social Fund, Operational Human Resources Development Programme 2007-2013, contract nr. POSDRU/89/1.5/S/61755.

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