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Technical Progress as a Solution for Romania and Greece to Face the Global Crisis' Problems and the Bad Forecasts

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Abstract:

The paper deals with the two Member States which were put down by the crisis: Greece and Romania. As a result, the analysis is focused on 2009-2012 time period, in order to explain the economic situation, to forecast it and to find another solution to face the crisis challenge.

The first step was to analyse the possibility to define an economic model which to be able to quantify the support of the technical progress on the economic recovery.

A distinct part of the paper is that regarding to the model's equations and parameters which are used from qualified statistical surveys. The model consists of a specific production function which was defined in order to quantify the labour productivity and the fixed capital efficiency under the impact of the technical progress. This technical progress in the economy is quantified by the growth of the labour knowledge and the growth of fixed capital use degree.

The economic analysis is focused on labour productivity and capital efficiency and tried to offer solutions in order to optimise the economic behaviour under crisis using the human capital stock of knowledge.

The last part of the paper analyses the evolution of the fixed capital efficiency as a result of the labour knowledge growth and the evolution of the fixed capital efficiency supported by the new machines and equipments.

The main conclusion of the paper is that the technical progress represents a chance for the economic recovery in Romania and Greece. Both countries have relative advantage in using their relative high skilled labour and paying lower wages caused by the crisis. But their ability to obtain benefits from these is still far away. The model used in the paper is able to offer a useful instrument of analysis in order to quantify the impact of the technical progress on the economic development.

The whole analysis is based on official databases: Eurostat, IMF, World Bank and National Statistic Institutes.

Key Words: *Production Function, Labor Productivity, Fixed Capital Efficiency, Technical Progress, Romania, Greece*

JEL Classification*: O15, O32, O33*

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1. Introduction

Greece and Romania have a common historic, cultural and economic destiny. This is why both countries have to face to a complicated challenge nowadays. The global crisis forced both countries to adopt severe austerity measures in order to obtain the economic survive. Greece and Romania asked for the international financial institutes' support and started to implement painful economic reforms which attract the hostility of the civil society.

On short and medium term will be not much financial possibilities to support a big recovery of the jobs, industries and welfare. This is why an alternative possibility would be the efficient use of the technical progress. We talk about human capital and technical support of it, because both countries have enough average and high skill labour, which is able to support the economic recovery.

The technical progress in economy represents a dynamic complex process which introduces the latest techniques and scientific research's results on capital and labour, in order to increase productivity, output and economic efficiency. An important element of the economic development is the optimal dimension and the efficient use of the demo-economic resources.

As a result of the obsolete and relative labour decrease in economy related to the demographic trend, the training and the human capital become essential to a modern economy.

In order to analyse the economic development in Romania and Greece under the technical progress impact, a production function will be used. This production function is based on two control parameters and one behaviour parameter.

Cobb and Douglas used the production functions for the first time in 1928. During the 50s-70s, there were a lot of theoretical debates on this kind of function. The greatest problems were focused on aggregate production functions, even that the microeconomic production functions were put under scrutiny, as well. The debate in this field started criticizing the way the factor input, capital, was measured and how the notion of factor proportions had distracted economists.[2]

Other specialists succeeded to make the production function more realistic by adding in natural resources.[3] Other specialist criticised Solow and Stieglitz's approach which was considered a trick against the laws of thermodynamics.[4]

Neither Solow nor Stiglitz addressed his criticism, despite an invitation to do so in the September 1997 issue of the journal *Ecological Economics*.[5]

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[2] Robinson, J., 1953, *The Production Function and the Theory of Capital*, 1953-4, RES.

[3] Solow, R.M. and Stiglitz, J.E., 1968, *Output, Employment, and Wages in the Short Run*, The Quarterly Journal of Economics, no.4/1968.

[4] Georgescu-Roegen, N., 1972, *Process analysis and the neoclassical theory of production*, in American Journal of Agricultural Economics

An interesting retrospective of the production function approach evolution was made in 2003.[6] The same historical approach was made by in 2007, as well.[7]

In the same period, the analysis concerned production functions and was robust with respect to increases in the number of independent variables and to alternative functional forms.[8]

On the other hand, the meta-production function was presented as best-practice production function.[9]

The paper takes a supplementary step under production function approach, in order to use this type of function to quantify the technical progress on economic development and to realise a pertinent comparative analysis between Greece and Romania.

