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ANALYZING THE IMPACT OF HUMAN CAPITAL FACTORS ON COMPETITIVENES

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Original Scientific Paper

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There are a number of approaches to measure national competitiveness. However, in these reports human capital typically appears indirectly. The author's purpose is to uncover how human capital contributes to competitiveness of economies and to propose an approach to identify the most effective improvement opportunities for countries, illustrated on the example of Hungary. The analysis is based on the data of the Global Talent Index Report (2011) and the Global Competitiveness Report 2012-2013. The components of the Global Talent Index (GTI) and their relation to the Global Competitiveness Index (GCI) were analyzed with a linear programming based similarity analysis method, component-based object comparison for objectivity (COCO). Based on the output of the analysis it was identified how sensitive the Global Competitiveness Index is to the components of the GTI. Hungary's position was analyzed further to quantify improvement opportunities and threats based on the step function resulted by the COCO analysis. The author concludes that the human resource of a country is a pivotal element of national competitiveness. By developing human capital of the country the overall competitive position may be improved. Areas of priorities may be identified and the level of intervention may be quantified specific to a country. This could help policy makers to decide in the allocation of resource to maximize effectiveness, leading to improve (or protect) a country's overall competitive position in the global arena.

Key words: competitiveness, human capital, Hungary.

COMPETITIVENESS IN CONTEXT

Models of competitiveness originally were developed to measure the performance potential of companies. The models which describe the competitiveness of nations stem from these (Csath, 2010). There are several definitions and approaches, one of the most quoted one is the so called "diamond model" created (and later developed further) by Porter (1990), where the conditions of the competitiveness is beyond the firm strategy and structure, certain conditions need to be there in the operating environment, such as appropriate demand, basic infrastructure and related supporting industries. Government policies should facilitate the effective operation of these conditions. This model could be interpreted both at micro and macro level.

The European Commission approaches competitiveness from the perspective of increasing level of wealth of the population at the lowest possible level of unemployment (UNU-MERIT, 2011). In this definition low unemployment level becomes a criterion for competitiveness. Porter, however, argues that the ultimate purpose is not the creation of workplaces but establishing fundamentals which act as a catalyst to competitiveness of the economy, and as a consequence, this will lead to the creation of sustainable workplaces (Snowdon and Stonehouse, 2006).

Another approach to define competitiveness set out in the World Competitiveness Report (Schwab, 2013) takes a broader view: "a set of institutions, policies, and factors that determine the level of productivity of a country". This definition focuses on productivity as an outcome and gives particular

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importance to available factors, such as policies, institutional background and available resources.

The Competitiveness Research Centre of the International Institute for Management Development (IMD) conducts and publishes regular competitiveness studies. They define competitiveness as „how nations and enterprises manage the totality of their competencies to achieve increased prosperity" (IMD, 2011). The outcome here is not the economic productivity, but the prosperity of the nation, and it does not name any particular element on the input side, but refers to the total competencies the nations have.

Measuring competitiveness of countries is a complex task. There is a number of approaches to construct competitiveness measures. These are based on different methodologies and assumptions, but there are similarities in the key steps in the process

- identifying (and grouping) a number of indicators believed to have an impact on competitiveness,
- collecting data for these indicators (statistical data or specific survey data),
- creating an overall score for each country, and
- ranking the countries based on the scores.

Because of the different methodologies and indicators it is difficult to compare the scores of various reports, therefore the most cited data from each report is the final rank of the countries, which could be compared to the rank in other reports, for example, within a set of identified competitors.

Whilst the single score serves the purpose of comparison, the drivers of competitiveness are analyzed in depth in each of the reports. Drivers of competitiveness are the components of the overall competitiveness measure, which are measurable, and could be influenced to increase competitiveness (e.g. through policies or legislations). Therefore when analyzing a specific economy, it should highlight which aspect of the economy should be improved to move up on the ranking.

