ECONOMIC COMPLEXITY AT WORLD LEVEL: DIAGNOSIS AND IMPACT ON ECONOMIC GROWTH

Olimpia Neagu and Mircea Constantin Teodoru
Assoc. Prof., PhD, Assoc. Prof., PhD, "Vasile Goldiş" Western University of Arad

Abstract:Economic complexity is a multidimensional phenomenon with several appraches. It can be defined as the level of interdependence between the component parts of the economy but also as the productive knowledge that a country holds. In the view of researchers from the Center of International Development at Harvard University "the complexity of an economy is related to the multiplicity of useful knowledge embedded it and it is expressed in the composition of a country's productive output and reflects the structures that emerge to hold and combine knowledge".
The paper uses data series on Economic Complexity Index (ECI) provided by the Center of International Development at Harvard University in the period of 1995-2016 for 110 economies and from World Bank Database to examine the dynamics of economic complexity in the world economy and its relationship with economic growth.
The cross-country analysis shows that economic complexity and GDP per capita are positively associated in the sample of 110 economies, suggesting that public policies stimulating the products complexity would produce positive effects on economic growth.

Keywords: economic complexity index, world economy, economic development, GDP per capita, economic growth

Introduction

According to the experts of the Center for International Development at HarvardUniversity, the Economic Complexity Index (ECI) is an expression of how diversified and complex a country's export basket is. It is calculated as the mathematical limit –or eigenvector– of a measure based on how many products a country exports and how many other exporters each product has (Hausmann, Hidalgo et al., 2014). The construction of the index is based on two concepts: diversity and ubiquity.Diversity is related to the number of products that a country is connected and it is equal to the number of links that a country has in the network. Ubiquity is related to the number of countries that a product is connected and it is equal to the number of links that a product has in the network. They calculated this index for 127 countries each year based on data from COMTRADE data base of the United Nations, International Monetary Fund and World Development Indicators.

The ECI reflects the production characteristics of a country, meaning that a higher value of ECI indicates higher level (sophisticated) capabilities of a country in the production process (Hausman, Hidalgo et al., 2011).

The process of economic development can be explained as a process of learning how to produce and export more complex products (Hidalgo et al., 2007; Hidalgo and Hausman, 2009) and also a process that requires more complex capabilities nedeed to develop new activities and get higher level of productivities. Such capabilities are related to the physical and human capital,

the legal system and institutions in a country, as well as the know-how at firm's level and organisational capabilities (management) (Hidalgo and Hausman, 2009).

The positive effect of economic complexity on economic development was detected within the study developed by Felipe et al. (2012). The authors proved thatexport shares of the most complex products increase with income, while the export share of the less complex products decrease with income and a more complex productive structure enables countries to engage in high productivity activities that lead to faster development, in a study including 124 countries.

Economic complexity was also examined in connection with income inequality (Hartman et al., 2017), suggesting that a country's productive structure may limit its range of income inequality.

The present paper intends to provide evidence on the positive association of economic complexity with economic growth in a cross-country analysis including 110 countries.

Methodology and data

In order to investigate the link between economic complexity and economic output, we consider the following regression equation:

$$\ln GDPpc = \alpha + \beta \cdot ECI + \varepsilon \quad (1)$$

where:

α is a constant (the intercept), GDPpc is Gross Domestic Product per capita, ECI is the Economic Complexity Index, β is the regression parameter and ε is the error.

The values of ECI are extracted from the Center of International Development at HarvardUniversitydata base and those of GDP per capita from the World Bank data (GDP per capita in constant 2010 USD). The sample under examination consists of 110 economies; countries without complete data series were excluded. In the equation (1) we use the calculated average values of GDP per capita and of ECI in each country for the period of 1995-2016.

Main findings

In order to explore the evolution of economic complexity in the world economy we divided the 110 countries in three main groups: advanced, emerging and low developed countries, taking into consideration the average values for 1995-2016 of their GDP per capita. 33 countries (GDP per capita from 13523 to 85006 USD) are placed in the advanced group, 39 countries (GDP per capita from 3047 to 12371 USD) in the second group and 38 countries in the third group (GDP per capita from 286 to 2898 USD).