2. Methods

This proposal is a model based on a production function. In order to apply this theoretical approach to the macroeconomic evolution, a Cobb-Douglas function is used as follows:

$$Y = AL^a K^b,$$

in which:

A: technical parameter, $A < 1$;
L: labour;
K: fixed capital;
a: parameter proportional to relative labour productivity;
b: parameter proportional to fixed capital efficiency.

Both labour productivity and fixed capital efficiency are under the impact of the technical progress. This technical progress in the economy is quantified by the growth of the labour knowledge (α) and the growth of fixed capital use degree (β).

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[5] Daly, H., 1997, *Forum on Georgescu-Roegen versus Solow/Stiglitz*, in Ecological Economics 22 (3): 261–306.

[6] Cohen, A.J. and Harcourt, G.C., 2003, *Retrospectives: Whatever Happened to the Cambridge Capital Theory Controversies?,* in Journal of Economic Perspectives, 17(1), pp. 199–214.

[7] Mishra, S.K., 2007, *A Brief History of Production Functions*, in Working Paper Series, Social Science Research Network (SSRN).

[8] Barnett, W., 2007, *Dimensions and Economics: Some Problems*, in Quarterly Journal of Austrian Economics 7(1).

[9] Moffat, M., 2008, *Meta-production function, Economics Glossary - Terms Beginning with M*, Monomics.about.com/library/glossary/bldef-metaproduction-function.htm, accessed June 19, 2008.

The labour knowledge level can be approximated by the learning stock. This learning stock represents the sum of the years of elementary education, secondary education and advanced studies, as well. The learning stock can be calculated as:

$$S_i(a) = \sum_{i=1}^{n} n_i k_i ,$$

where:

ni: the labour from i category;

ki: coefficient which represents graduated studies years of the labour from i category.

The labour productivity will increase as a result of learning stock growth, mentioned as α. It can be considered:

$$a \to a(\alpha)$$

Moreover, the use of the new machines and equipments needs a specific knowledge quantum (α_K). This is why:

$$a \to a(\alpha_K)$$

If $\alpha = \alpha_K$, the labour productivity is normal and will note:

$$a_0 \to a + a(\alpha_K) .$$

If $\alpha \neq \alpha_K$, the labour productivity will increase or decrease, as in the following equation:

$$a(\alpha) \approx a_0 + a_1(\alpha - \alpha_K) .$$

On the other hand, the use of the new machines and equipments needs specific technologies (β). As a result:

$$b \to b(\beta) .$$

If we note the actual technologies b1, we shall obtain:

$$b(\beta) \approx b_0 + b_1(\beta - \beta_K) .$$

Using these calculations, the Cobb-Douglas function becomes:

$$Y = A\left[L^{a_1(\alpha-\alpha_K)} K^{b_1(\beta-\beta_K)}\right] L^{a_0} K^{b_0} .$$

Using the decomposition relations:

$$u^v = e^{\ln u^v} = e^{v \ln u} \text{ and}$$
$$e^m e^n = e^{m+n},$$

the function which is able to present the impact on the technical progress on the economy in Romania or Greece becomes:

$$Y = Ae^{a_1(\alpha-\alpha_K)\ln L} \cdot e^{b_1(\beta-\beta_K)\ln K} \cdot L^{a_0} K^{b_0} \text{ and}$$
$$Y = Ae^{a_1(\alpha-\alpha_K)\ln L + b_1(\beta-\beta_K)\ln K} \cdot L^{a_0} K^{b_0}.$$

These two above equations allow us to observe the importance of the relative labour productivity growth and fixed capital efficiency on the national economic output. But the relative labour productivity growth and fixed capital efficiency are the result of the labour knowledge growth (α) and the use of the new technologies (β).

It is very difficult to collect economic information in Romania. The official statistical system is not developed as a result of low public financial support. Moreover, it is a great lag between the data collecting moment and the official data publishing. As a result, correlated parallel sources were used for this study. These sources are: the yearbooks of the National Statistics Institute of Romania, periodicals of the Ministry of Development and Tourism and so on. The same situation is in Greece.