The interpretation of drivers of competitiveness depends on which definition of competitiveness is considered as a starting point. This also determines the set of indicators which measure competitiveness in a particular framework. There is subjectivity in the assumptions when creating these frameworks to measure competitiveness. This is also mirrored in the selection of the specific indicators. Also there are subjective elements in the assessment of these indicators, i.e. how they influence competitiveness (e.g. weighting, excluding outliers, etc.). However, if such frameworks are consistently applied over a number of time periods (usually each year) then there could be useful information gained in terms how an economy changes, and that in which specific area it gains or loses compared to previous periods and economies of other nations. Some of these frameworks are considered to be so well grounded that key decision makers both at micro and macro levels often rely on their information.

HUMAN CAPITAL AND COMPETITIVENESS

Similarly to competitiveness, there is a wide range of definitions of human capital. Another similarity is that the concept also started to be developed in the context of companies before it was extended to a macro level. The introduction of the term "human capital" is attributed to the Nobel-prize winning economist, Theodore Schulz, who researched underdeveloped countries. He claimed that the welfare of poor people depends on knowledge more than on any other (physical) resources. He referred to this qualitative economic factor as human capital (Fitz-enz, 2000).

All resources apart from human resource are passive, they need human intervention to make them produce economic value. The stock markets recognize the impact of human knowledge. Tech companies often have a market value worth many times of their book value (Fitz-enz, 2000). There are successful efforts to link the quality of human resource to the profitability of companies by various studies carried out by global consulting firms, such as PwC Saratoga or Watson Wyatt. The latter published a book on the findings on how a variety of common human resources practices contribute to the value of the company. They analyzed the people practices of a sample of 750 publicly traded companies, and based on this, they defined the human capital index (HCI) for each company. They found a significant correlation between the HCI and the total shareholder return (TSR). They also found using longitudinal data that HCI predicts TSR much better than TSR predicts HCI (Pfau and Kay, 2002).

Whilst leading companies see human capital as a distinct source of competitive edge and align their practices accordingly, this appears to be less obvious at the level of national economies. People

related systems and policies such as education (compulsory or higher levels), healthcare, social benefits or labor regulations often handled in isolation, being dependent on strict budget constraints and serving political value choices of ruling governments, the link between these factors and the economic performance and ultimately the standard of living of nations is not transparent. Even in some global competitiveness reports the people aspect remain rather indirectly addressed. For example in the IMD World Competitiveness Yearbook there are several aspects measured which are directly or indirectly are related to human capital (such as employment level, labor regulations, labor market, management practices, attitudes and values or education), but these are spread across the various groups of variables (IMD, 2011). The EU Innovation Scoreboard (which is positioned as an innovation report but in its structure is similar to other competitiveness reports) dedicates a set of measures to human capital, however these are narrowly composed, and include only a ratio of the population in certain age groups completing various levels of education based on statistical data of the member states (UNU-MERIT, 2011).

The availability of properly qualified talent in a country is considered a key factor of its competitiveness. It is therefore important to establish measures for human capital, related to the country's ability to produce, develop, attract and retain adequate talent in the country. This implies also the environment and conditions in which human capital required to perform. The Economic Intelligence Unit developed an approach "to measure not only a country's natural potential for producing talent in sociodemographic terms, but also the existence of conditions necessary to realize this potential" (EIU, 2011). This is summarized in their Global Talent Index Report (EIU, 2011).

PURPOSE OF THE STUDY

Using available data for both human capital (Global Talent Index Report) and competitiveness (Global Competitiveness Report) the intention was to understand the relationship between these two factors, and gain some insights how the development of the human capital may influence the competitiveness of an economy. Specific objectives were in particular:

- to identify the factors of the Global Talent Index which have the largest effect to the country's competitiveness index (GCI),
- to quantify the sensitivity of the GCI to various human capital related factors, and
- to find the areas of strengths and improvement opportunities of Hungary through human capital development, which would contribute to the improvement the country's position in the GCI ranking.

