International Competitiveness and Sustainable Development: are they apart, are they together? A quantitative approach.

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Abstract

This paper deals with the problem of measurement in the field of two well-known concepts – international competitiveness and sustainable development. The authors developed a methodology for composite index construction of Sustainable Competitiveness and created the world picture, showing potential for long-term development of different countries.

Correlation analysis conducted for 105 countries has revealed a link between the indicators of sustainable development and national competitiveness and the level of country's development. Newly constructed index encompassed global competitiveness index adjusted for the value of environmental performance index. An industry value added criteria was used for countries' aggregation. In addition to the new rankings of countries, the index is of particular interest when considering countries in terms of per capita income: the data revealed a polynomial dependence of the authors' sustainable competitiveness index on GDP per capita, which allowed pointing out the most promising countries in the world.

Key Words: *International Competitiveness, Sustainable Development, Sustainable Competitiveness, Global Competitiveness Index, Environmental Performance Index, Global Rankings, Sustainability Measurement.*

Technology and globalization have accelerated the trend towards a world, which is not only open, but also transparent and immediate. Enterprises now benefit from an enormous choice in selecting their business locations. Consequently, nations need to promote their respective comparative advantages in various areas.
(IMD World Competitiveness Yearbook 2013)

Executive Summary.

The contemporary world is changing very fast and the rate of this change is speeding up. How will it look in 25-50 years? Who will be at the top? This paper represents an attempt to assess the current situation in the world by using two well-known concepts – the theory of international competitiveness and the model of sustainable development. The authors argue that on the country level a long-term effective development is not possible without both preserving natural resources at home and successfully competing on the international arena. The purpose of this research is to create and test a quantitative approach for measuring countries' sustainable competitiveness and as a result to set up the world map which will give an inclination of every country's potential in terms of long-term development.

The hypothesis tested in this paper is:

There is a connection between the overall level of country's development and its sustainable competitiveness.

The overall level of development of a country is measured by GDP per capita based on purchasing-power-parity. To evaluate sustainable competitiveness the authors construct a composite index, based on two indices – the index of international competitiveness (GCI –Global Competitiveness Index) and one of the possible sustainable development indices (EPI – Environmental Performance Index).

To prove the hypothesis the authors are consequently testing the relations between GDP, EPI and GCI. The article suggests a new approach to the construction of the aggregate Index of Sustainable Competitiveness (SCI). Based on SCI, all countries, covered by the research, are ranked and the world map is constructed.

Introduction

Since the 90s international organizations and agencies, such as World Bank, IMF, UN etc., have been publishing various surveys and reports concerning the indicators of sustainable development and national competitiveness for different countries. The World Economic Forum (WEF) produces one of the best known competitiveness indices – the Global Competitiveness Index (GCI). The Forum defines national competitiveness as the 'set of institutions, policies and factors that determine the level of productivity of a country'. The scientists underline different levels of the approach to this problem – micro-level, presented mostly by the methodology of firms 'competitiveness analysis, and macro-level, usually used for the international comparisons.

In 2011 the EU Directorate-General for Regional Policy suggested a new approach – that one of the regional competitiveness – and has developed a regional competitiveness index (L. Dijkstra, P. Annoni, K. Kozovska, 2011). Under the regional framework a region is considered to be neither a simple aggregation of firms nor a scaled version of nations. The competitiveness of a territory is defined as the ability of a locality or region to generate high and rising incomes and improve the livelihoods of the people living there.

But all concepts and approaches mentioned above, tried to compare the countries/territories only in one dimension – the competitiveness or the sustainable development. The attempts to encompass both concepts are relatively recent. The latest Global Competitiveness Report (2012) and a research by South Korean Agency SolAbility (2012) have presented new sustainable competitiveness indices. Yet as all authors admit there is still a long way to go to finding the combination of factors & methods that will give the true picture of sustainable competitiveness.

Theoretical Background: two core concepts and the problem of measurement.

The term "international competitiveness" is associated first of all with the name of Michael Porter (1990) and his famous book "The Competitive Advantage of Nations", also known as Porter's diamond theory. Later Porter and Esty suggested merging the concepts of sustainable development and competitiveness (Esty & Porter, 1998). This paper represents an attempt of such iteration.

The measurement of international competitiveness is one of two cornerstones of this research. At present there are two most notable world indicators and countries' rankings – the first provided by the World Economic Forum, in its Global Competitiveness Report, and the second presented by the Institute for Management Development, in its World Competitiveness Yearbook (2013). The regional dimension of the international competitiveness, recently developed by EU, repeats the general logics of the composite index construction.