The indicators into monetary units are standardised in order to eliminate the influence of inflation and the labour skill categories were defined according to the Romanian and Greek national educational systems.

3. Results and Discussion

The above model was implemented on Greek and Romanian economies because these are the most affected by the crisis in 2010. As a result, the GDP average growth rates in these countries were negative during 2009-2010: -7.1% in 2009 and -1.3% in 2010, in Romania, and -2.0% in 2009 and -4.5% in 2010, in Greece, and the forecasts are not so good[10].

The evolution of the GDP in Romania and Greece is presented in Table 1.

[10] European Commission, *European Economic Forecast Spring 2011*, in European Economy, no. 1/2011, Brussels, pp. 107, 152.

Table 1. Evolution of the GDP in Romania and Greece

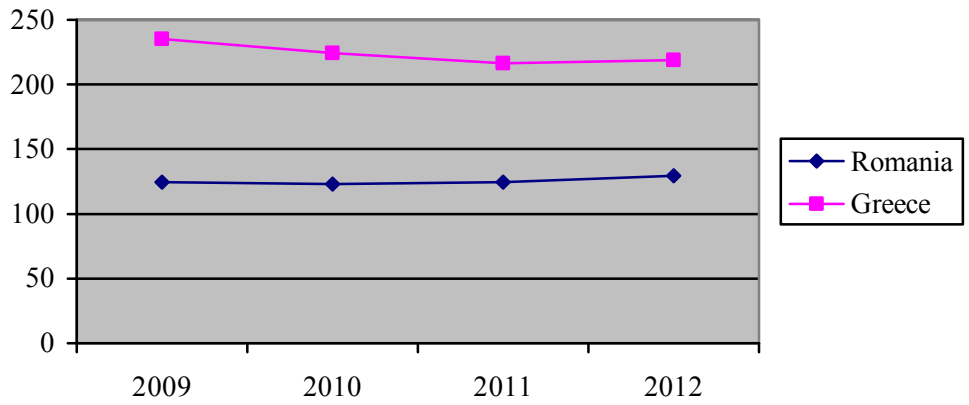
Year	2009	2010	2011	2012
Romania (bn. Euros)	124.5	122.9	124.7	129.3
Greece (bn. Euros)	235.1	224.5	216.6	219.0

Source: personal calculation using European Commission database

According to Table 1, the GDP decreased powerfully in 2009 and slowly in 2010 in Romania. 2011 is the year of total recovery of the GDP and 2012 will mark a 3.7% GDP growth.

Greece presents a worst situation, because it faces to three years of negative GDP growth rates (2009-2011). The economic growth will be restarted in 2012 (see figure 1).

Figure 1. GDP trend in Romania and Greece (bn. Euros)



Source: personal information processing after Table 1

The first observation is that the economic crisis' impact on both economies was felt at the end of 2008. Practically, these two countries had a supplementary lag of three quarters compared to other member states, but they were not able to adopt efficient anti-crisis measures to protect their economies. The GDP decreased in 2009 and 2010, as a result of the present global crisis and deficient management and policy.

These deficiencies came from a wrong legislation, which supported the domestic demand's growth using consumption credits, lack of any coherent support for SMEs from government and the economic instability. This is the general framework which affected the labour productivity and the fixed capital efficiency, as well.

During 2009-2010, the gross fixed capital formation decreased by 13.2% in Romania and 16.5% in Greece and it will be not able to recover even in 2012. This process was followed by a total labour decrease by 2.2% in Romania and 2.0% in Greece (see Table 2).

Table 2. Evolution of the gross fixed capital formation and labour in Romania and Greece

Year	2009	2010	2011	2012
Romania				
Gross fixed capital formation (bn. Euros)	32.7	28.4	29.4	31.1
Total labour (mill. persons)	9.1	8.9	8.9	8.9
Greece				
Gross fixed capital formation (bn. Euros)	40.2	33.6	28.0	24.7
Total labour (mill. persons)	5.2	5.1	5.0	5.0

Sources: personal information processing after World Bank (2009) and NIS (2010)

Using the information from Table 2, we can quantify the evolution of the capital efficiency and labour productivity. As a result of the labour decreasing, the capital efficiency increase by 13.66% in 2010 in Romania. This efficiency will decrease by 2% in 2011 and other 2% in 2012.