DATA USED FOR THE ANALYSIS

For the purpose of this analysis data of two independently published reports were used: the Global Competitiveness Report 2012-2013 (Schwab, 2013), and the Global Talent Index Report (EIU, 2011).

The Global Competitiveness Report issued annually by the World Economic Forum structures its data hierarchically. The Global Competitiveness Index (GCI) is calculated from three subindexes (basic requirements, efficiency enhancers and innovation & sophistication). Within subindexes are built of 12 pillars, each of them are built up from a variety of 111 indicators. (The number of indicators may change slightly from year to year as the methodology gets refined. This study uses the data of the 2012-2013 report, which includes 111 indicators).

According to the methodology, the three subindexes have different importance (weight) in the GCI, depending on the country's stage of development. There five stages of development referred to in the report (factor driven, efficiency driven and innovation driven economies, and the transition phases between these stages). The stages of development are defined by the GDP per capita of the economy (Table 1).

The three established stages have fixed weights, while the transitional stages are allocated variable weights within a defined range. This approach implies that the same performance in a specific indicator is "rewarded" or "penalized" on the ground how the country's overall efforts are reflected in the GDP per capita measure.

There is some criticism to the method of allocation weights to the subindexes. Some studies attempt to eliminate the subjectivity implied by the above weighting structure. For example, Bowen and Moesen (2011) suggest a linear programming based approach to determine a unique set of weights for each country by calculating the competitiveness index based on the same underlying data, but optimizing it for the highest

overall index performance for each country. This way the weights are determined by the data actually measured for each indicators instead of a previously fixed set. In other words, they let the data to "reveal" their so called endogenous weights (Bowen and Moesen 2011). This is a useful approach to highlight the relative strengths and weaknesses of each country within the GCI framework, highlighting the sources of advantage and disadvantage of the given economy.

Table 1: Stages of development and related weights of sub-indexes

	Factor-Driven stage (1)	Transition from stage 1 to stage 2	Efficiency-Driven stage (2)	Transition from stage 2 to stage 3	Innovation-Driven stage (3)
GDP per capita (US$) tresholds	<2,000	2,000-2,999	3,000-8,999	9,000-17,000	>17,000
Weight for basic requirements	60%	40-60%	40%	20-40%	20%
Weight for efficiency enhancers	35%	35-50%	50%	50%	50%
Weight for innovation and sophistication factors	5%	5-10%	10%	10-30%	30%

Source: Schwab, K. (2012): Global Competititveness Report 2012-2013, p. 9.

The Global Competitiveness Report 2012-2013 edition includes 144 countries in its sample, measured across 111 indicators.

The Global Talent Index Report is prepared by the Economist Intelligence Unit (and published by Heidrick & Struggles, a global executive search and HR consulting firm) is similar to the Global Competitiveness Report in the way it structures and groups the variables. It focuses on the human capital related measures, creating a global talent index (GTI) based on the availability and quality of human capital in 60 analyzed countries. Their data is also hierarchically structured: the index is calculated from 7 components, each composed form 2 to 8 of the 30 indicators. The source of data is either statistics or data collected by their own survey. The weighting of the components are fixed, two components bearing twice as much importance than the other ones. The components of the index are demographics (age and growth of the population, weight 0.11), compulsory education (duration and efficiency of the education, weight 0.11), university education (enrolment rates and expenditures, weight 0.22), quality of labor force (technical, language and managerial abilities of the workforce, weight 0.22), talent environment (conditions contributing to retain talent, weight 0.11), openness (flow of international trade, FDI and foreign talent, weight 0.11) and proclivity to attract talent (income levels and growth of available jobs, weight 0.11). The issue of weighting the variables is also present here, although, unlike in the case of the Global Competitiveness Report, the weights here are identical across the entire sample.

The 2011 edition of the Global Talent Index Report includes 60 countries, and measure 30 indicators (grouped in 7 components).

ANALYSIS PROCESS

For the purpose of this analysis, the 7 components of the GTI will be used as attributes, and their connection to the GCI will be analyzed.

