

Panel Analysis of Relationship between Supply Chain Strategy in Competitive Area and Economic Growth in the European Union

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Abstract— Theoretically, the supply chain competitiveness is conclusively believed to be positively related with economic growth. While empirically, this relationship does not always hold in many countries for several reasons. In the empirical literature, the link between economic growth and competitiveness has been highly debated. Thus, the main purpose of current article is to examine the link between economic growth and competitiveness in European Union (EU-28 countries) over period from 2007 to 2017. Using Panel Models (Fixed and random effects models). In conclusion, the findings suggest that competitiveness is robustly and positively associated with real GDP per capita, if we make a policy to increase the GDP per capita, it included rise in competitiveness score for the country.

Keywords— European Union, Supply chain strategy Panel Models, Competitiveness, Economic Growth.

1. Introduction

The competitiveness of a nation is of vital importance for its current living standard, but also for its growth prospects. The relationship between competitiveness and economic growth has been strongly discussed. Historically, the term of competitiveness has been primarily used to give attention to the cost situation of firms or countries, it is this narrow focus on costs that has been criticized by many authors and theories. There are many (theories) schools discussing competitiveness, the differences between these schools are assumptions, consequences and policy implication; this schools for example: Classical theories; Neoclassical theory; Keynesian theory; theory of economic development; New trading theories. Every one of the thought's schools had important effects on the concept of competitiveness, even if we refer to international, national, regional or firm competitiveness [1-5], [6].

The World Economic Forum structures a Growth Competitiveness Index (GCI), which covers a weighted average of 112 different components. These components are grouped into 12 pillars of competitiveness and each of them measures a different aspect of it. The WEF puts a different

weight on each of the three groups and divides countries according to the development stage, because developing countries are competitive in the field of basic requirements, the competitiveness of emerging countries is depending on the efficiency enhancers, finally, most developed countries compete thanks to their innovations. Although the GCI is one of the most accepted and recognized indicators of national competitiveness in the literature, it is not excluded from criticism [7-14]. In reality, the majority of these different pillars of competitiveness represent, explicitly or implicitly, the factors of endogenous growth. Thus, Romer (1986) supposed that human capital is a source of endogenous growth [1].

Therefore, the main purpose of this article is to examine the relation between economic growth and competitiveness in the European Union (EU-28 countries) through the period from 2007 to 2017. The rest of article divided into 3 section: Part 2, introduces the literature review, Part 3 presents the methodology and estimation, Part 4 conclusions.

2. Literature

Most of the theories of competitiveness argue that the competitiveness position of any country, region and company is strongly influenced by productivity, which considered as a major determinant of competitiveness. Based on Oesterreich, the country aimed to increase the productivity which supported the sustained growth of the level of income for at least one period., productivity can be defined output per unit of input [2]. Also, Porter highlighted that the measurement of national competitiveness is depended on the country's sustain growth. Ezeala-Harrison (1999) states that international trade is the engine of economic growth, while competitiveness is considered the fuel that empowers the engine [4-10].

Other studies are examined the relations between real GDP growth rate, GDP per capita, inflation, etc. and national competitiveness in order to evaluate and estimate the national competitiveness. For example, Hatsopoulos et al. claim economic competitiveness is reflected by trade balance and rising living standards or income. Nevertheless, the

authors argue that the increase exports can also be achieved at the cost of diminished real income, this situation not reflecting competitiveness. Gabrisch and Staehr, used the Granger causality tests and VAR models to assess the link between current account balance and unit labor costs, they conclude that changes in external balance affect relative competition, although no significant effects in the opposite direction is identified [10- 15] , [16-20].

The most prominent economist to critique the competitiveness concept is Paul Krugman, he made a strong attack against the competitiveness concept and those who use it. Although Krugman's data shows a strong correlation between improvements in labor productivity and standard of living, the fact that modern economies are very complex systems [15, 21-26]. Clearly, there are many different factors behind the growth in living standards, and productivity, it means that there is no single factor can explain economic growth and standard of living.

Fagerberg & Srholec examined several relations such as the relations between GDP per capita in PPPs and real GDP growth rate, and unit labour costs etc. in order to detect and analyze competitiveness in a certain time period [8].

In recent years, the empirical literature was devoted to the critical analysis of GCI, including optional improvements, for example, Xia et al., Podobnik et al., are more numerous than those studies that recognize GCI as a general indicator to estimate and compare nations regarding the nation competitiveness [3], [20], [23]. Xia et al. argue that WEF should insert improvements to GCI methodology and its indices, in this case, GCI can become a much better predictor for economic growth than other variables [23, 27]. Podobnik et al. examined how the level of competitiveness affects the dynamics of a country's wealth during a recession, the authors developed a new measure, which is called a relative competitiveness, to evaluate an economy's competitiveness relative to its GDP [20].

