

A Statistical Analysis of the Expenditures on Research and Development and the Increase of Gross Domestic Product: an sensible way for Easing the Effects of Greek Economic Crisis

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Abstract-In this paper, we introduce the Global Competitiveness Index(GCI) which is based on the Gross Domestic Expenses for Research and Development and Innovation and we derive two Linear Statistical Models which show the positive influence of the GCI on the Gross Domestic Product(GDP). Hence, the reduction of GCI results on the reduction of the GDP. We construct,also a quadratic Regression model in the variables, showing that the reduction of GDP resulted in the increase of Income Inequality ,in the case of Greece during the economic crisis 2009-2016.

We, also, present facts which justify the opinion that the unemployment in Greece, today, is a by-product of austerity and the austerity is a product of the Memorandum of Understanding (MOU) between Greece and the European Union(EU), the European Central Bank(ECB) and the International Monetary Fund (IMF) . The MOU is , in turn, the result of the excessive debt, the tax evasion, the clientist State and the lack of competitiveness of the Greek Economy.

Keywords - Entrepreneurship , Global Competitiveness Index, Innovation, Linear Statistical Model

I. INTRODUCTION

GREECE became a member of the European Union with the purpose of entering the Global Economic “Village” of the developed countries. Nevertheless, the Greek economy remained a services economy and it has enforced these services.The causes of the Greek financial crisis are the following:

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The excessive debt, the tax evasion, the non-productive public sector, the over- consumption, and the clientist relations between the Greek politicians and the Greek voters.[1].

The real cause of the Greek debt crisis is the mentality of the Greek voters who seek the clientist relations and the political system which encourages this catastrophic tendency.

II .INNOVATION AND ENTREPRENEURSHIP

Innovation is the characteristic of creative enterprising initiative .Greece ranks in the last positions between the developed countries with respect to innovative activities. When we speak about innovation , we mean the pioneering ideas for the realization of establishing an enterprise in every sector or the new processes applied for this establishment as well as the application of new inventions and discoveries for the fulfillment of a purpose, commercial, scientific, social or other.

III. BUSINESS COMPETITIVENESS

A. Definition

At market level, competitiveness is the ability of a company to survive financially and to grow, within the competitive environment of the market, despite the severe competition of the other companies in the same commercial sector or in the market.

B. Competitive advantages of companies.

These are the following: (a).High quality (b).Low price (c).Low labor cost, keeping in mind the expectations of the workforce. If , at this point, the company is against the understandable expectations of the workforce ,there will be the degrading of the workers and a level of wages “Boulgaria type” .Other competitive advantages are :(d). A strong capital base, (e).Clever marketing mix (product, price, distribution channels, promotion) (f).Existence of a sizable portion of the market in the company portfolio and (g). Ability of the company to manufacture products of higher quality and lower cost than its international competitors in a continuous base.

IV. COMPETITIVENESS OF A COUNTRY

A. Definition

In a somewhat narrow interpretation of this term, a country is considered competitive if it can maintain for its products a large market portion in the international market environment ,which means that these products must have high quality and logical cost. The relevant definition of the International Organization of Cooperation and Development (OECD) is: Competitiveness of a country is the degree that this country ,under fair conditions of the free market, can sell its products internationally , maintain a larger portion of the international market than its competitors and simultaneously maintains a long- term increase of the real income of its citizens.

B. Global Competitiveness Index.

The World Economic Forum [2] ,produced the Global Competitiveness Index(GCI) which is based on 12 criteria (entrepreneurship, innovation, education, products” cost, market portion, exports, e.t.c.). More specifically, Greece was ranked in the 96th position of the international competitiveness for the year 2012-2013, according to (GCI) , 6 positions below the rank (90) which it occupied in the year 2011-2012. Also, Greece, was the last country, according to (GCI) score , between all the 27 members of the European Union.

V. STATISTICAL ANALYSIS

A. Derivation of the Linear Statistical tendency model for the (GCI) on time (t).

We derive a linear statistical model of second order with respect to the time variable, based on data from the World Economic Forum,for the period 2005-2015. The depended variable is (GCI) and the independent variable is time.We use the Software SPSS 20, [3] and the results are as follows :

$$E(GCI/t)=b_0 + b_1*t + b_2*t^2 \quad (1)$$

R=0.98, R²=0.97, b₀ = 3,794, b₁ = 0.087, b₂ = -0,006, F=57,5 ,p-value= 0,001. For t = 2014-2015, we obtain: GCI=97. Hence, in 2015, Greece is predicted to rank 97th with respect to Global Competitiveness Index (GCI) and the Research and Development Expenses. (R and D expenses).

