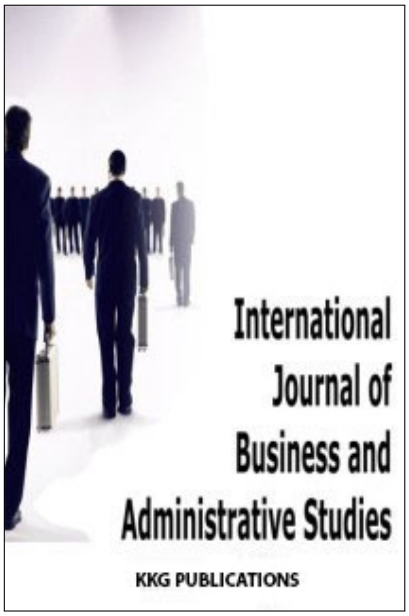


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# COMPETITIVENESS IN THE CONTEXT OF EURO 2020 STRATEGY

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**Abstract**. We relied this research on the findings of a previous study (Popa & Stefan, 2015b) which (using Factor Analysis procedure) revealed two factors/dimensions of country-level competitiveness in the initial dataset of twelve variables provided by the raw data (Competitiveness Dataset - Xls), on which was built The Global Competitiveness Report 2014 -2015 (World Economic Forum, 2014a). Furthermore, the first factor/dimension of competitiveness (Smart Growth) suggests a possible link with the objectives set by the Strategy Euro 2020 (a smart, inclusive and sustainable Europe). In this respect, the aim of this paper is (based on the data as mentioned earlier and findings) to propose a synthetic indicator of country-level competitiveness and to deepen the analysis by investigating the possible causal relationships between the proposed index and the objectives of Euro 2020 Strategy. Thus, we have proposed several nine research hypotheses, which have been tested, and most of them validated employing linear regression procedure.



## INTRODUCTION AND BACKGROUND

The economic crisis which mankind faced at the end of the last decade has left deep scars until this day. Both the European countries' economies and the European Union as a whole, are not the same as we got used to know them. In this context, more than ever, we need to focus on design and put in practice the best solutions to be able to increase the competitiveness of a nation/industry/organization.

But, first of all, we have to put ourselves before two major questions:

1. What means for a country/nation to be competitive?
2. Which are the key determinants of competitiveness at the country/nation level?

The first stage of our research (Popa & Stefan, 2015b) in this area started almost a year ago when, based on what Porter (1998, p. 57) considers to be "the most frequently asked economic question of our times: Why do some nations succeed and others fail in international competition?", we have tried to summarize some of the theoretical approaches in terms of competitiveness of a country / nation. More than that, by means of Factor Analysis procedure was revealed a pattern in the initial dataset, with two factors/dimensions of country-level competitiveness: Smart Growth and Market Development, which recovered almost 76% of common variability of the twelve original variables. The twelve original variables of Factor Analysis were provided by the raw data (Competitiveness Dataset - xls), on which was built The GCR 2014-2015 issued by World Economic Forum (2014a). The report "assesses the competitiveness landscape of 144 economies, providing insight into the drivers of their productivity and prosperity" (World Economic Forum, 2014b). Furthermore, the first factor/dimension of competitiveness (Smart Growth) corresponds to the targets set by the Euro 2020 Strategy (European Commission, 2010): a smart, inclusive and sustainable Europe. Launched in March 2010 by the European Commission, Europe 2020 Strategy (European Commission, 2010) puts forward three mutually reinforcing priorities (Europen Commission, 2016b): (1) smart growth through more effective investments in education, research and innovation, (2) sustainable growth thanks to a decisive move towards a low-carbon economy and (3) inclusive growth with a strong emphasis on job creation and poverty reduction.

