

Comparison of National Competitiveness: Non-parametrical Approach

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Abstract. The presented paper deals with a non-parametric approach to some indicators of national competitiveness among the Member States of the Organisation for Economic Co-operation and Development. A set of indicators such as GDP per capita, Global Competitiveness Index, International Institute for Management Development ranking, and Ease of Doing Business by World Bank Group are often used to evaluate competitiveness at the national level. The aim of the paper is to estimate possible associations between these variables. The Kendall τ coefficient of concordance was applied. The first part of the paper contains definition of the national competitiveness and approaches to its measurement. The second part presents empirical results including of the non-parametrical approach methodology. Empirical results showed that there were large differences among the selected countries. Value of the Kendall τ coefficient of concordance implies associations between these variables (except DB) and concordance seems to be significant.

Keywords: Competitiveness, GDP per Capita, Kendall τ Coefficient of Concordance, OECD.

1. Introduction

Competitiveness is a concept that has become one of the most used and vogue word in today's globalized world. It is very often discussed topic and lots of policy makers express serious interests about competitiveness at macroeconomic level, but such interest is not new, new is its intensity and spread (Lall, 2001). Competitiveness is not only a mystic word (for many still does), there are lots of experts and institutions which focus on national competitiveness (i.e. competitiveness at macroeconomic level) and attempt to specify determinants and processes that affect national competitiveness.

Besides concept of competitiveness, it's analyzing, measuring and calculating there is another extensive framework called national accounts. National accounts offer lot of valuable information about elements within the economy, relationship among them, analyzes the economic movement, provide summary information about outcomes of national economy by means of e.g. gross domestic product, national income etc.

In this paper, we have applied a non-parametric approach to some indicators of national competitiveness; or in other words, we try to measure the strength of the associations between selected variables. We have chosen the Kendall τ coefficient of concordance which is one of a number of measures of correlation or association. We have chosen basic macroeconomic indicators like GDP per capita in PPS, Global Competitiveness Index; Institute for Management Development ranking, and Ease of Doing Business by World Bank Group.

The paper is structured as follows. The first part of the paper deals with a concept of the national competitiveness and approaches to its measurement. The second part of the paper deals with non-parametric testing methodology and it is focused on empirical result. The last part concludes.

2. Theoretical Background

2.1. Concept of National Competitiveness

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There are lots of concepts and definitions of competitiveness at macroeconomic level and therefore there is not only one approach to national competitiveness. According to Aiginger (1998) defining the competitiveness of nations is a controversial issue. If we apply microeconomic approach (at firm level and market), we can define competitiveness by means of export performance, i.e. capability of a country to sell more abroad than it purchases from abroad. Trade balance or current account balance should we suppose as a measurement of national competitiveness. CESES (2004) comprehensive concept expresses the possibility of national economy to stand the test of international products.

Ulengin (2002) confirms trade balance and market share are insufficient indicators of overall competitiveness. Previous approach does not take into account for instance products quality, products safety, labour conditions, standard of living or environment.

Another approach by Scott & Lodge (1985) national competitiveness means country's ability to create, produce, distribute, and service products in international trade while earning rising returns on its resources. The only meaningful concept of competitiveness at national level is national productivity, argues Porter (1998). However, we cannot see competitiveness as a synonym for productivity (Oral et al, 1999). It implies that productivity is one of the key factors to improve national competitiveness (Önsel et al, 2008). Interesting attitude has Krugman (1994), who likened national competitiveness to a dangerous obsession. Boltho (1996) explains competitiveness as the longer-run aim of rising standard of living. Fagerberg (1996) extends this approach and consider competitiveness as an ability of an economy to secure a higher standard of living than comparable economies for the present and the future. European Union defines competitiveness like an ability to provide its citizens high and still rising standard of living and employment to all who wants to work (Klvačová & Malý, 2008). As we can see modern approaches to national competitiveness stress the standard of living and human well-being.