The ranking of the components of the Global Talent Index (GTI) of 60 countries as the human capital related data set, and analyzed its relation to the GCI (which is available for 144 countries, all 60 of the GTI countries included). The data considered to be sufficient both in terms of size (60 countries) and depth (7 variables) for the selected method. The data collection period of the two reports were similar, most data from both reports referred to 2011 (EIU, 2011; Schwab, 2012).

A similarity analysis technique, component-based object comparison for objectivity (COCO) method was applied. This method investigates the connection between independent variables (attributes) and the dependent variable (result variable) via an algorithm based on linear programming. The weight of the variables in this method is a staircase function of the variable value. The linear programming based methodology constructs this staircase functions depending on the approximating formula type (in this case linear), the error minimization type (in this case least squares) and other parameters, such as the number of the steps in the staircase (which is maximized in

the number of the observation in this case) (Bánkuti - Pitlik, 2010).

The analysis results the following outputs: a staircase function with parameters on the solution where the sum of squares of the distances between the actual and estimated values are at the minimum. In other words, based on similarities of the analyzed countries the algorithm builds up the GCI estimates for each country from the GTI components' ranking. This approach investigates the impact of the 7 components of GTI on competitiveness in isolation from other influencing forces, leading to a better understanding the behavior of the analyzed factors in relation to the competitiveness. Based on the estimated values of the model a simulation may also be performed to find the degree of the improvement in each components which would lead to improvement in the position in overall competitiveness ranking. I illustrate this simulation in case of Hungary. To perform the analysis I used the free online analysis tool for COCO, made available as the courtesy of the online journal called Medium on Internet for Agricultural Applied Informatics in Hungary, accessible on the following URL: http://miau.gau.hu/myx-free/coco/beker_std.php.

The independent variables (attributes) were the rankings of the 7 talent index components and the dependent variable the GCI. The value of the GCI ranges between 1 and 7 by definition. The values of the staircase function are shown in Table-2. If the staircase function values of all countries were the same in any given variable it would mean that improvement in that variable would not impact the result variable (GCI) at all, in other words, the variable is redundant from the standpoint of the result variable. There was no such variable in my analysis, which means that all of the included attributes influence the level of competitiveness to some degree. Where the values of the staircase function are identical for several objects in a row it means that within that range of identical step values changes will have no impact on the estimate of the result variable. In order to achieve tangible impact, the improvement in the given variable should aim for the level of the object with the next highest staircase function value as a minimum.

The means of the staircase values also indicate the weight (importance) of the given variable in the dependent variable. According to the analysis, the most important factor among the 7 factors in the analysis is the Talent Environment, which has the highest average weight. The factor with the second highest weight is Openness, and Compulsory Education comes third. Knowing the staircase functions of each variable also allows quantification of the expected impact on the result variable. Summary of the distance to the next higher and next lower staircase function value and the theoretical improvement opportunity for Hungary is shown in Table 2.

Based on the staircase function it may be estimated that on the given variable what level of improvement should be made, in order to achieve improvement in the result variable. I illustrate this process on the example of the three most important variables in the model.

In the Talent environment variable Hungary is ranked 26th of the 60 countries. Table-2 shows the corresponding value in the staircase function, 2.697. The related score on this component in the Global Talent Report is 59.7. In order to improve competitiveness through this variable, its rank should be improved at least to the next highest staircase function value, 2.7969, which is the country on the 24th place (New Zeeland, with a score of 75.0). Changes in this area may require both policy and cultural changes, therefore achieve improvement within some indicators of this component (protection of property, wage and labor regulations, meritocratic remuneration) however another indicator, R&D spend as % of GDP, may be achieved by allocating available funds.