The following EU headline targets have been agreed to be achieved until 2020 (European Commission, 2010, p. 5), (European Commission, 2016a): (1) Employment: 75 % of the population aged 20-64 to be employed, (2) R&D: 3% of the EU's GDP to be invested in R&D, (3) Climate change and energy sustainability: lower the greenhouse gas emissions by 20% than 1990, 20% of energy from renewable sources and increase the energy efficiency by 20%, (4) Education: to reduce the rates of early school leaving below 10% and at least 40% of 30-34year-olds to complete third level education and (5) Fighting poverty and social exclusion: 20 million less people should be at risk of poverty.

Considering all above, it raises another question:

Is there a causal relationship between the achievement of targets

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set by Euro 2020 Strategy and the competitiveness level of the European countries?

In this respect and based on the above-mentioned data and findings, the two main objectives that we intend to accomplish through this paper were formulated as follows:

O1. To propose a synthetic indicator of country-level competitiveness,

O2. To investigate the possible causal relationships between the proposed index and the objectives of Euro 2020 strategy.

Thus, we have proposed nine research hypotheses, as follows:

H1. Employment rate has a positive influence on Competitiveness Index;

H2. Gross domestic expenditure on R&D has a positive influence on Competitiveness Index;

H3. Greenhouse gas emissions has a negative influence on Competitiveness Index;

H4. Share of renewable energy in gross final energy consumption has a positive influence on Competitiveness Index;

H5. Primary energy consumption has a negative influence on Competitiveness Index;

H6. Final energy consumption has a negative influence on Competitiveness Index;

H7. Early leavers from education & training have a negative influence on Competitiveness Index;

H8. Tertiary educational attainment has a positive influence on Competitiveness Index;

H9. People at risk of poverty or social exclusion have a negative influence on Competitiveness Index.

## DATA AND METHODS

The methodology that we have adopted to achieve the two objectives mentioned above also involves two stages:

I. In the first stage, we intended, based on two factors/dimensions of competitiveness resulted from factor analysis previously carried out (Smart Growth and Market Development), to build an index of country-level competitiveness. In this respect, we followed the ten steps recommended by (OECD, 2008, p. 5) in the construction of a composite indicator: (1) theoretical framework, (2) data selection, (3) imputation of missing data, (4) multivariate analysis, (5) normalization, (6) weighting and aggregation, (7) uncertainty and sensitivity analysis, (8) back to the data, (9) links to other indicators and (10) visualization of the results.

II. Subsequently, in the second stage, we investigated the possible causal relationships between the proposed index and the objectives of Euro 2020 strategy by testing the research hypotheses. In this respect, the simple linear regression procedure was employed by means of SPSS 23.0 Statistics statistical package.

The appropriate data series required were retrieved in April 2015 from the Eurostat website (European Commission, 2015) and then imported into an SPSS database:

(1) ER - Employment rate (% of the population aged 20-64); (2) GERD - Gross domestic expenditure on R&D (of GDP); (3) GGE - Greenhouse gas emissions (index 1990 = 100). This indicator shows trends in total man-made emissions of the 'Kyoto basket' of greenhouse gasses. It presents annual total emissions in relation to 1990 emissions; (4) RE - Share of renewable energy in gross final energy consumption (%); (5) PEC - Primary energy consumption (index 2005 = 100). This quantity is relevant for measuring the true energy consumption and for comparing it to the Europe 2020 targets; (6) FEC - Final energy consumption (index 2005 = 100). This quantity is relevant for measuring the energy consumption at final place of energy use and for comparing it to the Europe 2020 targets; (7) ELECT - Early leavers from education and training - % of the population aged 18-24 with at most lower secondary education and not involved in further education or training; (8) TEA - Tertiary educational attainment (% of the population aged 30-34 who have successfully completed tertiary studies); (9) PSE - People at risk of poverty or social exclusion (% of total population).

The analysis covers all the 28 EU states, namely: Austria - AT, Belgium - BE, Bulgaria - BG, Croatia - HR, Cyprus - CY, Czech Republic - CZ, Denmark - DK, Estonia - EE, Finland - FI, France - FR, Greece - EL, Germany DE, Hungary - HU, Ireland - IE, Italy - IT, Latvia - L, Lithuania - LT, Luxemburg - LU, Malta MT, Netherlands - NL, Portugal - PT, Poland - PL, Romania - RO, Slovak Republic - SK, Spain - ES, Slovenia SL, Sweden - SE and United Kingdom - UK.

