Can We Be Competitive without Being Educated? Empirical Findings from European Data

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Abstract: This paper finds positive cross-effects between investment in education and innovation for a cross-section of economies in the European Union (EU) and other selected advanced economies. Other things being equal, economies with a higher level of higher education and training and higher level of innovation tend to experience a higher level of ranking in the global competitiveness index compared to countries with a lower level of education and innovation. The results of this study based on a panel of selected emerging and advanced economies during the 2007-2013 period seem to signal some internationally leading advanced countries (such as the United States) have lost their competitive advantage in the aftermath of the great recession. However, the results also indicate potential methodological inconsistencies in terms of ranking countries based on variables that seem to be statistically significantly correlated with each other, which is a common problem in economics known as endogeneity or reverse causality.

Keywords: Education, innovation, competitiveness.

1 Introduction

There is a widespread consensus on the role of competitiveness in deriving long-term economic growth. This has become even more crucial in the context of the changing nature of the global economic landscape given the intensity of globalization and the advancement of information and communication technologies (ICT). The competition pressure ranges from productivity and efficiency on the firm level to macroeconomic economic policies on the government level and has become largely a question of survival. It is recognized that education and innovation go hand in hand and ensure the emergence of vibrant industries and services that dictate both the level of competitiveness and its dynamics over time.

This paper sheds some light on the link between key determinants of the global competitiveness index with emphasis on education and innovation. The paper is organized as follows: The first part briefly discusses the key theoretical underpinning of the global competitiveness index (GCI) that is compiled by the World Economic Forum (WEF) and the second part discusses the relationships between key factors of competitiveness (pillars) and the position of countries in the global competition index. The third part briefly discusses the theoretical links between innovation and education and their role in the global competitiveness index. The last part brings some conclusions.[1]

2 The global competitiveness index (GCI)

Using a competitiveness index as an indicator of countries' overall performance is undoubtedly a complex issue, as it encompasses both qualitative and quantitative indicators. The complexity of the competitiveness index is also recognized by the World Economic Forum that defines *the global competitiveness index as a set of institutions, policies, and factors that determine the level of productivity of a country, conditions of public institutions and*

[1] We recognize the existence of various competitiveness indices, such as the IMD and World Bank; however, in this paper we will address the broader competitiveness index that is compiled by the World Economic Forum.

technical conditions (Blanke, PAUA , and Sala-I-Martin, WEF, 2003-2004; WEF, 2014).[2] The main ingredients that make up the global competitiveness index are summarized in Table 1 below. As shown in the table, there are basically three pillars (basic requirements, efficiency enhancers and innovation and sophistication factors) that determine a country's competitive advantage. Each pillar consists of several other indicators that are indispensable in terms of achieving and sustaining some level of competitiveness.

Table 1

	Subindexes		
	Basic Requirements	**Efficiency Enhancers**	**Innovation and Sophistication Factors**
	Institutions	Higher Education and Training	Business Sophistication
	Infrastructure	Goods Market Efficiency	Innovation
	Macroeconomic Environment	Labor Market Efficiency	
	Health and Primary Education	Financial Market Development	
		Technological Readiness	
		Market Size	

World Economic Forum (2013), The Global Competitiveness Report 2012-2013 Dataset, Global Competitiveness Index, accessed 28 June 2013.

However, given a significant level of variation across countries in terms of their stages of both human capital and economic development, the drivers of competitiveness are obviously different in different countries. Table 2 summarizes the subindex weights and income thresholds for each stage of development. This seems to signal the difficulties of the global competitiveness index in terms of making cross-country comparisons based on uncommon measurement parameters at least in terms of weights.[3]

Table 2: Subindex weights and income thresholds for stages of development

	STAGE OF DEVELOPMENT				
	Stage 1: Factor-driven	Transition from stage 1 to stage 2	Stage 2: Efficiency-driven	Transition from stage 2 to stage 3	Stage 3: Innovation-driven
GDP per capita (US$) thresholds*	<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%

As is clearly shown on Table 2, the key pillars for the poorest part of the world are different indicators classified under basic requirements in Table 1 while innovation seems to be a predominant variable for advanced economies.

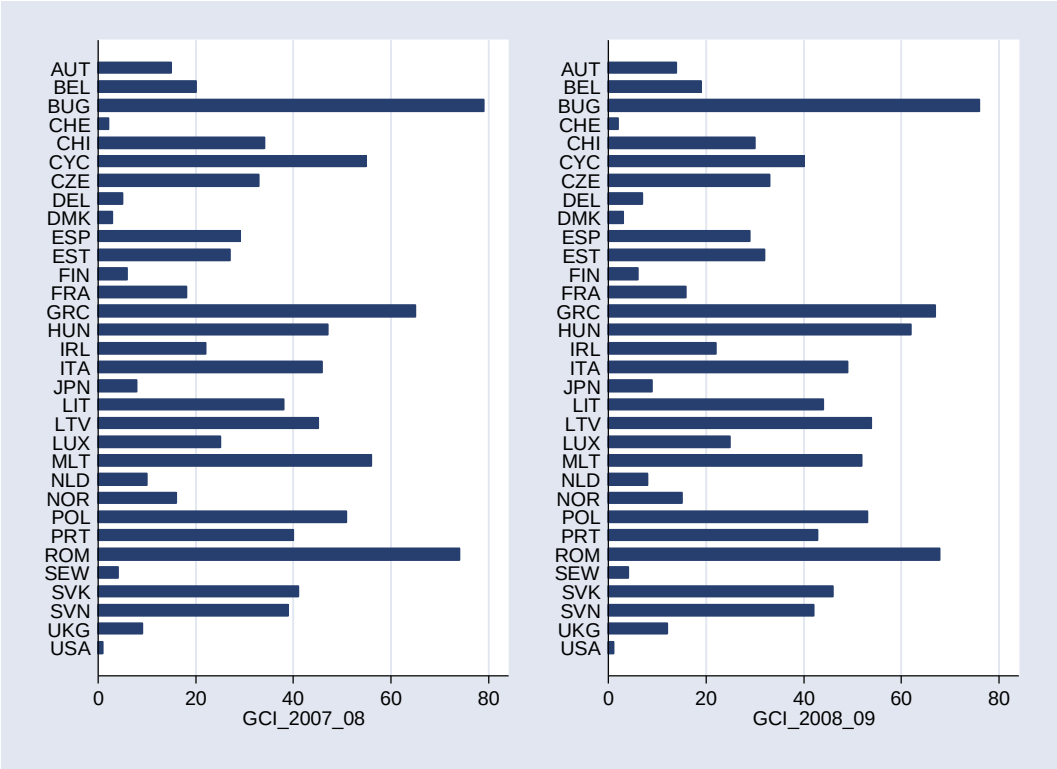
The global competitiveness index as compiled by the WEF in the past two decades or so seems to indicate the leading position of advanced economies. However, it should be recognized that other emerging economies have