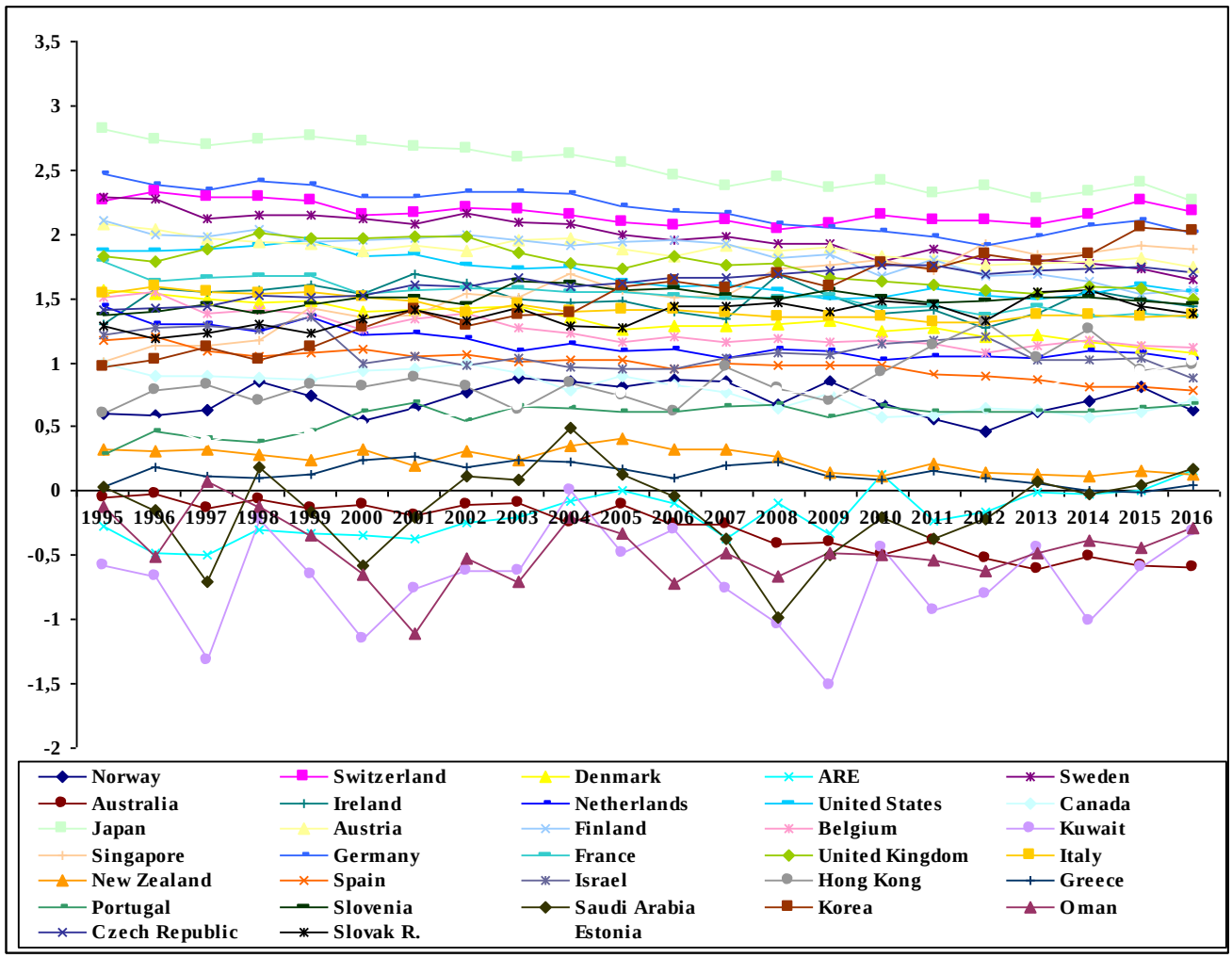

Figure 1 Dynamics of ECI for 1995-2016 in advanced economies

Source: authors' computation based on Center of International Development at HarvardUniversity data

In advanced economies, the values of ECI range from -0,5 in Kuwait to 2,8 in Japan. Kuwait Oman and Australia registered negative values for the whole examined period, as well as United Arab Emirates (ARE) which became positive only in the last 2 years. The highest values of ECI (1.98-2.52) are registered in Japan, Germany, Switzerland and Sweden. New Zealand and Greece have positive near to zero values of ECI and Saudi Arabia positive and negative values around zero. As a general evolution of ECI, we notice that almost all economies have a stationary trend, except Kuwait, Oman, United Arab Emirates and Australia (Figure 1).