As for the common logics of composite index construction in social sciences – it was developed by Lazarsfeld in 1958 (Lazarsfeld 1958). Currently this methodology is widely used by scientists and researchers all over the world. According to Lazarsfeld, there are several successive phases of the composite indicators' construction:

1. Concept — conceptual analysis;
2. Dimensions — identification and selection of variables;
3. Indicators — measure;
4. Weighting
5. Aggregation
6. Index

It is obvious that researchers could have different opinions concerning each of the above-mentioned stages, which, as a result, will affect the index construction and the comparisons, based on it. Each approach originates from some assumptions, presupposes biases and contains its own strengths and weaknesses.

For example, the World Economic Forum calculates the index of global competitiveness (GCI) based on 9 variables, such as: institutions, infrastructure, macroeconomics, health and primary education, higher education and training, market efficiency, labor markets, financial markets, technological readiness, business sophistication, innovation. EU Regional Competitiveness Index (RCI) modifies the approach of the Global Competitiveness Index of the World Economic Forum. It consists of eleven pillars grouped in three groups: basic, efficiency and innovation. It takes into account the level of development of the region by emphasizing basic issues in less developed regions, and innovative capacity in more developed regions (L.Dijkstra and others, 2011)

The construction of the indices, the measurement procedure and the countries' coverage are highly debated by academicians and politicians, especially concerning the global forecasts. Thus, J. Walter (2005) identifies three main reasons for criticism of GCI index: weak theoretical economic base; unreliable statistical methods and predictions based on the criteria that the authors themselves are constantly changing. Constant change in the composition of the index from year to year, the growing number of countries, various methods of calculations – they all make it impossible to construct reliable time-series and to evaluate the dynamics of changes for both: one selected country, and for the world as a whole. The recent attempt to evaluate the comparative shifts in the international competitiveness for the period of 1997-2013 and to construct a kind of competitiveness roadmap for the world was made by IMD (IMD World Competitiveness Yearbook 2013).

The lack of social and environmental data when calculating a country's competitiveness, which is also recognized by the experts of the World Economic Forum, leads to the idea of creating an indicator of a new kind – Sustainable Competitiveness Index (SCI), – which will include the above mentioned factors.

The measurement of sustainability is still a disputable point for scientists all over the world. Currently there exists a wide range of indicators, which reflect different aspects of sustainable development, such as the UNDP Human Development Index, the ISEW (Index of Sustainable Economic Welfare) created by Daly and Cobb (1990), the GPI (Genuine Progress Indicator, (see Talberth et al, 2006), the MDP (Measure of Domestic Progress, Jackson, 2004), the Index of Economic Well-being created by Sharpe and Osberg (2002), the HWI (Human Wellbeing Index Prescott-Allen, 2001), Happy Planet Index (2006), The Ecological Footprint Index, "Emergy Sustainability Index" (ESI) by M.Brown and S.Ulgiati, etc. To have a reliable critical overview of the main sustainability indicators and their creation process one could address the article by P.-M. Boulanger (2008) "Sustainable development indicators: a scientific challenge, a democratic issue".

At present the concept of sustainable development implies a balanced combination of economic, social and environmental development (Munier N., 2005, Inclusive Wealth Report, 2012).

As global competitiveness index (GCI) has already been chosen as an economic component for the construction of the final index, further only social and ecological dimensions in sustainability indicators will be commented on.

The theoretical content of the social dimension of sustainable development is relatively little described in the literature. Thus, many authors (Eames, 2002, Colantonio, 2006, McKenzie, 2004, Murphy, 2012) emphasize the lack of integration of social issues in the context of sustainable development, as well as indicate the need to further develop the theoretical framework on the issue. The authors of this paper had to accept this limitation: at this stage of the research not to include any social component into their sustainable competitiveness index.

As for the ecological component – Environmental Performance Index (EPI) was selected, which creation, features, advantages and limitation are described below.

In 2006 in conjunction with Columbia University, Yale University developed Environmental Performance Index (EPI), which includes 22 indicators. The index assesses the environmental changes and allows outlining the strengths and weaknesses of different countries within two aspects: the reduction of adverse environmental impacts on human health and the development of proper use of natural resources to maintain the stability of ecosystems. Main disadvantages of this index are mostly connected with the lack of variables, which could measure recycling, climate change, drinking water quality, desertification, etc., i.e. those factors that yet have to be measured accurately in most of the countries.