[2] JENNIFER BLANKE FIONA PAUA, and XAVIER SALA-I-MARTIN, The Growth Competitiveness Index: Analyzing Key Underpinnings of Sustained Economic Growth, http://www.weforum.org/pdf/Gcr/GCR_2003_2004/GCI_Chapter.pdf

[3] For a broader discussion of criticisms against the Global Competitiveness Report, see Sanjaya Lall (2001), Competitive Indices and Developing Countries, An Economic Evaluation of the Global Competitiveness Report, *World Development*, Vol. 29, No. 9, pp. 1501-1525.

managed to achieve a remarkable convergence during the past few years or so. Graph 1 shows the position of selected advanced and emerging economies during the pre-crisis period. The results indicate the leading position of the United States and Switzerland, followed by other western European economies.

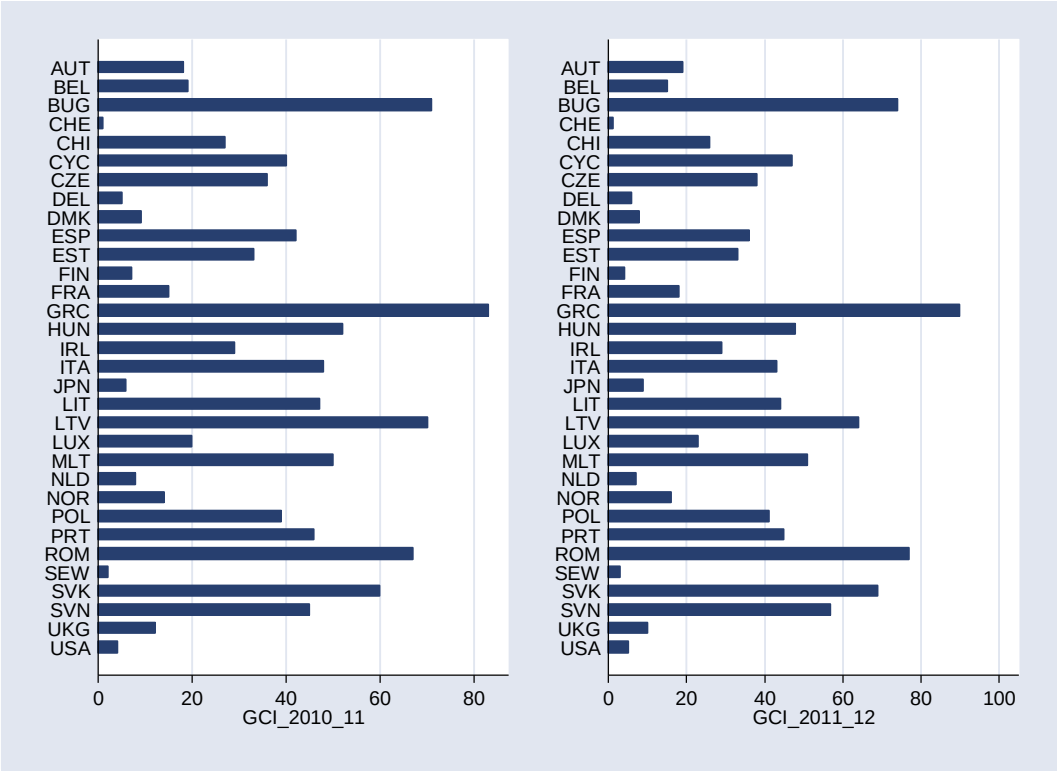
Graph 1: Global competitiveness index 2007-2008 and 2008-2009



Authors' compilation based on WEF (2008)

As the crisis deepened (2010 and beyond), however, the United States lost its competitiveness, and other countries, notably Switzerland and Scandinavian countries, came out as winners (see, graphs 3-5).