2.2. Measurement of National Competitiveness

The well-known international organizations dealing with national competitiveness are The World Economic Forum (WEF) and The International Institute for Management Development (IMD). Both institutions publish every year comprehensive report on the national competitiveness, analyze and evaluate national competitiveness and compute own competitiveness indices. IMD has published World competitiveness yearbook since 1989, measures almost 59 countries on the basis more than 300 criteria. IMD ranks and analyzes the capability of economies to create and maintain an environment in which enterprises can compete (IMD, 2011). WEF has published Global competitiveness report since 1979. WEF (Schwab, 2011) defines national competitiveness as the set of institutions, policies, and factors that determine the level of productivity of a country. Index ranks more than 120 countries and consists of twelve pillars which include over than 300 criteria. The Doing Business Report (DB) is a study elaborated by the World Bank Group since 2004 every year that is aimed to measure the costs to firms of business regulations in 183 countries in 2010. The study has become one of the flagship knowledge products of the World Bank Group in the field of private sector development, and is claimed to have motivated the design of several regulatory reforms in developing countries. The study presents every year a detailed analysis of costs, requirements and procedures a specific type of private firm is subject in all countries, and then, creates rankings for every country. The study is also backed up by broad communication efforts, and by creating rankings, the study spotlights countries and leaders that are promoting reforms. The DB contains quantitative measures of regulations for starting a business, dealing with construction permits, employing workers, registering property, getting credit, protecting investors, taxes, trading across borders, enforcing contracts, getting an electricity connection and closing a business.

3. Non-Parametrical Approach

The Kendall τ coefficient of concordance is a non-parametric (distribution-free) rank statistic proposed by Kendall and Smith (1939) as a measure of the strength of the associations between three or more variables. The Kendall τ coefficient of concordance is the natural extension of Spearman ρ and Kendall τ coefficients for two variables to measure association between three or more variables.

Suppose we have random samples of n multivariable observations measured on at least an ordinal scale and drawn from any continuous multivariate distribution with $k \geq 3$ variables.

The Spearman rank correlation coefficient can be used to give an R -estimate, and is a measure of monotone association that is used when the distribution of the data make Pearson's correlation coefficient undesirable or misleading. As with any other hypothesis test, for Spearman's test you take a sample, work out the test statistic from the sample and compare it to the critical value appropriate for the sample size, the required significance level and whether the test is 1- or 2-tail.

Row sums of ranks, R_i , is defined as:

$$R_i = \sum_{j=1}^m r_{i,j} \quad (1)$$

where r_{ij} is the rank of i -country by rank number j .

The mean value of total ranks, R , is defined as:

$$R = \frac{1}{2} m(n+1) \quad (2)$$

where n is the number of countries and m is the number of variables.

The sum of squared deviations, S , is defined as:

$$S = \sum_{i=1}^n (R_i - R)^2 \quad (3)$$

The Kendall \hat{s} coefficient of concordance (W) can be obtained the following formula (Legedre, 2005):

$$W = \frac{12S}{m^2(n^3 - 1)} \quad (4)$$

We can also compute the Kendall \hat{s} coefficient of concordance according an alternative approach which is defined by Hudec et al. (2007):

$$W = \frac{12}{r^2(n^3 - n)} \sum_{i=1}^2 A_i^2 - 3 \frac{n+1}{n-1} \quad (5)$$

Where r is the number of variables, n is the number of countries, A_i is the sum of ranks for the each country. W may vary from 0 to 1 and we shall call it the coefficient of concordance. W value +1 means perfect positive correlation, W value close to zero means no correlation. Moreover, the smaller the correlation coefficients the more likely the data points will be scattered on the graph. Without considering scatter plots, t-test significance analysis, and slope analyses it is easy to misinterpret correlation coefficients.

Because the ranks used in Spearman test are not drawn from a bivariate Normal population, the tables of critical values are worked out differently from those for the Pearson \hat{s} product moment correlation coefficient and, hence, have different values.