On the Openness variable Hungary could have a room to improve (score 17.4), but it already has the second highest value of the staircase function in this variable, only the first in this category could be matched to improve the overall position (Singapore, with a score of 68.4). It may be less realistic to achieve easily such difference in this score. Improving the score to a lower level than that, according to this model, would not lead to a tangible effect on the competitiveness, so efforts and spends on this area may be waste of valuable resources, especially considering that the effect of improvement is half or the previous factors. I am far from suggesting that this area should be excluded from any development. However, if resources are constrained, this is not the area the country could achieve the best return on the resources invested, it should be focusing on the areas which have the most beneficial return according this model.

Table 2: Staircase function of the COCO analysis

Stairs	Demographics	Compulsory education	University education	Quality of labour force	Talent environment	Openness	Proclivity to attracting talent
S1	1.1487	1.0239	0.2997	0.3246	3.2464	1.3735	0.3496
S2	1.0488	1.0239	0.2997	0.3246	3.2464	1.3235	0.3496
S3	1.0488	1.0239	0.2497	0.3246	3.2464	1.3235	0.1998
S4	1.0488	1.0239	0.2497	0.3246	3.2464	1.3235	0.1998
S5	1.0488	1.0239	0.2497	0.3246	3.2464	1.3235	0.1998
S6	1.0488	1.0239	0.2497	0.3246	3.2464	1.3235	0.0999
S7	1.0488	1.0239	0.2497	0.3246	3.2464	1.3235	0.0999
S8	0.7741	1.0239	0.2497	0.3246	3.2464	1.3235	0.0999
S9	0.7741	1.0239	0.2497	0.3246	3.2464	1.3235	0.0999
S10	0.7741	1.0239	0.2497	0.3246	3.2464	1.3235	0.0999
S11	0.7741	1.0239	0.2497	0.2747	3.1965	1.3235	0.0999
S12	0.7741	1.0239	0.2497	0.2747	3.1965	1.3235	0.0999
S13	0.7741	1.0239	0.2497	0.1748	3.1965	1.3235	0.0999
S14	0.5993	1.0239	0.2497	0.1748	3.1965	1.3235	0.0999
S15	0.5993	1.0239	0.2497	0.1748	3.1965	1.2236	0.0999
S16	0.5993	1.0239	0.2497	0.1748	3.1965	1.2236	0.0999
S17	0.4495	1.0239	0.2497	0.1748	3.1965	1.2236	0.0999
S18	0.4495	0.924	0.2497	0.1748	3.1965	1.2236	0.0999
S19	0.4495	0.924	0.2497	0.1748	3.1965	1.2236	0.0999
S20	0.4495	0.924	0.2497	0.1748	3.1965	1.2236	0.0999
S21	0.2747	0.924	0.2497	0.1249	3.1965	1.2236	0.0999
S22	0.2747	0.924	0.2497	0.1249	3.1965	1.2236	0.0999
S23	0.2747	0.924	0.2497	0.1249	2.7969	1.2236	0.0999
S24	0.2747	0.924	0.2497	0.1249	2.7969	1.2236	0.0999
S25	0.2747	0.924	0.2497	0.0999	2.697	1.2236	0.0999
S26	0.2747	0.924	0.2497	0.0999	2.697	1.2236	0.0999
S27	0.2747	0.924	0.2497	0.0999	2.697	1.2236	0.0999
S28	0.2747	0.924	0.2497	0.0999	2.697	1.2236	0.0999
S29	0.2747	0.924	0.2497	0.0999	2.697	1.2236	0.0999
S30	0.2747	0.924	0.2497	0.0999	2.697	1.2236	0.0999
S31	0.2747	0.924	0.1498	0.0499	2.697	1.2236	0.0999
S32	0.2747	0.924	0.1498	0	2.697	1.2236	0.0999
S33	0.2747	0.924	0.1498	0	2.697	1.2236	0.0999
S34	0.2747	0.924	0.1498	0	2.697	1.2236	0.0999
S35	0.2747	0.924	0.1498	0	2.697	1.2236	0.0999
S36	0.2747	0.924	0.1498	0	2.697	1.2236	0.0999
S37	0.2747	0.924	0.1498	0	2.5971	1.2236	0.0999
S38	0.2747	0.924	0.1498	0	2.5971	1.2236	0.0999
S39	0.2747	0.924	0.1498	0	2.5971	1.2236	0.0999
S40	0.2747	0.924	0.1498	0	2.5971	1.2236	0.0999
S41	0.2747	0.924	0.1498	0	2.5971	1.2236	0.0999
S42	0.2747	0.924	0.0999	0	2.5971	1.2236	0.0999
S43	0.1498	0.924	0	0	2.5971	1.2236	0.0999
S44	0.1249	0.924	0	0	2.5971	1.2236	0.0999
S45	0.1249	0.924	0	0	2.5971	1.2236	0.0999
S46	0.1249	0.924	0	0	2.5971	1.2236	0.0999
S47	0.0999	0.924	0	0	2.5971	1.2236	0.0999
S48	0.0999	0.924	0	0	2.5971	1.2236	0.0999
S49	0.0999	0.924	0	0	2.5971	1.2236	0.0999
S50	0.0999	0.924	0	0	2.4723	1.2236	0.0999
S51	0.0999	0.924	0	0	2.4723	1.2236	0.0999
S52	0.0999	0.7242	0	0	2.4723	1.2236	0.0999
S53	0.0999	0.3746	0	0	2.4723	1.2236	0.0999
S54	0.0999	0.0999	0	0	2.4723	1.2236	0.0999
S55	0.0999	0.0999	0	0	2.4723	1.2236	0.0999
S56	0	0.0999	0	0	2.4723	1.2236	0.0999
S57	0	0.0999	0	0	2.2225	1.2236	0
S58	0	0.0999	0	0	2.2225	1.2236	0
S59	0	0	0	0	2.2225	1.2236	0
S60	0	0	0	0	1.3985	1.2236	0