Graph 2: Global competitiveness index 2009-2010

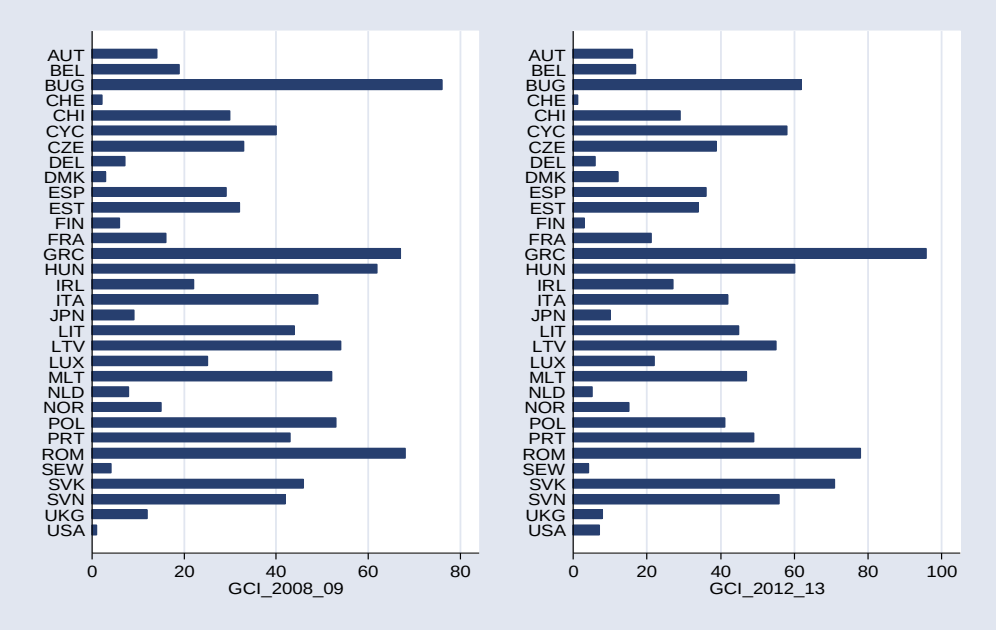


Authors' compilation based on WEF (2008)

The differences in global competitiveness ranking are even more remarkable when one compares the crisis period against the "post-crisis" period, where the United States, for instance, moved from the first place in 2008-2009 to the seventh place in 2012-2013, while Switzerland came out first, taking over the US's position. In this respect, Slovakia is among those countries that lost their competitiveness ranking in recent years.[4] In contrast, most of the Scandinavian countries and some emerging economies (such as Brazil, Turkey, Mexico and others) have either maintained their global competitiveness position or improved over time.

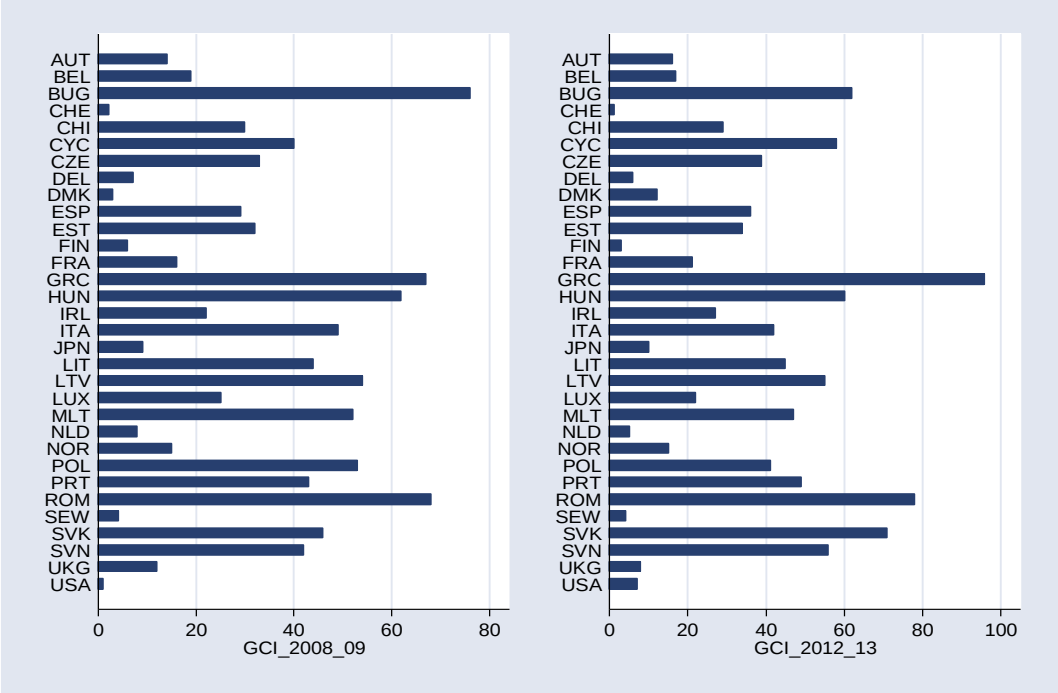
[4] Slovakia, for instance, is lagging behind not only in ICT investment but also in ICT use, such as e-learning (Melicheríková and Bušíková, 2012, and Simuth, 2015) and strategies to improve e-learning in small and medium size companies in selected EU member states.

Graph 3: Global competitiveness index 2010-2011



Authors' compilation based on WEF (2008)

Graph 4: Global competitiveness index 2008-2009 and 2012-2013



Authors' compilation based on WEF (2008)

3 The role of education and innovation in competitiveness

As has been discussed, the global competitiveness index consists of three pillars and twelve variables. While the contribution of each variable in boosting competitiveness is undisputable, there are differences when it comes to their relative significance to the global competitiveness index. Table 3 summarizes correlation matrices of GCI ranking and aggregate pillars during the 2007-2013 period. The results are based panel data of the aforementioned period. Descriptive statistics are summarized in Table 4.

Table 3: Correlation matrices of competitiveness ranking and other pillars based on panel data (2007-2013)

	GCI_ranking	BR_ranking	EE_ranking	ISF_ranking
GCI_ranking	1			
BR_ranking	0.9001* (0.000)	1		
EE_ranking	0.9649* (0.000)	0.8283* (0.000)	1	
ISF_ranking	0.9431* (0.000)	0.8179* (0.000)	0.9251* (0.000)	1

Authors' computations based on WER data, 2007-2013 panel data
Notes: GCI – Global Competition Index, BR - Basic Requirements, EE – Efficiency Enhancers, and ISF - Innovation and Sophistication Factors.