The authors of this research rely on this approach when measuring the sustainability of development. Statistics are taken from the site of Yale Center for Environmental Law and Policy Yale University, New Haven and Yale University Center for International Earth Science Information Network Columbia University.

When constructing a composite index the authors of this paper follow the general methodological approach, developed by Lazarsfeld. The hard data from WEF is used, but the components of the final index and the process of aggregation are different. The paper represents the attempt of the international comparative statics analysis, mostly based on data for 2010.

Methodology of the construction of Index of Sustainable Competitiveness.

Briefly the suggested approach consists of two components:

- Analytical component:
  a) The analysis of the expert opinion survey, the identification of the average weights of the components for the final index for all the selected countries;
  b) Choice of a sampling criterion that will define the shift in expert opinion derived weights.
- Mathematical component:
  a) Bringing the components of the final index to the same dimension;
  b) Calculation of the required shift in each group of countries, the adjustment of weights, obtaining the final value of the index.

As far as weighting and aggregation of the data need to be explained more deeply, let's look at the procedure step by step.

1) Selecting the components for the final index of sustainable competitiveness (SCI):
   In theory, SCI should be a combination of indicators, such as: global competitiveness, environmental and social sustainability. In this paper, due to the above-mentioned lack of countries' data and indicators of social sustainability, SCI is constructed with the environmental component only.
   In order to select environmental component for the final index an analysis was performed to assert compositions of available indices for adequacy of coverage of environmental indicators, the country sample and match components with components of the global competitiveness index. As a result, the choice was made in favor of the environmental performance index (EPI), developed by the University of Yale.

2) The country sample:
   Country selection is primarily determined by the availability of data, i.e. the presence of both index values (global competitiveness and environmental performance index) for each country (113 countries).
   As an additional criteria population size was selected: countries with a population of less than one million people (Luxembourg, Brunei and Iceland) were not included in the final sample.

3) Bringing the components to one dimension:
   When constructing an additive index of sustainable competitiveness there is not only a question of the components' weights, but also of their dimensions. Environmental efficiency is measured on a scale of 1 to 100 and global competitiveness on a scale of 1 to 7. For convenience, we present the latest on a scale of 1 to 100.

4) The method of peer review:
   A questionnaire has been compiled in order to obtain expert opinion weights for the components of the future sustainable competitiveness index. Data processing and sequential analysis are performed to determine the average weights of the final index components for the entire array of countries: 70% for global competitiveness index and 30% for environmental performance index.

5) Choice of criteria for countries' aggregation:
   The heterogeneity of the countries in the general sample indicates that it would be wrong to give the same weights to the final index components, regardless of the specific country.
   As it is noted in IMD World Competitiveness Yearbook: *"Nations* thrive on *prosperity*, a concept that we define as "economic growth" plus "something else" that is less economic and measurable. The latter goal evolves with the economic and social development of a country: a poorer nation may emphasize access to food and shelter for its population, a more advanced economy may give priority to environmental protection or education. In both cases however, economic growth remains a prerequisite, a condition that is necessary but not sufficient."(IMD World Competitiveness Yearbook, 2013, appendix 3)

Thus, countries' grouping, which could adjust the weights obtained by peer review, is necessary. Ideally, the criteria should be an indicator that affects both components, but in a different direction. The authors of this research assume that it could be Industry Value Added (IVA): when industry value added is big, the country's competitiveness will be high, however, the damage to the environment will be more too, and hence the index of environmental performance will be lower. Conversely, a low IVA indicator means the competitiveness of the country will be lower, but the environment will suffer less, therefore environmental performance will be higher. The value added indicator could also be used as a kind of barometer of country's overall productivity and a mean of the split and aggregation of the countries. The authors proved this assumption by EPI/GCI ratio, which is increasing, when we move from the most developed economies (in terms of industry value added) to the least developed ones (table 1 of the appendices).

Table 1. EPI/GCI ratio.

	group 1	group 2	group 3	group 4
EPI average	57.38653846	53.9453125	54.4575	51.1973913
GCI average	68.08441002	62.40236803	56.58607753	53.31551774
EPI/GCI	0.842873404	0.864475407	0.96238337	0.960271858

Sorces*: www.wef.org*; *www.epi.yale.edu*; *authors' calculations.*

Because of the lack of data Greece, Israel, Kuwait, Qatar and Oman were excluded from the general sample. Thus, only 105 countries are left.