Kalimeris, Dimitris, using VAR models for four Euro Area states (Greece, Ireland, Italy and Spain) shows that economic development is influenced by different subcomponents of GCI, mainly related to fiscal balance, health expenditures, FDI and unemployment rate [13]. Sanchez and Varoudaki, used data from 1975 to 2011 for 13 European countries, analyze external balance dynamics and find that economic growth changes seem to be the key determinant of current account fluctuations, while the price competitiveness factors have only a limited role in explaining external imbalances. At the same time, Nkusu, Mrs Mwanza investigates the interlinkages among competitiveness, exports, economic growth, and fiscal performance [18], [26]. The author concludes that declines in price competitiveness, reflected by real effective

exchange rate appreciation, hinder exports and economic growth. At the same time, gains in exports improve output and fiscal performance [19].

3. Methodology and Estimation

The econometric analysis of panel data renders an account, both individual and temporal dimensions of the observations in supply chain strategy. A high number of observations permit us to take account of the individual differences of performances that is due to the influence of other factors that are considered in the regression. The wealth of information in the estimation of panel data models leads to the following consequence: an important observed number of individuals allow great precision of the estimates. While we estimate a sample with panel data, the first thing that it is suitable to verify that is the homogeneous or a heterogeneous specification of the generating process of the data. After that, we apply the individual-specific test to determine if we can suppose that the studied model is perfectly identical for all countries or each country have some specificities [17], [25].

We use the methodology the panel models (fixed and random effect models), for assessing the causal relationship between economic growth and competitiveness variables in the European countries through period from 2007 to 2017. The estimations were done in Eviews package edition 10; Thus, our regression is based on the following relation:

$$\begin{aligned}
 GDPPP = & C(1) + C(2) * GCI_{it} + \\
 & C(3) * GDPP_{it-1} + C(4) * \\
 & GFC_{it} + C(5) * FCEXP_{it} + \\
 & C(6) * LEB_{it} + C(7) * UNE_{it} + \\
 & C(8) * SET_{it} + \varepsilon_{it}
 \end{aligned} \tag{5}$$

In the table 1, the variables which used in panel model for EU-28 countries, and “*i*” indicates the countries ($i = 1, 2, 3, \dots, N$) and “*t*” represents the time ($t = \overline{1:T}$), and C(1) is vector of intercepts, and $t = \overline{1:T}$ denotes time,

Table 1. shows the variables which used in panel model un EU-28

<i>Variable</i>	<i>Description</i>	<i>Source Data</i>	<i>Expected Sign</i>
GDPPP	GDP per capita (constant 2010 US\$)	World Bank data base (WDI)	
$GDPPP_{t-1}$	First lag of GDP per capita (constant 2010 US\$)		+
GCI	Global Competitiveness index, (expressed in units; it ranges from 1 to 7, 7 representing the highest score),	the Global Competitiveness Reports", published by the World Economic Forum.	+
GFC	Gross formation capital (constant 2010 US\$)	World Bank data base (WDI)	+
FCEXP	Final consumption expenditure (constant 2010 US\$)	World Bank data base (WDI)	+/-
LEB	Life expectancy at birth, total (years)		+
UNE	Unemployment rates as a percentage of workforce		-
SET	School enrolment, tertiary (% gross)		+

3.1 Data and descriptive statistics

1. **Cointegration tests:** The econometrics literature places a good deal of emphasis on procedures for interrogating the quality of a model's specification. These procedures address the assumptions that may have been made about the distribution of the model's error term, and they also focus on the structural specification of the model, in terms of its functional form, the choice of regressors, and possible measurement errors [7]. The diagnostics tests indicate that the residuals are normally distributed, homoscedastic and serially uncorrelated and the parameters appear to be stable in the first difference.

We do Johansen Fisher Panel Cointegration Test: If the Trace Test Statistics more than Max-Eigen Test Statistics in the level and at most 1, we reject the null hypothesis also the Probability is very low (0.000), it means that there is no cointegration between the two variables. For the individual cross section results there is no cointegration between two variables in (19 countries from EU-28 countries, and there is cointegration in 9 countries are: Denmark, France, Germany, Hungary, Italy, Netherlands, Poland, Slovak Republic, and Sweden. Unit root examination is done with two tests: Im, Pesaran and Shin (IPS) and Maddala and Wu (MW) [9], [12].