Table 4: Descriptive statistics of global competitiveness ranking and other rankings

Variable	Obs	Mean	Std. Dev.		Min	Max
GCI	276	37.2	25.1754		1	96
BR	276	38.8	25.8131		1	101
EE	276	33.7	22.4177		1	98
ISF	276	38.3	29.1458		1	124

Authors' computations based on WER data, 2007-2013 panel data

From the results summarized in Table 3 it seems apparent that while all the pillars contribute to global competitiveness ranking, efficiency enhancers (EE) and innovation and business sophistication factors (ISF) seem to have played a more valuable role in the ranking compared to basic requirements (BR). The results of the correlation matrices of overall ranking of countries in GCI and other pillars have been confirmed by ranking of countries in terms of scores (Table 5). Descriptive statistics for the scores are summarized in Table 6 and indicate the highest standard deviation in ISF indicator (the minimum value of 2.57 and maximum value of 5.80).

Table 5: Correlation matrices of scores of each pillar and overall competitiveness (panel data, 2007-2013)

	GCI_Score	BR_Score	EE_Score	ISF_Score
GCI_Score	1			
BR_Score	0.9349* (0.000)	1		
EE_Score	0.9779* (0.000)	0.9043* (0.000)	1	
ISF_Score	0.9696* (0.000)	0.8857* (0.000)	0.9340* (0.000)	1

Authors' computations based on WER data, 2007-2013 panel data

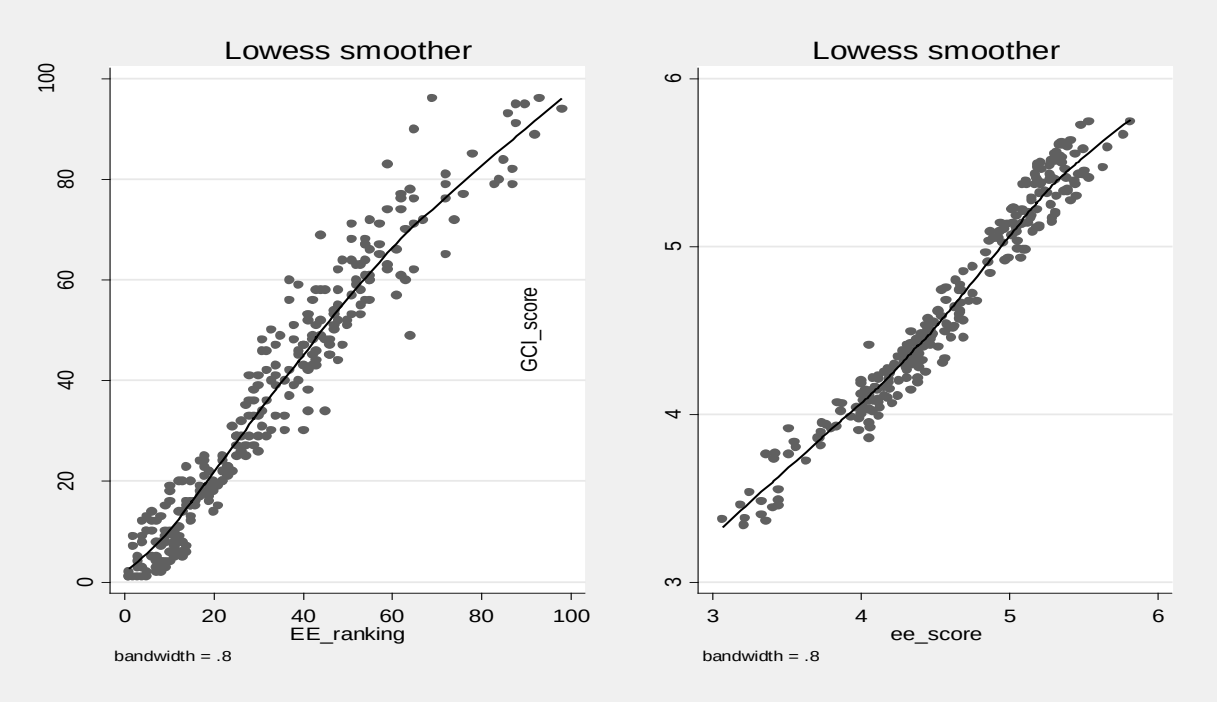
Table 6: Descriptive statistics of ranking according to scores (panel data, 2007-2013)

Variable	Obs	Mean	Std. Dev.	Min	Max
GCI_score	270	4.640407	0.60576	3.34	5.74
BR_score	270	5.046185	0.68000	3.40	6.22
EE_score	270	4.586037	0.68000	3.07	5.81
ISF_score	270	4.241889	0.87034	2.57	5.80

Authors' computations based on WER data, 2007-2013 panel data

The results in this respect are in line with what we would expect given the fact that most of the countries under investigation in the study have advanced economies. However, the results also suggest that the pillars themselves are correlated to each other and this makes the ranking of countries methodologically difficult to interpret.