Paradoxical, Greece achieved a growth of the capital efficiency during 2009-2010 and will continue this trend during 2011-2012, as a result of the new austerity plan implementing (see Table 3).

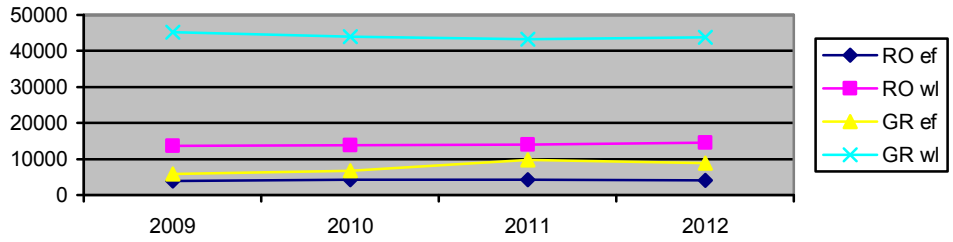
Table 3. Evolution of the capital efficiency and labour productivity in Romania and Greece

Year	2009	2010	2011	2012
Romania				
Capital efficiency (Euros)	3807.3	4327.5	4241.5	4157.6
Labour productivity (Euros/person)	13681.3	13809.0	14011.2	14528.1
Greece				
Capital efficiency (Euros)	5848.3	6681.5	7735.7	8866.4
Labour productivity (Euros/person)	45211.5	44019.6	43320.0	43800.0

Sources: personal information processing after World Bank (2009) and INS (2010)

Greece performs a higher labour productivity, as well. The evolution of the labour productivity is positive in both countries during 2009-2012, as in Figure 2.

Figure 2. Capital efficiency and labour productivity's trends in Romania and Greece (Euros)



Source: personal information processing after Table 3

The evolution of the capital efficiency and labour productivity is supported by the labour knowledge stock. In order to quantify this stock, the following approach will be used: seasonal workers have an insignificant variation of the knowledge stock from year to year; the permanent labour with graduate and postgraduate studies has the main importance in changing labour knowledge stock.

As a result, the analysis is focused on those personnel who activate especially in R&D activity, as shown in Table 4.

Table 4. Evolution of the R&D personnel in Greece and Romania (persons)

Year	2009	2010	2011	2012
Romania1	40950	40050	40050	40050
Greece2	73320	71910	70500	70500

Sources: 1,[11] 2[12]

A real challenge for both economies is the decreasing of the R&D personnel, which will affect the economic recovery. Moreover, the data for 2011-2012 are too optimistically and they do not reflect the austerity measures adopted by Greece and Romania. Even more, the Eurostat "has expressed reservations as to the quality of the Romanian EDP figures" and it announced that the analysis of the economic situation in Greece "has not been updated to reflect the findings of the Economic Adjustment Programme".[13]

According to the above theoretical approach, the calculation of the parameter proportional to relative labour productivity (a) and the learning stock growth (α) is made in tables 5 and 6.

[11] World Bank, Trade. Economies, New York, 2009.

[12] National Institute of Statistics, *Labour in Romania: employment and unemployment,* Bucharest, 2010.

[13] European Commission, *European Economic Forecast Spring 2011*, in European Economy, no. 1/2011, Brussels, pp. 157, 105.