2. **Stationarity tests:** We utilize four different panel unit root tests in our analysis. These are

Levin et al., Im, Pesaran and Shin W-stat, ADF Fisher Chi-square and PP Fisher Chi-square tests [12], [16], [17]. While the null hypothesis of all these tests states the existence of unit root, the alternative hypotheses state the absence of it. We can say all variables stationary at the default and first difference, we may easily observe the stationarity of all the series at default and first difference. ** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality. All the statistical significance of the variables at 1%, 5% and 10% respectively. we can apply panel cointegration tests to detect the existence of long-run relationship.

3. **Correlations** are useful because they can indicate a predictive relationship that can be exploited in practice, it most often refers to how close two variables are to having a linear relationship with each other. But, the information given by a correlation coefficient is not enough to define the dependence structure between random variables. It means that correlation cannot be used to infer a causal relationship between the variables. As shown in Table 3 above, GDPP and its first lag are strongly correlated with GCI and GDPP (-1), and LEB, where the correlation coefficients (r) override 0.644. Also, it is moderately correlated with GFC, FCEXP and UNE, since the corresponding correlation coefficients (r) exceed 0.416. It is weakly correlated with SET.

Table 2. shows the Correlation matrix for the variables in EU-28 countries

	<i>GDPP</i>	<i>GCI</i>	<i>GDPP(-1)</i>	<i>GFC</i>	<i>FCEXP</i>	<i>LEB</i>	<i>UNE</i>	<i>SET</i>
<i>GDPP</i>	1							
<i>GCI</i>	0.70	1						
<i>GDPP(-1)</i>	0.99	0.70	1					
<i>GFC</i>	0.25	0.44	0.26	1				
<i>FCEXP</i>	0.22	0.42	0.23	0.98	1			
<i>LEB</i>	0.65	0.53	0.66	0.47	0.45	1		
<i>UNE</i>	-0.31	-0.47	-0.30	-0.08	-0.07	0.0002	1	
<i>SET</i>	-0.16	0.07	-0.16	-0.03	-0.03	0.12	0.42	1

Source: computed by author using Eviews 10.

The GCI series is moderately correlated with GFC, FCEXP, LEB and UNE. GFC sparingly correlated with LEB, strongly correlated with FCEXP, it is weakly correlated with UNE and SET. FCEXP is moderately correlated with LEB, it is weakly correlated with UNE and SET. LEB is weakly correlated with UNE and SET. Finally, UNE is sparingly correlated with SET, these pairwise correlations are significant at 1% and 0.05% level.

3.2 Estimation

We estimate *econometrically* the equation 5, using statistical method panel VAR model in Eviews software package edition 10, for the EU-28 countries, covering annually data through period during 2007-2017. The panel data used in estimation is unbalanced, for each country both GCI and GDP levels being observed for the entire

period. The estimation generates the fixed effects model in equation 6 and the random effects model in equation 7. Table 4 shows that the output Eviews for Panel data models (fixed and random) for all variables in the default level, as follows.

The *fixed effects model* has an R-squared around of 0.99 and Durbin-Watson static= 1.88 with the default level for all variables. The fixed effect model also, presents that all variables are significant, its probability more than 0.05 (see table 4). The Fixed Effect Model output can be written in the equation 6 as follows:

$$\begin{aligned} GDP_{it} = & -82732.8 + 2676.2 * \\ & GCI_{it} + 0.783 * GDP_{it-1} + 2.28E - \\ & 08 * GFC_{it} - 1.18E - 08 * FCEXP_{it} + \\ & 988.34 * LEB_{it} - 112.05 * UNE_{it} + \\ & 57.954 * SET_{it} + \varepsilon_{it} \end{aligned}$$

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Table 3. presents the output Panel Model (fixed and random effect models)

Dependent Variable: GDPP						
Method:	Panel Least Squares			Panel EGLS (Cross-section random effects)		
Variable	Coefficient	t-Statistic	Prob.	Coefficient	t-Statistic	Prob.
C	-82732.8	-6.04	0.000	287.7	0.078	0.938
GCI	2676.2	2.41	0.017	247.3	0.710	0.478
GDPP(-1)	0.783	17.11	0.0000	1.0027	79.17	0.0000
GFC	2.28E-08	3.32	0.001	4.91E-09	1.85	0.066
FCEXP	-1.18E-08	-2.24	0.026	-1.38E-09	-2.07	0.040
LEB	988.340	5.45	0.000	-4.437	-0.09	0.928
UNE	-112.05	-2.43	0.016	-40.632	-1.54	0.125
SET	57.954	3.53	0.0005	2.950	0.41	0.680
R-squared	0.991			0.986		
Prob(F-statistic)	0.000			0.000		
Durbin-Watson stat	1.883			1.753		

Source: Computed by Author using Eviews Package.