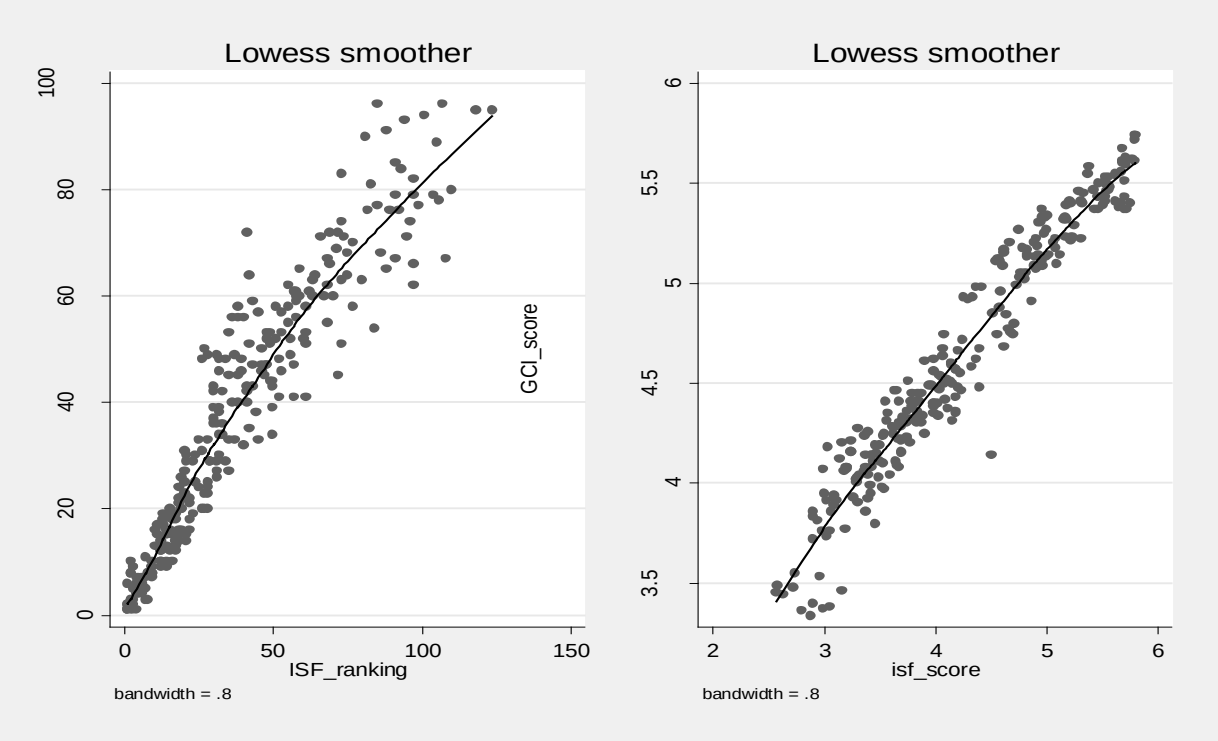
Graph 5:
Global Competitiveness Index ranking (score) and efficiency enhancers (EE) ranking (score)_2007-2013 panel



Source: authors' computations based on World Economic Forum data.
Note: In the ranking scale, the lower the value (closer to 1) the better the country is. In contrast, in scores, the higher the value (the closer to seven) the better a country is.

Graph 5 shows the relationship between overall ranking (both GCI ranking and GCI score) of countries against their EE (efficiency enhancers) ranking and scores during the 2007-2013 period. Both indicators show, to a large extent, a linear relationship between GCI ranking (score) and EE ranking (score) during the period under investigation. This seems to suggest that countries with the highest ranking and/or score (vertical scale) are those with the highest EE ranking and/or scale (horizontal scale). The results are in line with the results in Table 5.

Graph 6: Global Competitiveness index ranking (score) and innovation and business sophistication (ISF) ranking (score)_2007-2013 panel

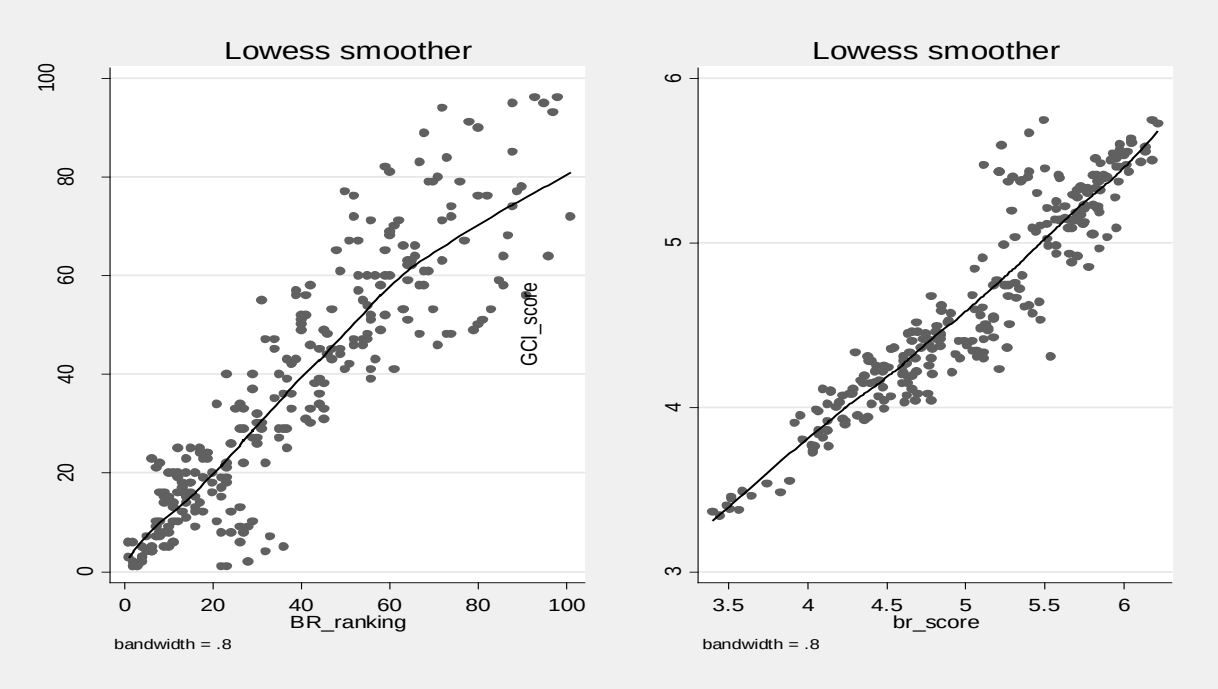


Source: authors' computations based on World Economic Forum data.