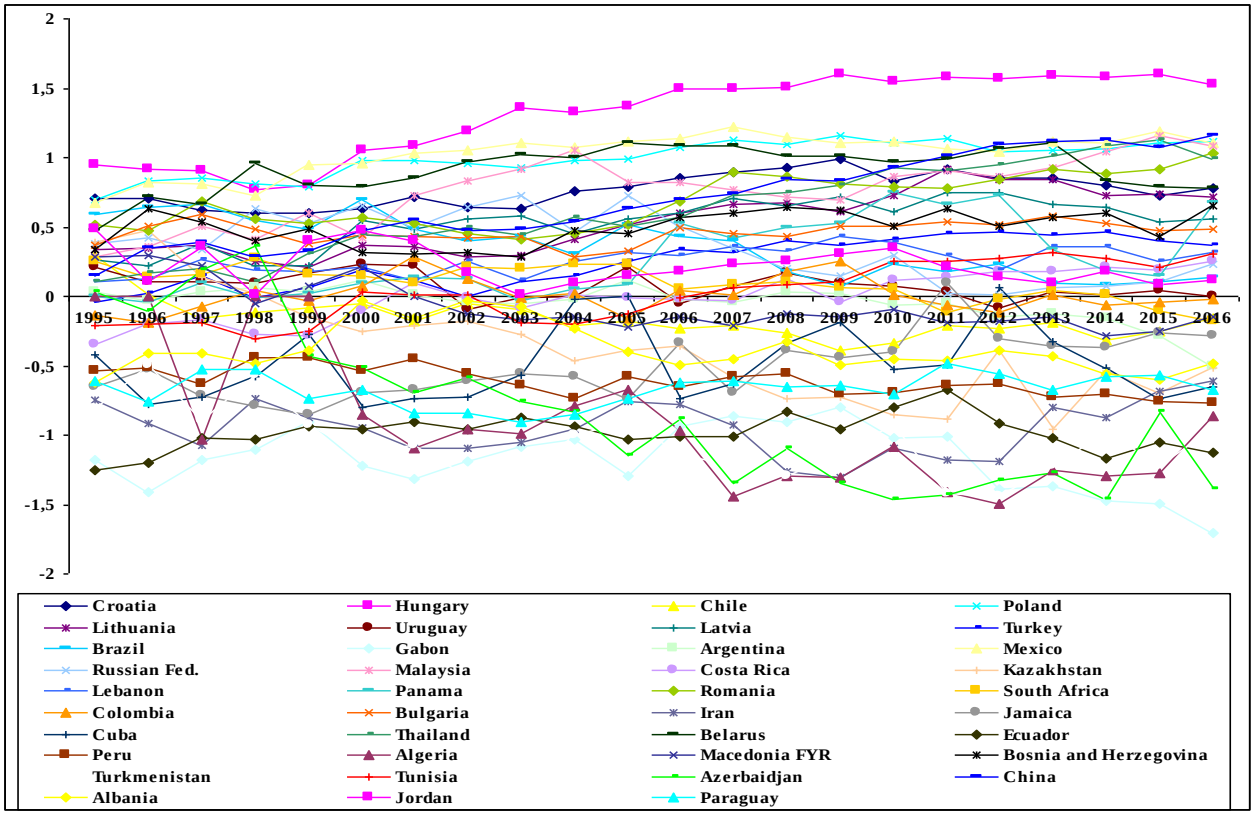

Figure 2 Dynamics of ECI for 1995-2016 in emerging economies
Source: authors' computation based on Center of International Development at HarvardUniversity data

In the group of emerging countries, Hungary is on the top, with the highest values of ECI, followed by China and Poland. Positive values near to zero are registered in India, El Salvador, Brazil, Jordan and Vietnam and negative values near to zero, in Indonesia, Uruguay, Colombia, Macedonia, Moldova, Chile, Egypt and South Africa. The lowest values are registered in Angola, Zambia, Azerbaidjan, Mauritania, Cote d'Ivoire, Nigeria and Gabon (Figure 2) .