The *random effect model* has an adjusted R-squared of around 0.986 and Durbin-Watson static= 1.753 with the default level for all variables. This model introduces results that, there are also two variables are significant (*GDPP(-1)*: GDP per capita (constant 2010 US\$) in the first lag and *FCEXP*: final consumption expenditure, its probability (0.000 and 0.040 respectively) less than 0.05, and all other variables its more than 0.05. The Random Effect Model output can be written as the equation 7:

$$\begin{aligned} GDP_{it} = & 0.783 * GDP_{it-1} - \\ & 1.38E - 09 * FCEXP_{it} + \varepsilon_{it} \end{aligned}$$

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Also, we run *Correlated Random Effect - Hausman Test* to choose which model is appropriate Null hypothesis: there is no difference between fixed effects model and random effects model. The probability of Chi-Sq. Statistic = 0.000 is less than 0.05, it means there is no difference between two model, so the appropriate model is Fixed Effects Model. It is a good result, where the R-squared is 0.991 and Durbin-Watson stat= 1.883

in the model fixed effects model with the default level for all variables [6].

3.3 The Model Results

The Eviews output indicates that, there is a strong relationship between GDP per capita (constant 2010 US\$) and global competitiveness index (GCI) in EU-28 countries. It can appear in the high adjusted R-square = 0.991 for panel data analysis and the probability of all model [Prob(F-statistic)] which equal zero. Also, Prob of t-Statistic of all variables less than 0.05, the coefficients appear as follows:

1. The impact of global competitiveness index (GCI) on GDP per capita (constant 2010 US\$): under the fixed effects model global competitiveness index (GCI) is significant, where probability of t-Statistic = 0.0017 less than 0.05 %, and the coefficient equal roundly 2676.2, it means that an increase in the score of GCI about 2676 point leads to rise one dollar in real GDP per capita.

2. The impact of school enrolment, tertiary on GDP per capita (constant 2010 US\$): We use school enrolment, tertiary as a proxy of education, the results model fixed effects show impact of school enrolment, tertiary (SET) on GDP per capita (constant 2010 US\$) is significant, where probability of t-Statistic = 0.0005 less than 0.05 %, and the coefficient equal 57.954, it means that an increase in the school enrolment, tertiary about 5.8% leads to rise 0.10 dollar in real GDP per capita.

3. The impact of labor on GDP per capita (constant 2010 US\$): We use UNE: unemployment as a percentage of workforce as a proxy of labor. The results of model conducted that, unemployment is significant because of the probability of t-Statistic = 0.0016 less than 0.05 %. Where the decrease in the unemployment rate about 11.2% leads to rise in the GDP per capita (constant 2010 US\$) about 0.10 dollar.

4. The impact of health on GDP per capita (constant 2010 US\$): We use LEB: life expectancy at birth, total (years) as a proxy of health, the results of model conducted that, life expectancy at birth, total (years) is significant because of the probability of t-Statistic = 0.000 less than 0.05 %. Where the increase in the Life expectancy at birth about 9.88 years leads to rise in the GDP per capita (constant 2010 US\$) about 0.01 dollar.

5. The impact of gross formation capital (GFC) on GDP per capita (constant 2010 US\$): under the fixed effects model, the gross formation capital is significant, where probability of t-Statistic = 0.001 less than 0.05 %, and the coefficient equal roundly 2.28E-08, it means that an increase in the gross formation capital about 2.28E-08 dollar, leads to rise one dollar in real GDP per capita.

6. The impact of final consumption expenditure (FCEXP) on GDP per capita (constant 2010 US\$): We use final consumption expenditure as a proxy of physical capital, the results model fixed effects show impact of final consumption expenditure (FCEXP) on GDP per capita (constant 2010 US\$) is significant, where probability of t-Statistic = 0.026 less than 0.05 %, and the coefficient equal -1.18E-08, it means that the decrease in the final consumption expenditure about 1.18E-08 leads to rise one dollar in real GDP per capita, this result against the Keynesian theory (effective demand) but this impact is very small.

7. Finally, the intercept is significant it means that, there are a difference between the sample of countries (EU-28 countries).

4. Conclusions

There is an important conclusion. It means that the determinants of competitiveness and economic growth are roughly the same in a modern economy. As a result, our search for a better theory of

competitiveness will also be a search for a better theory of economic growth. In addition, the established growth theories will provide an important building blocks for our theoretical framework. So, we can depend on only one indicator of them to evaluate the economic performance and standard of living in the economies.

Additionally, if we try to increase the economic growth the competitiveness increased automatically but with another present. Also, we can conclude that, there are a difference between the sample of countries (EU-28 countries) for the relationship between competitiveness an GDP per capita or economic growth.

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