Graph 6 presents the relationship between overall ranking (GCI ranking and/or score) and ISF ranking (score) during the 2007-2013 period. The results are fundamentally similar to the EE indicators discussed earlier. However, both efficiency enhancers and innovation and sophistication factors seem to have been less valuable for the overall ranking of countries above around the 60th place.

Graph 7 summarizes the link between GCI ranking (score) and BR (basic requirements) ranking (score) during the same period as previous pillars. This indicator is even harder to interpret as basic requirements in all advanced economies are taken for granted simply because neither efficiency enhancers nor innovation and sophistication factors would exist without having basic requirements in place. This is also apparent from the correlation matrices and corresponding descriptive statistics summarized in tables 3 and 5, where there is a statistically significant relationship between efficiency enhancers as well as innovation sophistication factors and basics requirements. The legitimate question is whether it is possible to clearly quantify the determinants of overall ranking of countries over time based factors that are significantly correlated to each other.

Graph 7:
Global Competitiveness Index ranking (score) and efficiency enhancers (EE) ranking (score)_2007-2013 panel



Source: authors' computations based on World Economic Forum data.

3.1 Education, innovation and competitiveness: A decomposition approach

There is a bulk of theoretical and empirical literature that deals with the role of human capital accumulation in innovation, competitiveness and long-run economic growth. One line of argument focuses on the link between human capital (often proxied by education) and technological advancement. In this respect, it is assumed that both production and diffusion of technology would have been minimalized, if not impossible, without having an educated population (Nelsen and Phelps, 1966, AER). Put differently, a larger stock of human capital makes it easier for nations to imitate new ideas developed elsewhere, which helps to accelerate the catch-up process both in innovation and in economic growth.

The second line of argument comes via endogenous growth theory (Romer,1986; Lucas, 1988) that emphasizes the role of human capital in research and development. Human capital (an educated population) is considered as a fundamental input into the research sector, where current research has a positive spillover for the productivity of future research, resulting in innovation and growth. In this context, there is widespread recognition that research and development are intensive in human capital relative to other sectors that produce consumables and intermediate goods. One peculiarity of the underlined relationship is that the cost of inventing a new product declines as the society accumulates more ideas.

In this paper, we look at the relationship between overall GCI ranking (score) and other variables with emphasis on education and innovation. The results in Table 7 indicate statistically significant correlation between GCI score and human capital and training (HET) score and innovation score. The descriptive statistics also indicate a significant level of variation across countries (as measured by standard deviation).

Table 7: Correlation matrices of selected competitiveness indicators (2007-2013) panel

	GCI_score	HET_score	TR_score	INOV_score	BS_score
GCI_score	1				
HET_score	0.8693*	1			
TR_score	0.7107*	0.7859*	1		
INNOV_score	0.9194*	0.8269*	0.7537*	1	
BS_score	0.9236*	0.8249*	0.7632*	0.9177*	1

Source: authors' computations based on World Economic Forum data.

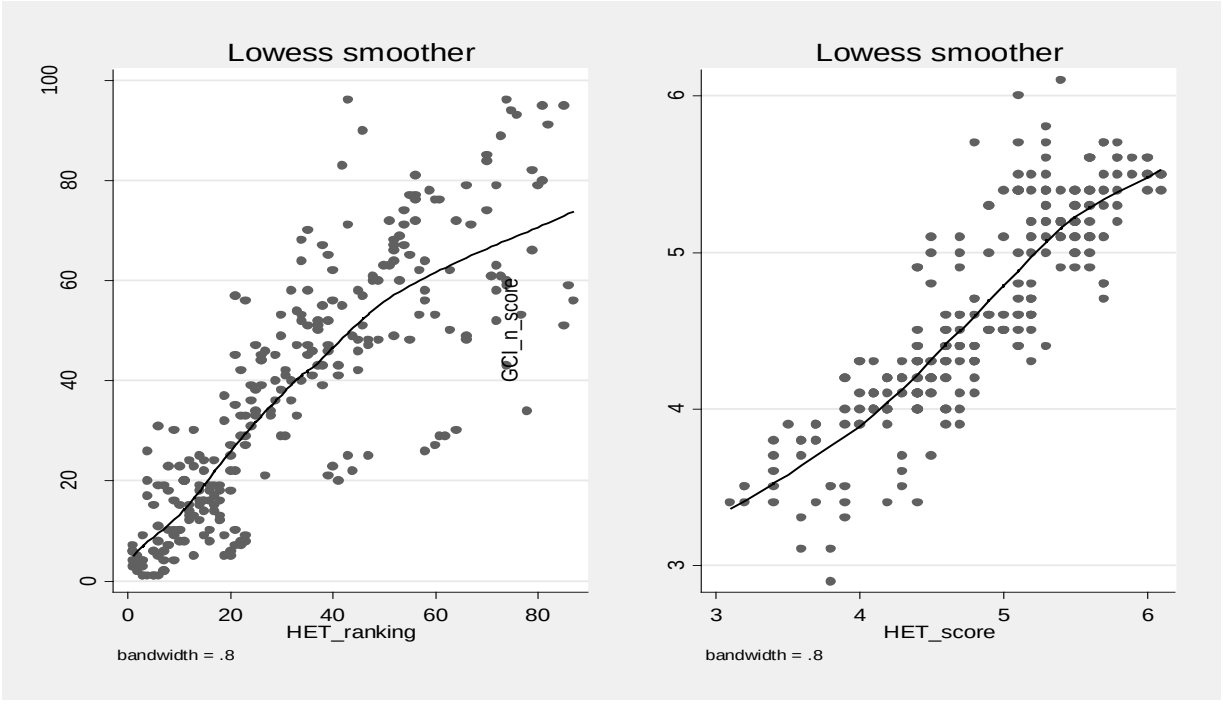
Table 8: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GCI_score	270	4.611111	0.6655257	2.9	6.1
HET_score	270	4.817037	0.6764263	3.1	6.1
TR_score	270	4.532222	1.036418	2.1	6.9
INOV_score	270	3.942407	0.9847966	2.01	6.64
BS_score	270	4.473704	0.8715309	2.1	6.6