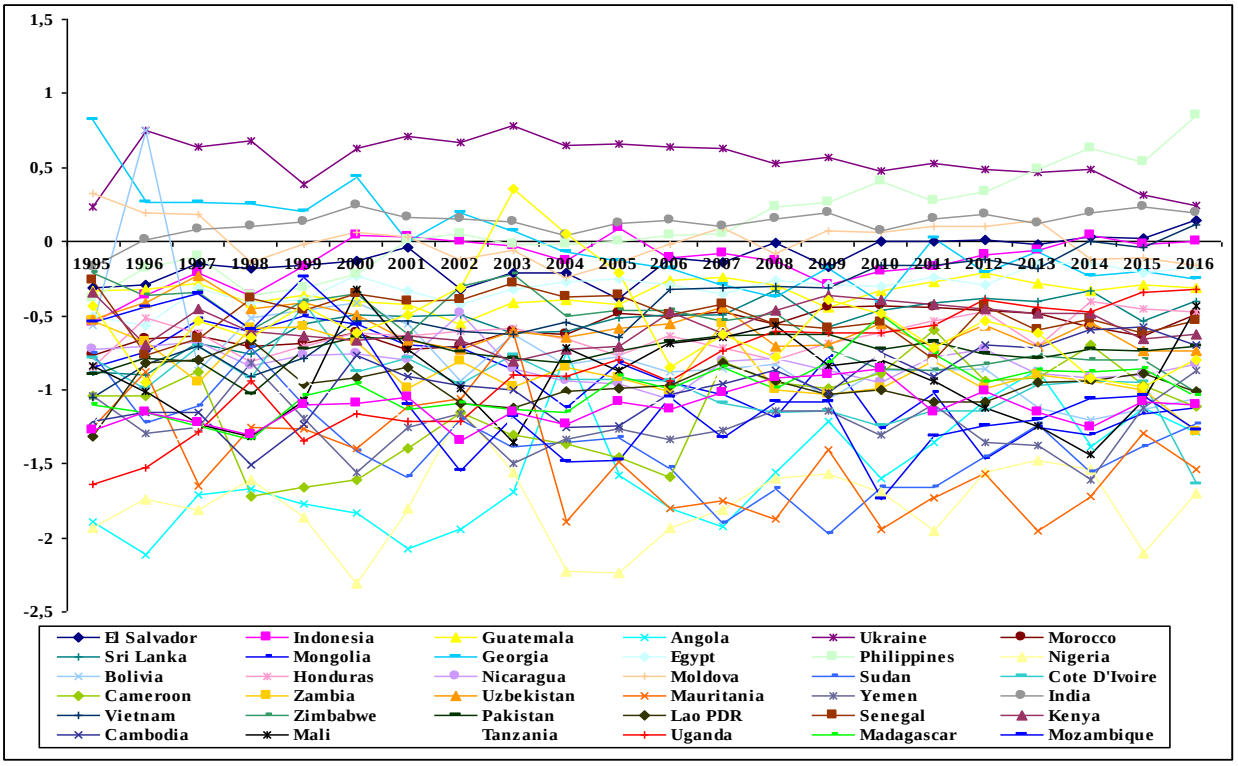

Figure 3 Dynamics of ECI for 1995-2016 in low developed economies

Source: authors' computation based on Center of International Development at HarvardUniversity data

Only three countries of the third grouop have positive values of ECI for the whole period. Almost all of members of this group registered negative values, with high fluctuations from year to year (Figure 3).

The figure 4 displays the graphical dependency between lnGDP per capita and ECI in the sample of 110 economies. We notice that countries are spread on both sides of regression line.

According to the regression results exhibited in the Table 1, the proposed cross-country model is statistically validated due to the fact the Value of Prob is 0.0000 <0.01. The intercept C and the coefficient of ECI are also validated for a significance level of 0.01, taking into consideration that the values of their Prob are 0.000.