6) Grouping of countries into relatively homogenous groups.
   First, all countries are ranked in terms of industry value added. Based on the fact that, to obtain statistically significant results, the preferred size of each group is at least 20 countries, the first 19 countries and the last 20 of the rankings are put into the first and last groups respectively in advance.
   Then, for each country, which for now doesn't belong to any group, the difference between its industry value added and industry value added of the country, next in the list, is calculated. All countries in the sample are ranked in decreasing order depending on the size of these differences. Thus, it is the ranking of the countries, after which in terms of industry value added follow the countries with the largest gap before them. That is, to comply with the idea of homogeneity, ideally each of the groups should end on the leading country in the rankings. However, it is also necessary to take into account previously agreed minimum group size.
   The leader of the «gap rankings» is Iran, the first group then is made up of 26 countries. Next the rankings should be «cleaned»: all countries that will cut less than 20 countries into the second group are removed. Next first country in the rankings is Ecuador, which leaves 32 countries in the second group. The subsequent «cleaning» of the rankings gives the following border – Latvia. In the end there are four groups with sizes of 26, 32, 24 and 23 countries. The groups with corresponding IVA can be seen in Table 32.

Table 2. The country groups.

GROUP 1

Country name	IVA
China	2770657993125
USA	2689500000000
Japan	1495521758943
Germany	821539473684
Brazil	514914873989
Italy	462101963297
Russia	453528557414
Canada	453110473834
France	450550995148
India	439683437918
UK	435420000000
South Korea	353898803168
Mexico	344236648162
Indonesia	332649235643
Spain	328430263158
Saudi Arabia	269362133333
Australia	208946208889
Venezuela	190636711959
Turkey	172354056259
Netherlands	165327631579
UAE	165268078240
Norway	149178476821
Thailand	142404933456
Switzerland	135482647856
Poland	130777777778
Iran	125701667207

Country name	IVA
Sweden	106437031900
Argentina	104620348779
Malaysia	101428185159
South Africa	101177508881
Austria	98966972368
Algeria	94871358605
Colombia	91819402379
Belgium	90552631579
Chile	78654937960
Egypt	78330264411
Libya	67569221968
Nigeria	66749453322
Philippines	65002859630
Czech Republic	64971047120
Ireland	64190119118
Finland	59827631579
Kazakhstan	59581172314
Denmark	58832562278
Romania	58770949369
Singapore	56015171134
Peru	50561302826
Portugal	45854868421
Viet Nam	43736562871
Pakistan	42549423374
Ukraine	37691102669
Hungary	33750240454
Azerbaijan	31130380614
Slovakia	27725827815
Bangladesh	27617797660
New Zealand	25066883117
Morocco	24245121955
Ecuador	20908599000

Country name	IVA
Dominican Republic	15233815502
Sri Lanka	14587546436
Croatia	13614424301
Slovenia	12901612483
Bulgaria	12102999221
Trinidad and Tobago	11854442344
Guatemala	11177434948
Lithuania	9141047462
Uruguay	8945637533
Costa Rica	8671989302
Serbia	8586434176
Lebanon	7326036484
Jordan	7104407913
Botswana	6401225356
Côte d'Ivoire	6238932689
Cameroon	6176338258
Bolivia	5923201425
Ghana	5795845635
Zambia	5735479200
El Salvador	5310400000
Kenya	5231522299
Tanzania	5127278173
Estonia	4740218421
Latvia	4690564615

Country name	IVA
Cyprus	4297982296
Panama	4134218153
Bosnia and Herzegovina	3819327470
Honduras	3772290339
Paraguay	3742267042
Namibia	3039519921
Armenia	2995620623
Senegal	2592024792
Ethiopia	2538001882
Cambodia	2458529008
Jamaica	2413045349
Zimbabwe	2296380493
Macedonia	2291899147
Nepal	2272377247
Georgia	2248081787
Mongolia	2048846475
Mozambique	1974550312
Nicaragua	1867649708
Albania	1622638912
Kyrgyzstan	1256604550
Tajikistan	1116935115
Benin	866873424
Moldova	637940208

Sources: *www.imf.org, authors' calculations*

7) Adjusting the weights:
After the division of the countries using the selected criteria, weights for each group are determined. The method of deviation averages is used.
We calculate the average values of global competitiveness index and environmental performance index for all the countries in each group and compare them with the averages for the whole sample. Then, the resulting deviations are put together and distributed equally between the two components to adjust expert estimated weights.