Source: authors' computations based on World Economic Forum data.

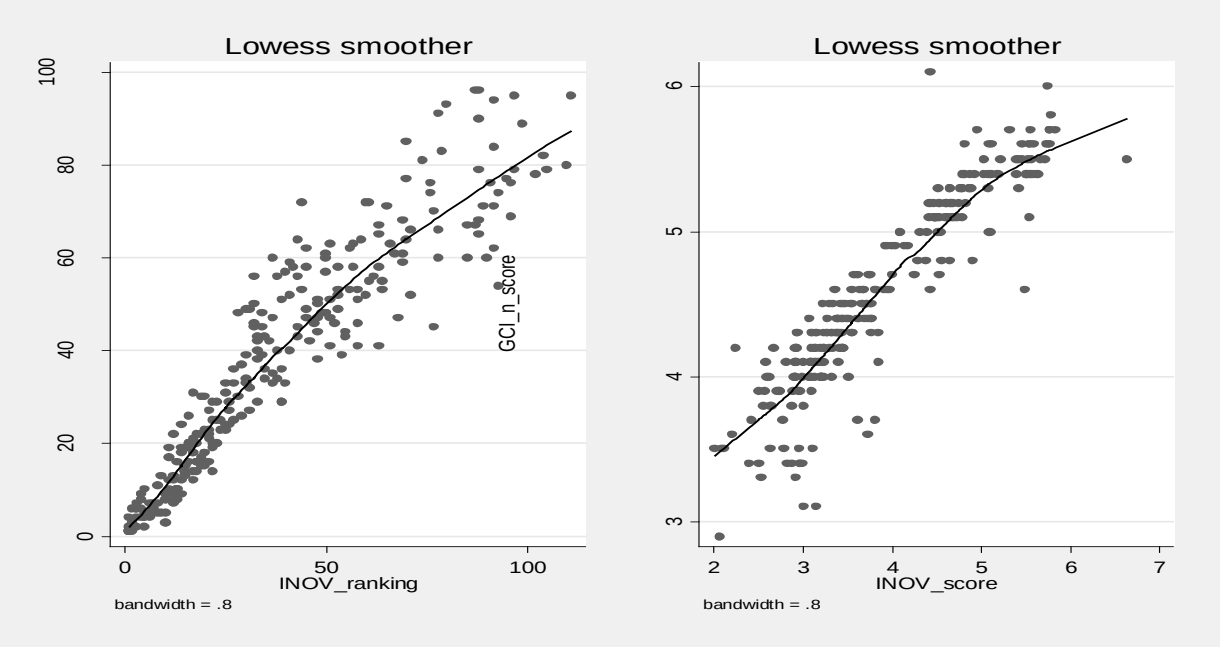
Graphs 8 and 9 present the relationship between overall GCI ranking (score) and human capital and training ranking (score) during the period 2007-2013. While the HET seems to be positively correlated to GCI, the results are less valuable compared to the correlation between GCI ranking (score) and innovation ranking (score).

Graph 8: GCI ranking (score) and HET ranking (score)_2007-2013 panel



Source: authors' computations based on World Economic Forum data.

Graph 9: GCI ranking (score) and Innovation (inov) ranking (score)_2007_2013 panel