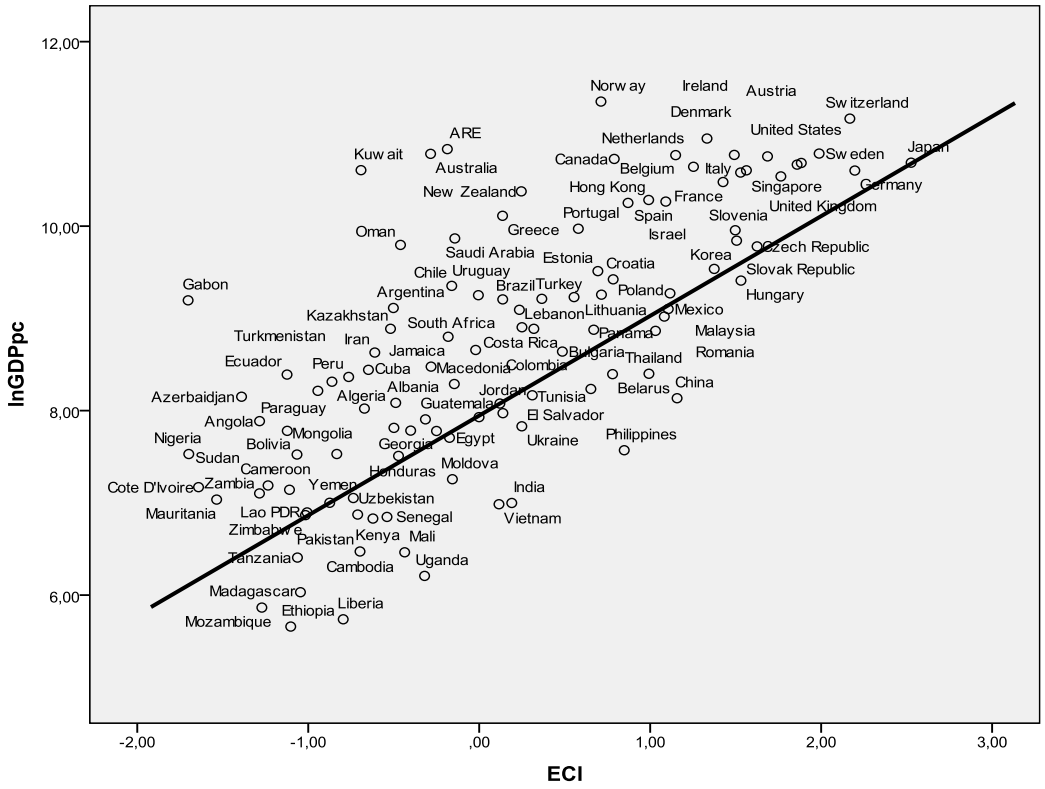

Figure 4 ECI and GDP per capita in 110 economies (average values from 1995 to 2016)
Source: authors' computation based on Center of International Development at Harvard UniversityWorld Bank data

Table 1 Regression estimation results
Dependent Variable: lnGDPpc
Method: Least Squares
Sample: 1 110
Included observations: 110

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.554409	0.095697	89.39041	0.0000
ECI	1.025506	0.093746	10.93918	0.0000

R-squared	0.525620	Mean dependent var	8.682809
Adjusted R-squared	0.521228	S.D. dependent var	1.439592
S.E. of regression	0.996102	Akaike info criterion	2.848080
Sum squared resid	107.1597	Schwarz criterion	2.897180
Log likelihood	-154.6444	Hannan-Quinn criter.	2.867996
F-statistic	119.6656	Durbin-Watson stat	1.170110
Prob(F-statistic)	0.000000		

Source: authors' computation by using Eviews 10 software

According to the Table 1, the estimated equation (1) is as follows:

$$\ln GDPpc = 8.55 + 1.02 \cdot ECI \qquad (2)$$

For an increase with one unit of ECI, the lnGDP per capita will increase with 1.02 units.

The value of R-squared is 0.52 (Table 1) indicating that the variation of lnGDP per capita is due in a proportion of 52% to the variation of ECI (when other factors remain constant).

In order to test the heteroskedasticity of errors, we used the White test (Table 2).

Table 2 Heteroskedasticity test

Heteroskedasticity Test: White			
F-statistic	3.141456	Prob. F(2,107)	0.0472
Obs*R-squared	6.100836	Prob. Chi-Square(2)	0.0473
Scaled explained SS	6.522808	Prob. Chi-Square(2)	0.0383

Source: authors' computation by using Eviews 10 software

The value of Obs*R-squared (6.100836)> $\chi^2_{0.05;2}$ =5.99, meaning that the null hypothesis is rejected and the errors are heteroskedastic, for a significance level of 5%: the variation of dependent variable is not constant for any level of independent variable.

We intend to check the autocorrelation of errors by using the Breusch-Godfrey Serial Correlation LM Test (Table 3).

Table 3 Detection of errors autocorrelation

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	37.76627	Prob. F(2,106)	0.0000
Obs*R-squared	45.76909	Prob. Chi-Square(2)	0.0000

Source: authors' computation by using Eviews 10 software

The value of Obs*R-squared (45.76909) > $\chi^2_{0.05;2}$ =5.99, meaning that the null hypothesis is rejected and the errors are autocorrelated.

We can conclude that we identified a strong validated correlation of GDP per capita with the economic complexity index (ECI). The cross-country regression model is statistically validated for a significance of 1%, but it is not stable due to the heteroskedasticity and autocorrelation of errors.

Conclusions

The aim of the paper was to explore the association economic complexity and economic growth in 110 economies in the period of 1995-2016. We found a positive strong association between economic growth, expressed by lngdp per capita and the Econiomic Complexity Index (ECI) (average values). The cross-country model is statistically validated and reflects the beneficial influence of economic complexity on gross domestic product per capita, suggesting that as complexity of economy improves the gross domestic product per capita increases.

Our findings are in line with conclusion of Hausman, Hidalgo et al. (2014),that economic complexity is related to a country's level of prosperity. They also, identified a tight relationship between economic complexity and income per capita in 128 countries in 2008.

The limits of the study consist on the fact that the analysis is made taking into consideration average values of 1996-2016 of GDP per capita and ECI in a cross-country

regression. The present study represents only a start for further detailed, panel and country analysis, of the link between economic complexity and growth, taking into consideration factors enabling or hindering the positive association between them.

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