## FINDINGS

### Building the Competitiveness Index

As previously mentioned in the methodological part of the paper, first we have built (based on results of the factor analysis carried out in the previously paper) an index of country-level competitiveness which would reflect as faithfully as possible the information contained by the initial variables.

According to Sharpe and Smith (2005, p. 7), a composite index is "the aggregation of individual indicators into a single index or bottom line using a certain weighting scheme". Considering all those available methods, in construction of our index, we have chosen the one introduced by Nicoletti, Scarpetta and Boylaud (2000) to weight and aggregate the composite index of competitiveness.

This method differs from other standard methods to weight composite indices found in the literature, using Principal Component Analysis/Factor Analysis as it does not only consider the first principal component/factor to weight the index but also the

factor loadings of all consecutively extracted components/factors.

The advantage of this method is that a higher percentage of variance in the data set could be explained. (Greyling, 2013)

**TABLE 1**
**The Two Factors Resulted from Factor Analysis**

| | Factor 1 (Smart Growth) | Factor 2 (Market development) | Total |
|---|---|---|---|
| Cronbachs Alpha | .951 | .877 | |
| Eigenvalues | 4.952 | 4.077 | 9.029 |
| Percentage of variance | 41.264% | 33.973% | 75.237% |
| Total percentage of explained variance | 54.845% | 45.155% | 100.000% |

Source: Made by authors with SPSS Statistics 23.0

We build the competitiveness index based on factor scores resulted from factor analysis and "aggregated by allocating a weight to each one of them equal to the proportion of the explained variance in the data set." (Greyling, 2013, p. 25). For example, the weighting of the first factor was 0.54845 (54.845%) and the second one 0.45155 (45,155%) calculated as follows:

$$W_1 = \frac{4.952}{4.952 + 4.077} = 0.54845 \quad (1)$$

$$W_2 = \frac{4.077}{4.952 + 4.077} = 0.45155 \quad (2)$$

The high correlation coefficient (.800) computed between the values of the new competitiveness index and GDP per capita (a traditionally single-dimensional measure of competitiveness of a nation) proves its robustness and that is fit to be used in subsequent analysis (see Table 2).

**TABLE 2**
**Correlation Matrix**

| | | CI | GDP per capita |
|---|---|---|---|
| CI | Pearson Correlation | 1 | .800** |
| | Sig. (2-tailed) | | .000 |
| | N | 35 | 34 |

**. Correlation is significant at the 0.01 level (2-tailed).
Source: Made by authors with SPSS Statistics 23.0

**Testing the Research Hypotheses**

In order to test the research hypotheses, a simple linear regression procedure was employed. "Linear regression is used to model the value of a dependent variable based on its linear relationship to one or more independent variables (predictors) as it is described in the following formula" (Popa & Stefan, 2015a, p. 109):

$$y_i = b_0 + b_1 x_1 i + b_2 x_2 i + ... + b_k x_k i + e_i \quad (3)$$

In this particular case, the dependent variable is CI Competitiveness Index, and the independent/predictor variables are the nine datasets corresponding to the Europe 2020 Strategy objectives mentioned above: (1) ER Employment, (2) GERD - Gross domestic expenditure on R&D, (3) GGE - Greenhouse gas emissions, (4) RE - Share of renewable energy in gross final energy consumption, (5) PEC - Primary energy consumption, (6) FEC) - Final energy consumption, (7) ELECT - Early leavers from education and training, (8) TEA - Tertiary educational attainment and (9) PSE - People at risk of poverty or social exclusion.

$$CI_i = f(ER) + e_i \quad (4)$$

$$CI_i = f(GERD) + e_i \quad (5)$$

$$CI_i = f(GGE) + e_i \quad (6)$$

$$CI_i = f(RE) + e_i \quad (7)$$

$$CI_i = f(PEC) + e_i \quad (8)$$

$$CI_i = f(FEC) + e_i \quad (9)$$

$$CI_i = f(ELECT) + e_i \quad (10)$$

$$CI_i = f(TEA) + e_i \quad (11)$$

$$CI_i = f(PSE) + e_i \quad (12)$$

First, the nine independent variables were introduced consecutively into the model to avoid possible problems generated by multicollinearity.