The null hypothesis should be written in terms of there being no association between the variables. This conveys the purpose of the test: investigating possible association in the underlying population.

Milton Friedman \hat{s} statistics is obtained from W using the formula:

$$\chi^2 = m(n-1)W \quad (6)$$

Where, W is Kendall's coefficient of concordance, n is sample size and m is the number of variables. It is recommended to use a table of critical values when $n \leq 7$ and $m \leq 20$; otherwise we should test χ^2 statistic using the chi-square distribution.

Then the null and alternative hypotheses are:

H_0 : variables produced independent rankings of the countries

H_A : variables produced dependent rankings of the countries (at least one of the variables is concordant with one, or with some of the other variables).

If the computed χ^2 statistic value does not exceed the critical χ^2 value, we may accept null hypothesis; otherwise we may reject it. In our case it means that four variables are not concordant with one other.

3.1. Empirical Results

In our case, we computed Kendall's coefficient of concordance for four variables for the years 2008, 2009 and 2010: (i) GDP per capita in US dollars at constant prices (based 2005); (ii) Global Competitiveness Index; (iii) International Institute for Management Development ranking; (iv) Ease of Doing Business by World Bank Group.

We had four variables and 30 selected OECD countries. First, we had to rank the values for our four variables separately. In the case of GDP the highest value was labelled "1" and the lowest value was labelled "30". In the case of the rest variables we used rankings of institutions which created these methods of national competitiveness's evaluation.

For statistical significance of Kendall's W relation was used. We tested the null hypothesis H_0 : "Computed Kendall's W does not evidence agreement among rankings ($W=0$)", against alternative hypothesis H_A : "Computed Kendall's W evidence agreement among rankings ($W \neq 0$)."

Data showed that DB ranking differed from other rankings significantly. This would lead to remarkably affect the value of Kendall's W. It let us to the idea that it would be appropriate to calculate Kendall's W also without DB ranking.

As seen from the Table 1 value of Kendall's W was equal to 0.290 for the year 2008 and this value shows us that there may be associations between chosen variables. The values of the Kendall's W did not differentiate for the years 2009 and 2010. However, these associations seem to be not strong. We also tested the null hypothesis using χ^2 statistic. Computed χ^2 statistic value did not exceeded the critical χ^2 value, so we may accept null hypothesis. In our case it means that these four variables are not concordant with one other.

Tab. 1: Empirical results including DB ranking.

	2008	2009	2010
Kendall's W	0.290517241	0.302586207	0.325361513
H_0 accepted	Yes	Yes	Yes
H_A accepted	No	No	No

Source: own calculations

Table 2 shows results of our calculation of the Kendall's W for all variables except DB ranking. The value of Kendall's W was equal to 0.837 for the year 2008. We can state that associations between these three variables seems to be strong. Computed χ^2 statistic value exceeded the critical χ^2 value, so we may reject null hypothesis and we may accept the alternative hypothesis. These results suggested conclusion that strong agreement could be demonstrated.

Tab. 2: Empirical results including DB ranking.

	2008	2009	2010
Kendall's W	0.836806328	0.84936349	0.863255469
H_0 accepted	No	No	No
H_A accepted	Yes	Yes	Yes

Source: own calculations

4. Conclusions

This paper discussed a specific non-parametric testing of selected rankings of the national competitiveness. The aim of the paper was try to find if any association between these approaches exist. We have compared these variables in the years 2008, 2009 and 2010. Empirical results showed that there were large differences among the selected countries. Value of the Kendall τ coefficient of concordance implies associations among GDP per capita, Global competitiveness index and International Institute for Management ranking (except DB) and concordance seems to be significant.

5. Acknowledgements

This paper was created in the students' grant project "Seeking Factors and Barriers of the Competitiveness by Using of Selected Quantitative Methods". Project registration number is SGS/1/2012.

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