B. The effect of Global Competitiveness Index on the Gross Domestic Product of Greece.

We make the following assumptions:

Assumption 1: The state of Unemployment subtracts a certain amount of income from every unemployed person , so the GDP is influenced from the Unemployment Rate of a country.

Assumption 2: The Global Competitiveness Index (GCI) shows the level of economic health of businesses in the climate of Economic Crisis and the level of keeping the number of their employees. Hence, the (GCI) influences the GDP of a country.

In order to prove the assumptions (1) and (2) ,we derive the following Linear Regression Model and ,using the Software Statistical Package SPSS 20.0, [3] we estimate its parameters

and we make some conclusions on the good quality of the model :

$$GDP_t = \beta_0 + \beta_1(GCI) + \beta_2(t) + \varepsilon, \quad (2)$$

where $E(\varepsilon) = 0, \text{Var}(\varepsilon) = \sigma^2$

Based on data from the World Economic Forum for the years 2005-2015, we obtain:

R=0,92, R²=0,84, b₀=-97597,5, b₁=26579,7, b₂= 1293,8, F=10,5, p-value=0,025. The p-values for the tests of hypotheses ,whether or not, $\beta_i \neq 0, i=0,1,2,$, are all less than the level of significance=0,05. Hence, the coefficients of the model (2) are statistically significant. The estimator b₁ has positive value and the statistic F is statistically significant. Hence, we conclude that the reduction or increase of the Global Competitiveness Index leads to the reduction or increase of the GDP ,as it happens under the present economic climate in Greece.

C. Influence of GDP of Greece in Gini Coefficient for Income Inequality.

O. Causa, Alain de Serres and N. Ruiz [4] argue that there is an inverse relationship between GDP and the Gini coefficient for income distribution for most OECD countries .In this section we derive a quadratic statistical model ,based on data of the Greek GDP and Gini coefficient, for the years 2001 to 2014,as follows :

$$GDP_t = \alpha + \beta(GINI_t) + e_t \quad (3)$$

With $E(e_t) = 0, \text{Var}(e_t) = \sigma^2,$ based on the following Data:

TABLE I
DATA FOR GREEK GDP AND GINI COEFFICIENT FOR 2001 TO 2014
(X100)

YEAR	GDP FOR GREECE	GINI COEFFICIENT
2001	17400	36.7
2002	17900	36.1
2003	18100	35.5
2004	18300	34.9
2005	19500	34.4
2006	20000	34.2
2007	21300	34.1
2008	22200	33.7
2009	22300	33.5
2010	23800	33.7
2011	24400	33.9
2012	24200	34.0
2013	23100	34.3
2014	22800	34.7

Using the Statistical Package for the Social Sciences ,(SPSS 21),we find the estimates of the parameters (a),(b),the Coefficient of Determination (R),the

Statistic (R²) and the Statistic F, with its p-value, as follows:

TABLE II
ESTIMATION OF COEFFICIENTS IN MODEL (3)

a= 93969.6	b =-2109.3
Std Error for a =458.1	Std Error for b= 1583.6
t statistic for a=-4.6	T statistic for b=5.9
p-value for a=0.001	p-value for b=0.0001
F statistic with 1 and 12 degrees of freedom=21.1	p-value for F Statistic=0.001

TABLE III
GOODNESS OF FIT MEASURE FOR MODEL (3)

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.79	0.639	0.608	1570.79

From the above findings we conclude that, in the case of Greece, the increase in income inequality, expressed by Gini Coefficient resulted in the reduction of GDP (Gross Domestic Product). In Table III, we find, using SPSS 20 [3] that the Std. Error of the Estimate is 1570.79. This result is a justification of the increase of both, the GDP and Gini Coefficient for year 2011. This holds, also, for Spain, although, for lack of space, we did not present the findings in this paper. This result does not hold for all the countries of the European Economic Community, depending on the distribution of the revenues from State Projects among all the members of the population in a just manner, according to Causa et. al [4].

VI. CONCLUSION

In this paper we have proved that, in the case of the Greek Economic Environment, there is a direct positive relation between the Gross Domestic Product and the Global Competitive index and a negative relation of GDP and Gini Coefficient [5]-[6]. The lower rank of Greece in terms of competitiveness, as it happens today, results to a reduction of GDP and the economic recession in the country [7]. The question is the following: is there an end to this spiral of slow but certain downgrading of the Greek economy and a light at the end of the tunnel? The answer is positive under the following conditions:

(a). Access to financing (b). Investments (c). Increase of exports (d). A stable political system (e) Elimination of corruption (f) Payment by everybody of their taxes, (g) Elimination of inefficiency in the public sector (h) Increase in Research and Development expenses.

ACKNOWLEDGEMENTS

We thank a referee for pointing out a peculiarity in the data of Table I, which we have justified in the discussion of Table 3.

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