8) Construction of the final index:
The thus-obtained weights are applied to countries depending on a particular group they belong to. Table 3 illustrates all the calculations made according to the described above methodology on the example of group 1. The procedure is similar for each group. Unfortunately, the size of the article does not allow to publish all calculations for all countries of the sample and for each group. The results of SCI calculations for all countries can be seen in Table 4 (Appendices).

Table 4. SCI scores and country rankings

Rank	Country name	SCI
1	Switzerland	78.96717422
2	Sweden	76.07873
3	Germany	73.02897635
4	Finland	72.84405505
5	UK	72.60670003
6	Denmark	72.11798369
7	Norway	72.08064838
8	Netherlands	72.06954474
9	France	71.58291458
10	Austria	71.51330867
11	Japan	71.48572058

Rank	Country name	SCI
54	Guatemala	56.104895
55	Peru	56.06083455
56	Romania	55.97270922
57	Mexico	55.67498111
58	El Salvador	55.63105068
59	Azerbaijan	55.58808518
60	Georgia	55.55031863
61	Jordan	55.27015082
62	Macedonia	55.19543191
63	Honduras	54.96308532
64	Jamaica	54.91005425

Rank	Country name	SCI
12	Singapore	71.41249981
13	Belgium	69.49614193
14	USA	69.37552159
15	Canada	68.95727605
16	New Zealand	68.92362191
17	Malaysia	67.49387847
18	Australia	66.60454044
19	South Korea	65.25687532
20	Czech Republic	65.12461593
21	Italy	64.93243232
22	Ireland	64.91627236
23	Poland	64.04132222
24	Costa Rica	63.58311587
25	Chile	63.37635423
26	Lithuania	63.30754146
27	Estonia	63.20935705
28	Slovenia	62.94109248
29	Cyprus	62.82890728
30	Thailand	62.68997215
31	Spain	62.67357305
32	Saudi Arabia	62.58518333
33	Slovakia	62.55418787
34	UAE	62.44099515
35	Latvia	62.1485009
36	Brazil	61.08423542
37	Portugal	60.99259815
38	Panama	60.97751847
39	Hungary	60.34933436
40	Colombia	60.16205378
41	Uruguay	59.533569
42	Croatia	59.43082404
43	Sri Lanka	59.33502647
44	Indonesia	58.98734496
45	China	58.58599547
46	Albania	58.35556165
47	Bulgaria	58.23488071
48	Viet Nam	57.81117059
49	Philippines	56.80736928
50	Botswana	56.76582947
51	Namibia	56.73481919
52	Egypt	56.4930665
53	Argentina	56.43712905

Rank	Country name	SCI
65	Ecuador	54.78584889
66	Russia	54.63184782
67	Turkey	54.46872618
68	Morocco	54.35818323
69	Trinidad and Tobago	54.1247824
70	Algeria	54.04068026
71	Lebanon	53.32570182
72	South Africa	53.21668625
73	Moldova	53.06778391
74	Dominican Republic	52.97266458
75	Nicaragua	52.79639588
76	Ukraine	52.78494769
77	Iran	52.72203176
78	Bolivia	52.66744248
79	Cambodia	52.58909179
80	Serbia	52.47885513
81	Armenia	52.37015665
82	Benin	52.20370951
83	Venezuela	52.06600779
84	Zambia	51.98115626
85	India	51.81786726
86	Mongolia	51.79190241
87	Tanzania	51.73711931
88	Kenya	51.32224376
89	Senegal	51.26865375
90	Kazakhstan	50.75328553
91	Ethiopia	50.67233186
92	Paraguay	50.43056958
93	Nepal	49.92102957
94	Ghana	49.90883204
95	Bosnia and Herzegovina	49.4550506
96	Côte d'Ivoire	49.38053417
97	Bangladesh	49.09143266
98	Kyrgyzstan	49.05642632
99	Cameroon	48.92506138
100	Libya	48.49671482
101	Tajikistan	47.97531311
102	Mozambique	47.56246319
103	Pakistan	46.57801187
104	Nigeria	45.69211812
105	Zimbabwe	45.25124597

Source: *authors' calculations*

Table 3. Example: Grouping procedure and final index construction.