Table 5. Calculation of a and α coefficients for Romania (2009=1)

Year	a	α	$a(\alpha) \approx a_0 + a_1(\alpha - \alpha_K)$
2009	1.00	1.00	a2009 = 1.00
2010	1.01	0.98	$a_{2010} \approx 1 + 1.01(0.98 - 1) \approx 0.9798$
2011	1.02	0.98	$a_{2011} \approx 1 + 1.02(0.98 - 1) \approx 0.9796$
2012	1.06	0.98	$a_{2012} \approx 1 + 1.06(0.98 - 1) \approx 0.9788$

Source: personal information processing

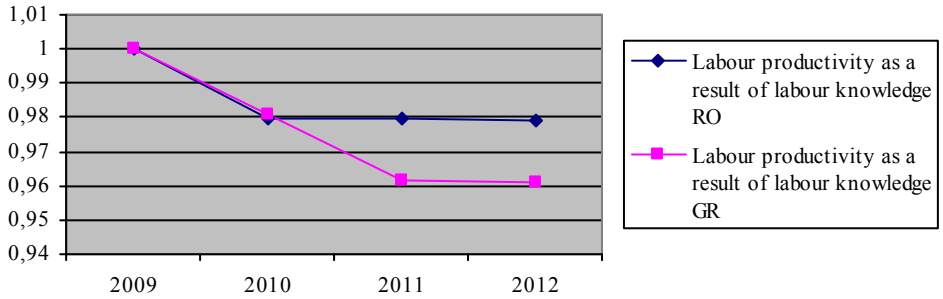
Table 6. Calculation of a and α coefficients for Greece (2009=1)

Year	a	α	$a(\alpha) \approx a_0 + a_1(\alpha - \alpha_K)$
2009	1.00	1.00	a2009 = 1.00
2010	0.97	0.98	$a_{2010} \approx 1 + 0.97(0.98 - 1) \approx 0.9806$
2011	0.96	0.96	$a_{2011} \approx 1 + 0.96(0.96 - 1) \approx 0.9616$
2012	0.97	0.96	$a_{2012} \approx 1 + 0.97(0.96 - 1) \approx 0.9612$

Source: personal information processing

During 2009-2010, both countries faced to a decrease of the learning stock growth's support to the labour productivity. As a result, the decreased of the labour productivity as a result of the labour knowledge evolution was greater during 2009-2010. Greece faces to the same decrease in 2011. The forecast talks about a relative stabilisation of this indicator at a lower level during 2011-2012 (see figure 3).

Figure 3. Labour productivity as a result of the labour knowledge growth under R&D



Source: personal information processing after Tables 5 and 6

The evolution of the fixed capital efficiency as a result of the labour knowledge growth is fluctuant. For the beginning, the analysis was focused on the latest Eurostat data connected to the R&D expenditures by all sectors as % of GDP (see table 7).

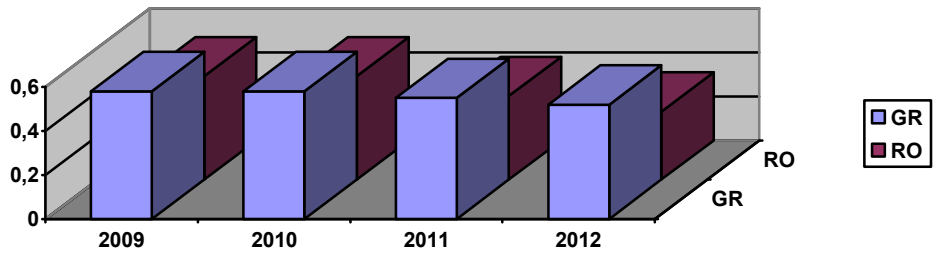
Table 7. Evolution of the R&D expenditures in Greece and Romania (% of GDP)

Year	2009	2010	2011	2012
Romania	0.47	0.47	0.38	0.31
Greece	0.58	0.58	0.55	0.52

Source: http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tsc00001&plugin=1

The R&D expenditures present a relative and obsolete decrease in Greece and Romania, if they are connected to the GDP evolution (see figure 4).

Figure 4. R&D expenditures (% of GDP)



Source: personal information processing after Table 7

On the other hand, the R&D expenditures in Greece are greater than in Romania during 2009-2012. As a result, Greece has a comparative advantage in order to achieve the economic recovery and positive economic growth in 2012.

Using the data from table 7, the paper can quantify the parameter proportional to fixed capital efficiency (b) and the specific technologies connected to the new machines and equipments use (β), as in Tables 8 and 9.