Hungary's current position | Next higher staircase value | Next lower staircase value

Source: Author's own analysis based on data of the Economist Intelligence Unit and the World Economic Forum

In the Compulsory education variable, on which Hungary is ranked 18th of 60 countries, the Table-2 shows the corresponding stair value, 0.924. The related score 77.4 on this component in the Global Talent Report. In order to improve competitiveness through this variable, its rank should be improved at least to the next highest stair value 1.0239, which is the country on the 17th place (Canada,

with a score of 77.5). This appears to be a realistic target which could be achieved by improving the indicators within this component: increase the spending to education (both in % of GDP and spending per pupil as a % of GDP per capita), increase secondary school enrolment, increase the expected years of schooling, or improve the pupil/teacher ratio. Some of these changes could be made relative quickly if there were available funds to be allocated in this area.

Demographics also makes room for improvement in the case of Hungary. However, it requires long term efforts and could be influenced only very indirectly. Achieving quick improvement on this area is unlikely, however the area needs attention in order to, at least, maintain the current relative position.

The quality of labor force is also a feasible change with only one step improvement, however, the GCI is less sensitive to this variable, and only half of the impact could be achieved than with the previous factors. In case of the university education the next stair value is far away, in order to achieve a measurable change in the competitiveness, the country should reach the level of the second ranking country from the current 25th position. The situation is even more difficult in the case of proclivity to attracting talent, where the 5th place should be reached from the 55th. This means that further development of these factors require resources out of proportion to improve competitiveness. What is important in these factors, however, is the protection of the current position, because decline in stair value is a few steps away, reaching that level would hit the overall competitiveness score.

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In case of the university education the next step value is 23 steps away, in order to achieve a measurable change in the competitiveness, and one that would mean only 0.05 GCI improvement, a half of the previously mentioned components. To achieve a positive impact, the country should reach the level of the second ranking country from the current 25^{th} position. The situation is even more difficult in the case of proclivity to attracting talent, where the 5^{th} place should be reached from the 55^{th}. This means that further development of these factors may require resources out of proportion to improve competitiveness. What is important in these factors, however, is the protection of the current position, because decline in step value is a few steps away, and falling to that level would deteriorate the overall competitiveness score. Table-3 shows the summary of improvement opportunity respective to each GTI components for Hungary.