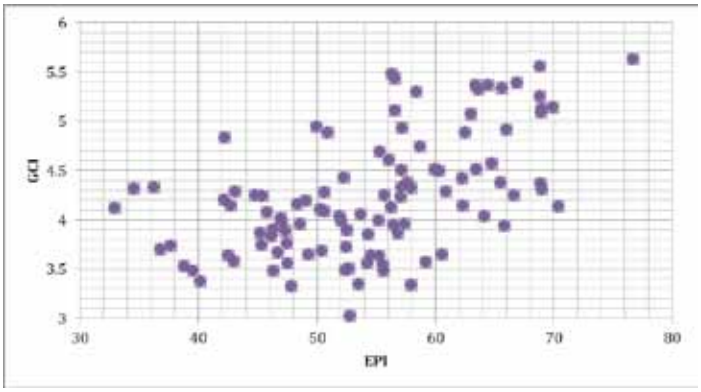
Country name	EPI	GCI	EPI adj	GCI adj	GDP per capita PPP, current US $	SCI
China	42.24	4.835890667	42.24	69.08415239	7553.377	58.58599547
USA	56.59	5.431088386	56.59	77.58697694	46811.056	69.37552159
Japan	63.36	5.369310482	63.36	76.70443546	34280.079	71.48572058
Germany	66.91	5.387120686	66.91	76.95886694	36172.675	73.02897635
Brazil	60.9	4.284179197	60.9	61.20255996	11216.095	61.08423542
Italy	68.9	4.366899335	68.9	62.38427621	29817.106	64.93243232
Russia	45.43	4.237919109	45.43	60.54170156	15687.183	54.63184782
Canada	58.41	5.301185836	58.41	75.73122623	40223.538	68.95727605
France	69	5.126924754	69	73.2417822	33959.535	71.58291458
India	36.23	4.328038334	36.23	61.82911906	3378.146	51.81786726
UK	68.82	5.252708617	68.82	75.03869453	35708.024	72.60670003
South Korea	57.2	4.93019622	57.2	70.43137457	29717.179	65.25687532
Mexico	49.11	4.192392166	49.11	59.89131666	13945.353	55.67498111
Indonesia	52.29	4.430208351	52.29	63.28869073	4353.813	58.98734496
Spain	60.31	4.493409855	60.31	64.19156936	29751.366	62.67357305
Saudi Arabia	49.97	4.948106768	49.97	70.68723954	27313.872	62.58518333
Australia	56.61	5.111644871	56.61	73.02349816	39674.441	66.60454044
Venezuela	55.62	3.484842833	55.62	49.78346904	12280.678	52.06600779
Turkey	44.8	4.247490161	44.8	60.67843087	13293.919	54.46872618
Netherlands	65.65	5.333473202	65.65	76.19247431	40888.008	72.06954474
UAE	50.91	4.889271478	50.91	69.8467354	45759.383	62.44099515
Norway	69.92	5.142782193	69.92	73.46831704	52034.15	72.08064838
Thailand	59.98	4.510130942	59.98	64.43044203	9215.488	62.68997215
Switzerland	76.69	5.630077683	76.69	80.42968119	43156.721	78.96717422
Poland	63.47	4.50857763	63.47	64.40825186	18961.841	64.04132222
Iran	42.73	4.139756481	42.73	59.1393783	12789.166	52.72203176
		average	57.38653846	68.08441002		
		average before grouping	54.31257143	60.48945911		
		deviation	-0.056597708	-0.125558255		
		weights deviation	0.091077981	-0.091077981		
		weights	0.391077981	0.608922019		

Sources: *www.imf.org; www.epi.yale.edu; www.wef.org., authors' calculations.*

Findings: Sustainable Development, International Competitiveness and GDP per capita

The matrix (Fig. 1), constructed in the dimension of EPI and GCI, shows quite obviously that there is no necessary trade-offs between national competitiveness and environmental sustainability. The value of Pearson's coefficient for EPI and GCI is 0,537, which means positive moderate relation, while the value of Spearman's coefficient (0,532) shows that the relation is linear, but no clear patterns could be identified. The graph shows the country-spread.

Figure 1. GCI & EPI correlation.