Table 8. Calculation of b and β coefficients for Romania (2009=1)

Year	b	β	$b(\beta) \approx b_0 + b_1(\beta - \beta_K)$
2009	1.00	1.00	b2009 = 1.00
2010	1.13	1.00	$b_{2010} \approx 1 + 1.13(1.00 - 1) \approx 1.00$
2011	0.98	0.81	$b_{2011} \approx 1 + 0.98(0.81 - 1) \approx 0.81$
2012	0.98	0.80	$b_{2012} \approx 1 + 0.98(0.80 - 1) \approx 0.80$

Source: personal information processing

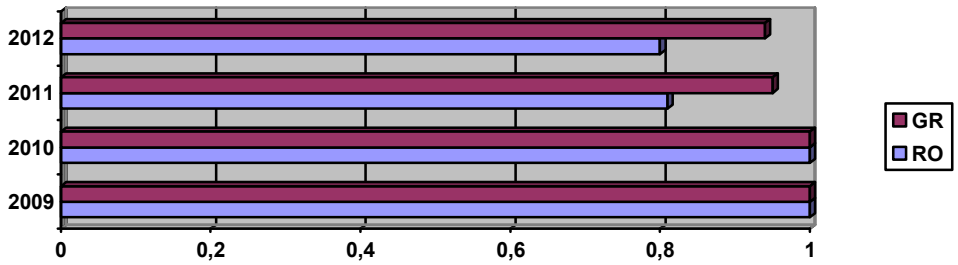
Table 9: Calculation of b and β coefficients for Greece (2009=1)

Year	b	β	$b(\beta) \approx b_0 + b_1(\beta - \beta_K)$
2009	1.00	1.00	b2009 = 1.00
2010	1.14	1.00	$b_{2010} \approx 1+1.14(1.00-1) \approx 1.00$
2011	1.16	0.96	$b_{2011} \approx 1+1.16(0.96-1) \approx 0.95$
2012	1.15	0.95	$b_{2012} \approx 1+1.15(0.95-1) \approx 0.94$

Source: personal information processing

The evolution of the fixed capital efficiency supported by the new machines and equipments use is negative for both countries during 2009-2012. Romania will face to a worst situation during 2011-2012 (see figure 5).

Figure 5. Fixed capital efficiency as a result of the agricultural labour knowledge growth



Source: personal information processing after Tables 8 and 9

5. Conclusion

The Romanian economy paradox is that it was able to achieve a GDP growth rate of 7.3% in 2008, and the same negative rate (-7.1%) in the next year. The economic decrease was lower in Greece, from 1.0% in 2008, to -2.0% in 2009. According to the European forecasts, Romania will achieve positive economic growth in 2011 and Greece in 2012.

The problem is that both countries are not able to support their economic recovery and they asked for international financial support. The main costs of this support are the financial austerity and the citizen's revolts.

Technical progress represents a chance for the economic recovery in Romania and Greece, but it has to be financed by FDI (Foreign Direct Investment) and European funds.

Both countries are not able to manage alone this situation. The implementation of the technical progress can become a priority for foreign investors, because it can use the relative high skilled labour from these countries and the relative lower wages caused by the crisis. These elements are perfect ingredients for a successful business in R&D.

On the other hand, the Romanian and Greek R&D activities did not supported important structural changes in the recent years, because it is still powerfully influenced by the budgetary financing. As a result, it is very important for both countries to be able to use efficiently their human capital, especially those persons who graduated or post graduated.

These persons represent a very important economic resource, which is not enough use in Greece and Romania.

It is necessary to consider that an optimum solution can be a new approach of the human resources' use connected to technical progress, growth of the average productivity and efficiency and the European Funds' attraction. The European financing is vital for Romanian and Greece economic recovery.

Moreover, other foreign specific investments would be used to support the R&D development and implementation. But the use of foreign investment, the implementation of the technical progress and a better macroeconomic management can be achieved only with high skill labour. This labour has to be supported in order to return to the practical research and to develop the economy.[14]

This model used in the paper is able to offer a useful instrument of analysis in order to quantify the impact of the technical progress on the economic development. And if we succeed with the countries which have the most difficult economic situation across the EU member states, the model can be used for all other states and can lead to pertinent conclusions.

[14] Ionescu, R., 2010, *European Business Environment,* GUP, Galatz.

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