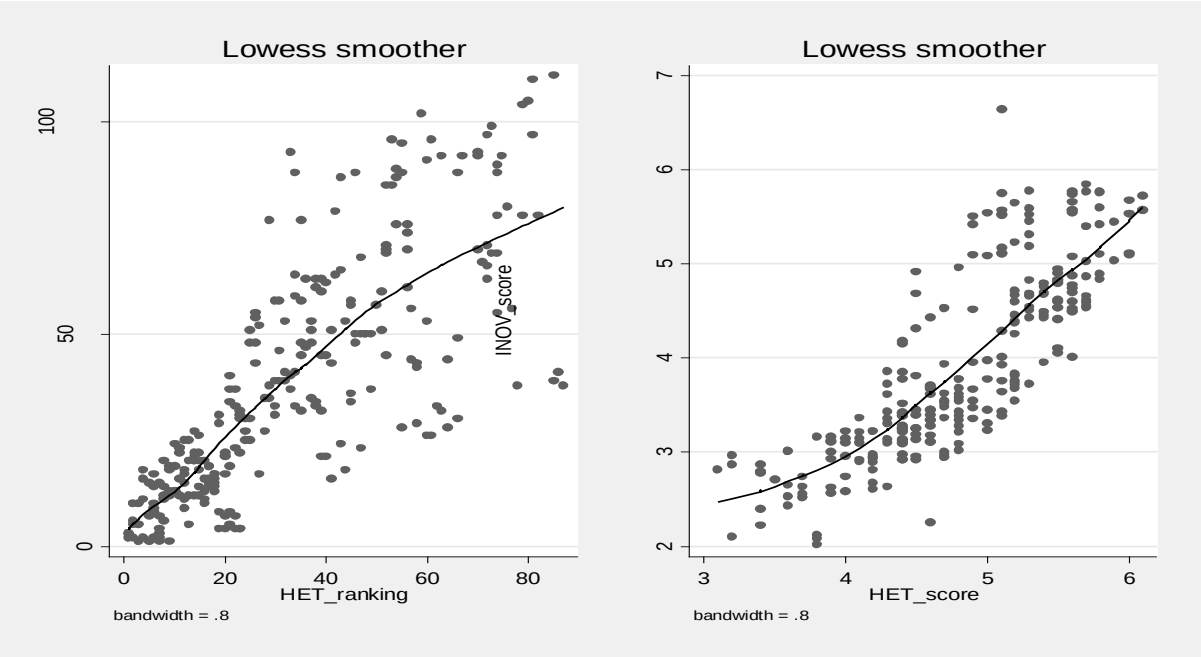


Source: authors' computations based on World Economic Forum data.

The results are also presented in graphs 8 and 9. However, we again emphasize the prevalence of an endogeneity (reverse causality) problem in measuring overall competitiveness based on variables that are correlated to each other. One piece of evidence to point out is the high level of correlation between the HET variable and the innovation variable (Table 7). This seems to suggest human capital may impact overall competitiveness through two or more channels. First, human capital, as measured by higher education and training (HET), may help economies to improve their competitive advantage through innovation, where human capital plays a pivotal role.

Graph 10 presents the relationship between the innovation ranking (score) and the higher education and training (HET) ranking (score). The graph is slightly concave for the ranking (left quadrant), implying the higher the ranking (the higher the value the worst the ranking) the less significant the education variable towards the ranking of countries. In other words, advanced economies in the ranking (the first top 20 places or so) seem to have benefited more from the HET variable compared to countries (economies) in the worst ranking (above 40th place or so). Nonetheless, the graph takes almost a convex shape when it shows the relationship between innovation ranking in terms of score and HET ranking in terms of score. This seem to suggest the higher the ranking in innovation in terms of scores (that is, the closer the ranking to 7, which is the highest ranking) the higher the ranking of countries in HET score. This is again in line with what we would expect, i.e. economies with the highest level of education and training are those that are innovative, and vice versa. Nonetheless, the significance of other variables in boosting innovation should also be recognized.

Graph 10: Innovation and human capital (HET) 2007-2013 panel



Source: authors' computations based on World Economic Forum data.

Table 9 presents correlation matrices of all the variables that are considered critical in determining the overall competitiveness ranking of countries during the 2007-2013 period. Table 10 presents respective descriptive statistics. The results indicate the role of innovation (taking the highest value) in the competiveness ranking of countries during the period under investigation.

Table 9: Correlation matrices of decomposed data

	GCI	INST	HPE	HET	FMD	TR	BS	INOV
GCI	1							
INST	0.8621* (0.000)	1						
HPE	0.6780* (0.000)	0.7354* (0.000)	1					
HET	0.7969* (0.000)	0.7969* (0.000)	0.8240* (0.000)	1				
FMD	0.6723* (0.000)	0.7481* (0.000)	0.4227* (0.000)	0.5139* (0.000)	1			
TR	0.7626* (0.000)	0.7817* (0.000)	0.7734* (0.000)	0.8696* (0.000)	0.5436* (0.000)	1		
BS	0.8950* (0.000)	0.8077* (0.000)	0.5934* (0.000)	0.6889* (0.000)	0.6323* (0.000)	0.7020* (0.000)	1	
INOV	0.9234* (0.000)	0.8230* (0.000)	0.6176* (0.000)	0.7550* (0.000)	0.5577* (0.000)	0.6953* (0.000)	0.8917* (0.000)	1

Source: authors' computations based on World Economic Forum data.
Notes: GCI - GCI Ranking; INST - Institutions; HPE - Health and Primary Education; HET - Higher Education and Training; FMD - Financial Market Development; TR - Technological Readiness; BS - Business Sophistication; and INOV – Innovation

Table 10: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GCI	258	34.03101	22.73428	1	96
INST	258	44.3062	33.59039	1	133
HPE	258	32.77907	23.77786	1	104
HET	258	30.08527	20.99621	1	87
FMD	258	44.58915	32.79855	1	132
TR	258	30.34109	21.0881	1	96
BS	258	35.56977	27.26218	1	119
INNOV	258	34.22868	25.26463	1	102

4 Conclusion

This paper discusses the contribution of various factors (as defined by the World Economic Forum - WEF) on the competiveness ranking of countries in the past two decades. The results of the paper indicate that while all the variables as defined by the WEF offer meaningful results and there is statistically significant relationship between the global competitiveness index (GCI) and all the variables that consist of three pillars and twelve variables, there are inconsistencies of the ranking methodology based on two fundamental problems. First, the results do not yield the same (identical) results when one takes overall rankings and scores. Second, an even more serious methodological problem emerges when one looks at the correlation matrices of both ranking values as well as rankings in terms of scores. This is an important reminder of the endogeneity (reverse causality) problem in economic analysis in general and ranking of countries based on variables that are correlated to each other. It is unthinkable for an economy to be innovative without research and development activities, which is again unthinkable without having a well-educated and trained population. Therefore, rankings of countries should only be taken within context and caution and could well be misleading at times. However, with the absence of better methodology and socio-economic indicators, they still may give some useful signals in terms of identifying weaknesses and strengths and help governments in terms of designing appropriate economic policies to improve countries' competitiveness position.

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