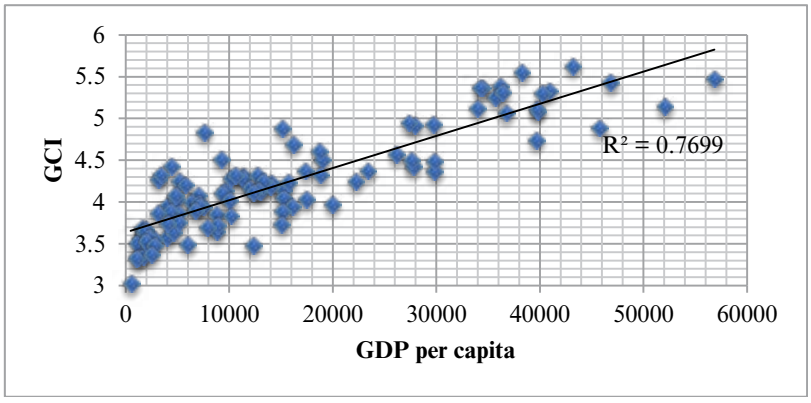
Source: authors' calculations

In some sense this conclusion coincides with this one of WEF:

"There are no necessary trade-offs between being competitive and being sustainable. The analysis found a positive correlation across the three dimensions of competitiveness and social and environmental sustainability" (Global Competitiveness Report 2012-13, p.57). The difference is that the last one included the social component of sustainability.

Pearson's coefficient for GCI and GDP per capita equals 0,877, which represents a strong positive relation; while Spearman's coefficient (0,852), also concludes that the relation is linear (Fig. 2)

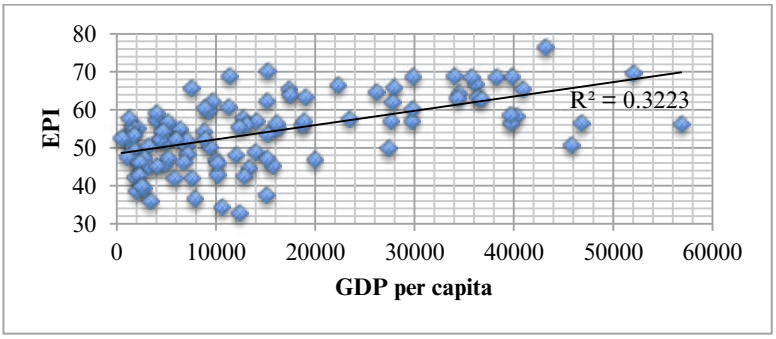
Figure 2. GCI & GDP per capita correlation



Source: authors' calculations

As for EPI and GDP per capita, the relation is only moderate but still positive, both Pearson's and Spearmen's coefficients equal 0,568. The country spread on the graph clearly shows that no reliable regression model can be constructed for EPI and GDP per capita (Fig. 3).

Figure 3. EPI & GDP per capita correlation.



Source: authors' calculations.

Findings: International Competitiveness and Sustainable Development- the picture of the world

The figure 4 reflects the overall model, describing the current world in the framework of suggested sustainable competitiveness approach. Two types of models were tested – the additive one and the multiplicative one; the additive model with the highest R^2 was chosen. Both models have proved a strong positive correlation between countries' level of economic development (measured by GDP per capita in PPP) and sustainable international competitiveness (measured by SCI, constructed by the authors of the research).

Figure 4. SCI & GDP per capita correlation.