Table 3: Calculated improvement in Hungary's GCI score by improving GTI components based on the output of the COCO analysis

GTI component	Mean of variable weights in estimates (all countries)	Realtive Variable weight (all countries)	Steps to next higher stair value (Hungary)	Steps to next lower stair value (Hungary)	Theoretical Improvement opportunity on GCI* (Hungary)
Demographics	0.3858	6.8%	1	-	0.1
Compulsory education	0.8403	14.9%	1	34	0.1
University education	0.1556	2.8%	23	6	0.05
Quality of labour force	0.1057	1.9%	1	-	0.05
Talent environment	2.7986	49.6%	2	11	0.05
Openness	1.2477	22.1%	5	9	0.1
Proclivity to attracting talent	0.1066	1.9%	50	3	0.1

*Calculation is based on achieving the score of the country with the rank matching the next higher staircase value

Source: Author's own analysis based on data of the Economist Intelligence Unit and the World Economic Forum

From methodology perspective it must be noted that the calculated theoretical GCI improvements in Table-3 will not achieve an actual GCI improvement of the same size in case the necessary intervention is made, due to the fact that other factors in the GCI index have been ignored for the purpose of this evaluation. However this figure is a good indication of the relative sensitivity of the CGI on this component compared to the other components analyzed together.

ADVANTAGES AND LIMITATIONS OF THE METHOD

The chosen COCO method has both advantages and limitations, therefore the results of the analysis need to be interpreted within this context. An advantage of the method is that it does not use the fixed weighting of the components from the source data, thus eliminating a subjective element from the analysis. It also may highlight redundant data, where the result variable's sensitivity is 0 to the particular attribute (in other words, the step values of all objects are identical). Another advantage is that the method quantifies the minimum improvement required to achieve any impact on the result variable. That may prevent suboptimal interventions, e.g. in this case prevents insufficient investment or overspending in a specific area compared to another.

One of the limitations of the method is the loss of information due to the fact that the analysis uses the rank of the GTI components instead of the actual scores, which may distort the final results to some degree. Another limitation is that the calculated theoretical improvements in the result variable are not comparable to the original GCI scores in this case, because the analysis ignores other components of the GCI and focuses only the human capital aspect.

Despite the limitations of the method there are valuable results of the analysis: based on the distance to the next higher or lower step value, as well as the relative sensitivity to the result variable an order of preference can be set among the areas of improvement, helping to highlight the most effective interventions. In order to have more robust results, similar analysis could be performed on different data sets (e.g. reports of consecutive years, or other competitiveness reports). The original question could be approached with other methodologies (e.g. dimension reduction or regression methods). If several analyses reaches similar conclusions, then more reliable decision making could be achieved.

CONCLUSIONS

My analysis of secondary data confirmed that components of the global talent index influence the overall competitiveness of a country. The sensitivity of the competitiveness to the components varies.

Based on the analysis of the GTI components, Hungary's relative strengths are in the openness and the compulsory education. Relative weaknesses of the country are in its demographics and the proclivity to attracting talent (both in the comparison within the overall sample and among the EU member states).

The results of the analysis with the COCO method suggest that in order to improve Hungary's competitiveness through the development of human capital, the most impactful component would be the compulsory education. Improvement on the talent environment and demographics would also make a positive impact on the competitive position of Hungary, however, changes in these areas take longer time and require changes in attitudes, too. Improvement of additional components would require more effort and resource with diminishing improvement in the country's position in competitiveness. On the other hand, protecting the current position is important especially on the demographics, university education and proclivity to attracting talent, because based the lower step values are near, and falling off to them would lead to a negative impact on the competitiveness.

Although the limitations of the research is recognized, the analysis reaches its goal to highlight the connection between the aspects of human capital and competitiveness, and to identify the areas where resources need to be focused in order to achieve positive changes in competitiveness through the development of human capital.

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