**TABLE 3**
**Simple Linear Regressions - The Impact of ER, GERD, TEA and PSE on CI**

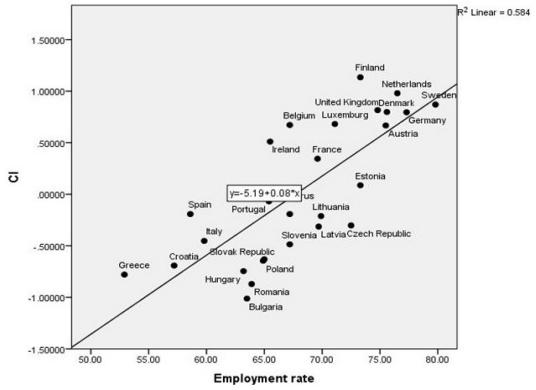
| Model | Coefficients | | | | | | | | | | R2 | F | Sig. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Constant | ER | GERD | GGE | RE | PEC | FEC | ELET | TEA | PSE | | | |
| 1 | -5.193** | .077** | | | | | | | | | .584 | 36.469 | .000 |
| 2 | -.850** | | .546** | | | | | | | | .552 | 32.008 | .000 |
| 3 | -.323 | | | .004 | | | | | | | .031 | .834 | .370 |
| 4 | -.095 | | | | .007 | | | | | | .015 | .384 | .541 |
| 5 | -2.012 | | | | | .022 | | | | | .097 | 2.792 | .107 |
| 6 | -1.456 | | | | | | .016 | | | | .054 | 1.494 | .232 |
| 7 | .209 | | | | | | | .018 | | | .018 | .469 | .500 |
| 8 | 1.397** | | | | | | | | .038** | | .298 | 11.063 | .003 |
| 9 | 1.481** | | | | | | | | | -.057** | .494 | 25.389 | .000 |

* significant at the .05 level, ** significant at the .01 level
Source: Made by authors with SPSS Statistics 23.0

As one can see in Table 3, second row, in case of the first equation, the statistically significant F test (F = 36.469, p <.01) shows that at least one of the independent variables is related to the dependent variable (CI), therefore the model is valid. The independent variable coefficient has a positive value of .077, statistically significant at .01 level (t = 6.039, p <.01), so the independent variable ER is significantly related to the dependent variable CI. Moreover, the coefficient of determination has a medium value ($R^2$ = .584), which means that approximately 58.4% of the variance of CI could be explained by the variance of ER. Therefore, we can validate H1 hypothesis, meaning that Employment rate has a positive influence on Competitiveness Index. Thus, the regression equation for predicting CI can be written as follows:

$$CI = -5.193 + 0.077 * ER \tag{13}$$

**FIGURE 1**
**Simple Linear Regressions - The Impact of ER on CI**

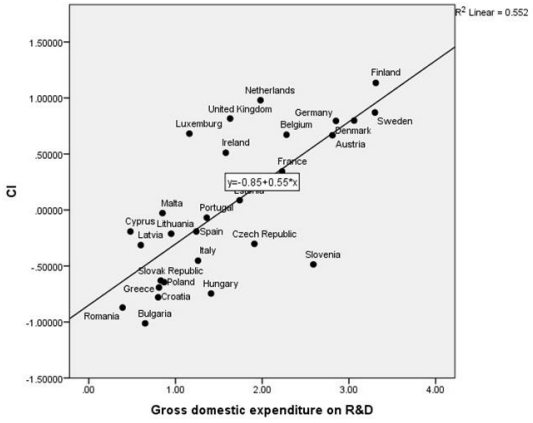



Source: Made by authors with SPSS Statistics 23.0

In respect to the second equation, as one can see in Table 3, third row, the statistically significant F test (F = 32.008, $p$ <.01) shows that at least one of the independent variables is related to the dependent variable (CI), therefore the model is valid. The independent variable coefficient has a positive value of .546, statistically significant at .01 level (t = 5.658, $p$ <.01), so the independent variable GERD is significantly related to the dependent variable CI. Moreover, the coefficient of determination has a medium value ($R^2$ = .552), which means that approximately 55.2% of the variance of CI could be explained by the variance of GERD. Therefore, we can validate $H_2$ hypothesis, meaning that Gross domestic expenditure on R&D has a positive influence on Competitiveness and the regression equation for predicting CI can be written as follows:

$$ECI = -0.850 + 0.546 * GERD \tag{14}$$

**FIGURE 2**
**Simple Linear Regressions - The Impact of GERD on CI**

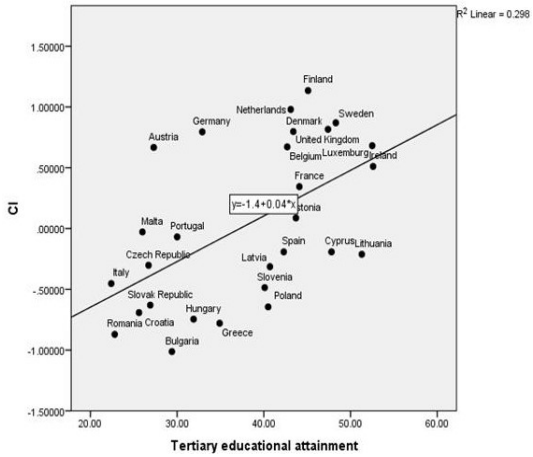



Source: Made by authors with SPSS Statistics 23.0

Considering the eighth equation (see Table 3, ninth row) the statistically significant F test (F = 11.063, $p < .01$) shows that at least one of the independent variables is related to the dependent variable (CI), therefore the model is valid. The independent variable coefficient has a positive value of .038, statistically significant at .01 level (t = 3.336, $p < .01$), so the independent variable TEA is significantly related to the dependent variable CI. Moreover, the coefficient of determination has a medium value ($R^2$ = .398), meaning that approximately 39.8% of the variance of CI could be explained by the variance of TEA. Therefore, we can validate H8 hypothesis, meaning that Tertiary educational attainment has a positive influence on Competitiveness Index. Thus, the regression equation for predicting CI can be written as follows:

$$ECI = 1.397 + 0.038 * TEA \quad (15)$$

**FIGURE 3**
**Simple Linear Regressions - The Impact of TEA on CI**

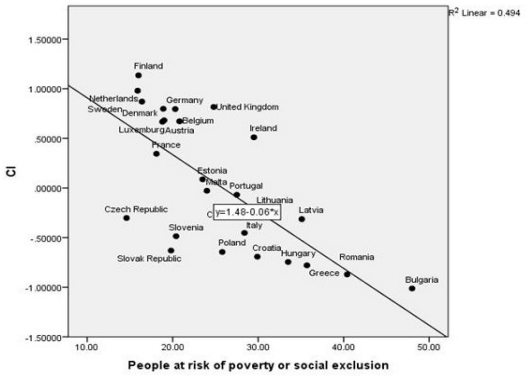



Source: Made by authors with SPSS Statistics 23.0

In case of the ninth equation (see Table 3, tenth row) the statistically significant F test (F = 25.389, p $<.01$) means that at least one of the independent variables is related to the dependent variable (CI), therefore the model is valid. This time, the independent variable coefficient has a negative value of -.057, statistically significant at .01 level (t = -5.039, p $<.01$), so the independent variable PSE is significantly related to the dependent variable CI. Moreover, the coefficient of determination has a medium value ($R^2$ = .494), meaning that approximately 49.4% of the variance of CI could be explained by the variance of PSE. Therefore, we can validate H9 hypothesis. In other words, People at risk of poverty or social exclusion has a negative influence on Competitiveness Index and the regression equation for predicting CI can be written as follows:

$$ECI = 1.481 - 0.057 * PSE \quad (16)$$

**FIGURE 4**
**Simple Linear Regressions - The Impact of PSE on CI**




Source: Made by authors with SPSS Statistics 23.0

The situation is quite different if we consider the other regression equation (3, 4, 5, 6 and 7). As one can see in Table 3, rows three to eight, the F tests are not statistically significant (p >.05) which means that none of the independent variables are related to the dependent variable (CI), therefore the model couldn't be valid. Therefore, we cannot validate $H_3$, $H_4$, $H_5$, $H_6$ and $H_7$ hypotheses.

Next, we wanted to determine that combination of independent variables of the nine considered (corresponding to the objectives of Euro 2020 Strategy) which would better predict the dependent variable CI.

$$CI_i = f(ER, GERD, GGE, RE, PEC, FEC, ELECT, TEA, PSE + e_i \quad (17)$$

Thus, stepwise multiple regression was employed, which implies that at each step, each of the variables to be included/excluded from the model is based on its ability to explain the variation in the independent variable. The criterion to include a variable in the model is probability of F to be $\leq$ .050 and the criterion to remove a variable in the model is probability of F to be $\geq$ .100.

**TABLE 4**
**Simple Linear Regressions - The Impact of ER, GERD, GGE and TEA on CI**

| Model | Coefficients | | | | | R2 | Adj. R2 | F | Sig. F | Change Statistics | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Constant | ER | GERD | GGE | TEA | | | | | R2 | F | Sig. F |
| 1 | -5.193** | .077** | | | | .584 | .568 | 36.469 | .000 | .584 | 36.469 | .000 |
| 2 | -6.372** | .084** | | .008** | | .700 | .676 | 29.142 | .000 | .116 | 9.664 | .005 |
| 3 | -5.042** | .060** | .245* | .007** | | .757 | .727 | 24.950 | .000 | .057 | 5.672 | .026 |
| 4 | -4.812** | .048** | .258* | .006* | .017* | .808 | .775 | 24.197 | .000 | .051 | 6.084 | .022 |

* significant at the .05 level, ** significant at the .01 level
Source: Made by authors with SPSS Statistics 23.0

After following four consecutive steps, finally, the stepwise algorithm has chosen ER (t = 3.443, p <.01), GERD (t = 2.645, p <.05), GGE (t = 2.760, p <.05) and TEA (t = 2.466, p <.05) as predictors of CI. A statistically significant F value (F = 24.197, p <.01) stands for the validity of the model.

The pretty high value of coefficient of determination ($R^2$ = .808) proves that 80.8% of the variation of dependent variable (CI Competitiveness Index) is determined by the variation of causal variables, namely: ER Employment, GERD - Gross domestic expenditure on R&D, GGE - Greenhouse gas emissions and TEA - Tertiary educational attainment. The remaining 19.2% of variation of the dependent variable is due to the variation of the residual variables.

$$CI = -4.812 + .048 * ER + .258 * GERD + .006 * GGE + .017 * TEA \quad (18)$$

## CONCLUSION

Based on data and findings of a previous paper, we have built a new synthetic index of country-level competitiveness and have investigated the possible causal relationships between the proposed index and the objectives of Euro 2020 Strategy.

The main findings of this research are that there is a causal relationship between the achievement of four of the five targets set by euro 2020 Strategy and the level of competitiveness of European Union countries, as our research validated the corresponding hypotheses.

Thus, ER - Employment rate, GERD - Gross domestic expenditure on R&D and TEA - Tertiary educational attainment have a positive influence and PSE - People at risk of poverty or social exclusion has a negative influence on CI - Competitiveness Index. The variables related to the targets concerning the climate change and energy sustainability seem to have no direct influence on the current level of competitiveness, but rather on level of a sustainable competitiveness. Investigating this issue may represent a future research direction.

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