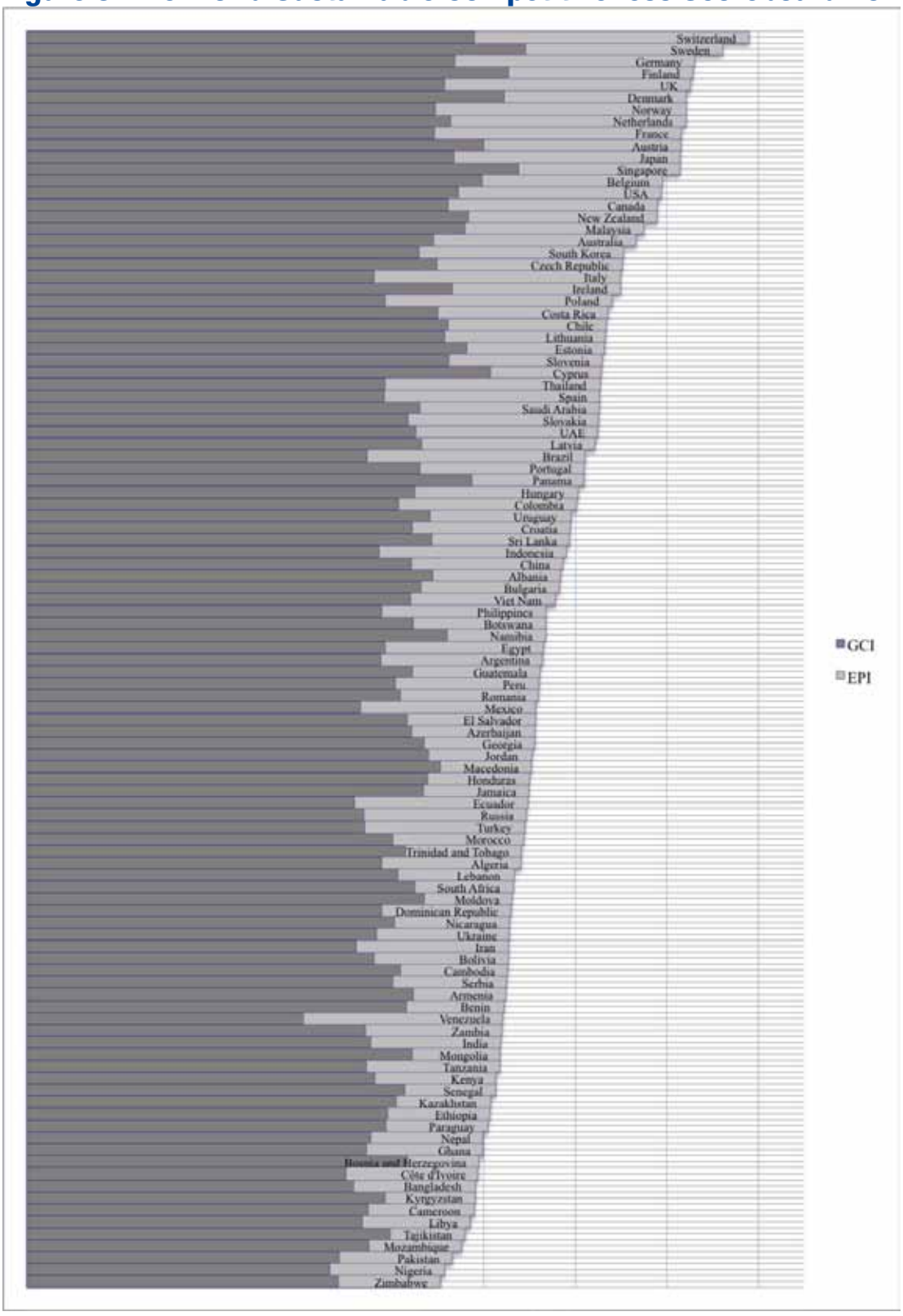
Source: *www.imf.org, authors' calculations*

According to the methodology suggested in this article, the most promising countries in sense of a long-term balanced development are Switzerland and Sweden, followed by United Kingdom, Germany, Finland, Japan, France and Netherlands. In fact, Switzerland also leads all alternative rankings, such as WEF and IMD ones, despite of the difference of index components and measurement approach.

Malaysia looks surprisingly good and promising, especially comparing with the USA, South Korea and Australia. Most of "oil oriented" countries (Russia, Kazakhstan, Venezuela, Iran, Saudi Arabia, UAE, etc.) demonstrate much lower than average level of sustainable competitiveness, which is a more or less expected outcome. The picture for least developed countries, mostly presented by group 3 and 4, is less obvious and needs to be considered at the by-country level.

The results of the authors' calculations allow to construct a world scoreboard together with high-lightening both components of the sustainable competitiveness for each country (Fig. 5, appendices)

Figure 5. The World Sustainable Competitiveness Scoreboard 2010.



Sources: authors' calculations.

Conclusions.

Thus, the comparative statics analysis showed, that according to the quantitative approach suggested in this paper, there is a positive correlation between the level of the development of the country measured by GDP per head, and the indicator encompassing national competitiveness and environmental protection: the more developed the country is, the more sustainable it is in the sense of national competitiveness.

The authors realize that the method they used has its biases and limitations and that the results received are ambiguous, especially concerning the countries with low GDP level. The by-group analysis confirmed the above-mentioned uniformity for all groups, although the degree of the relations between variables is different. Unfortunately this article does not allow commenting on all points of the results received. But the comparisons with the results of other researchers, the alternative global rankings show that there are no serious discrepancies in by-country rank for the most developed countries despite of the different approach. This fact could be considered as a confirmation of a viability of the methodology, presented in this article.

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