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A multidimensional, comparative analysis of the regional entrepreneurship performance in the Central and Eastern European EU member countries ¹

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Abstract

This paper aims to examine the entrepreneurial performance of the Central and East European (CEE) regions by applying the Regional Entrepreneurship and Development (REDI) index approach. The REDI index structures the individual and the institutional elements of entrepreneurship in a systemic way by taking into account the mutual dependence of its components. We have demonstrated that the overall entrepreneurial performance of the CEE regions is below that of the other two, South Europe (SE) and the North-Western European macro-regions. We found that CEE country regions tend to cluster together – as do SE and former East German regions. Besides notable similarities, CEE country regions differ significantly in terms of the configuration of their fourteen pillars. In general, CEE regions are weak in Entrepreneurial Attitudes but relatively strong in Entrepreneurial Aspirations related pillars. Albeit, the Entrepreneurial Abilities related Opportunity Start-up is the most problematic pillar that reflects to the high ratio of necessity motivated start-ups in these regions. In the final section, we present an entrepreneurship policy portfolio for each CEE region, based on the assumption that the weakest performing elements of entrepreneurship should be improved in order to achieve maximal improvement in the overall REDI scores. The Penalty of Bottleneck methodology underlines the importance of an individual based tailor-made policy as opposed to a uniform, “one size fit to all” approach.

Keywords

entrepreneurship, regional development, REDI, Penalty of Bottleneck, CEE regions

1. Introduction: Entrepreneurship and its measure

Entrepreneurship research has changed considerably over the last thirty years, and today entrepreneurship is widely accepted as a major driving force of economic development, of the creation of employment and of innovation (Acs et al. 2008, 2009, Carree and Thurik 2003, Braunerhjelm et al. 2010, Lazear 2004). However, the dynamics of the effect of entrepreneurship are very diverse and depend on many factors such as the development level of the home country and the institutional context (Acs et al. 2008). Whilst previous studies on entrepreneurship have focused on examining the role of entrepreneurial activity and start-up rates, recent research has shown that not all entrepreneurial activity is effective. High growth rates, such as those achieved by innovative gazelle companies, are responsible for the bulk of new job creation and growth, whilst other, non-innovative or traditional businesses have only minor economic influence (Acs and Mueller 2008, Baumol 1996, Wong et al. 2005).

The other major breakthrough of entrepreneurship research was the recognition of the environmental factors in venture creation and, ultimately, on growth and development. The design and implementation of successful entrepreneurial start-ups require attention, not only to individual and firm-specific strengths and weaknesses, but also to the wider institutional context within which the new ventures operate (Henrekson and Johansson 2011, Zahra and Nambisan 2011). Most recently, entrepreneurship researchers have acknowledged that the individual elements of the environment should not be interpreted in isolation from each other. In fact, the entrepreneurial ecosystem of a country or region comprises a system of mutually dependent factors (Furerlinger et al. 2014, Stangler and Bell-Masterson 2015).

Whilst the conceptualization and contextualization of entrepreneurship have developed rapidly, research into measuring within the topic has lagged behind. According to Acs et al. (2014) there are three major lines of approach which should be adopted, and these are output, attitude and framework. If entrepreneurship is defined as a start-up or existing business and quantified by output measures such as self-employment, total –early phased entrepreneurial activity (TEA) or business density data, then entrepreneurship is positively correlated with short term growth, but negatively with economic development as reflected in GDP per capita (Shane 2009, Szerb et al. 2013). A declining trend of ‘output-to-development’ rate is a frequent product of empirical studies (Carree et al. 2002, Noseleit 2013, Wennekers and Thurik 1999) and these findings underline the fact that not all entrepreneurship is good (Baumol 1996); and there is a place for alternative ways to measure entrepreneurship other than simple indicators (Stenholm et al. 2013).

Measuring attitudes is even more problematical since this is based on a survey of perceptions, attitudes and beliefs, which may or may not lead to a business being started (Acs et al. 2014). Framework measuring, with the help of tools such as the World Bank's 'Ease of Doing Business' or the Heritage Foundation's 'Economic Freedom Index', captures at least part of the entrepreneurial (regulatory) framework, but tells us little or nothing about the type of activity emerging in a particular framework context (Acs et al. 2014). We believe that the entrepreneurial performance of a given region can be measured and interpreted by examining the individual elements of the institutional framework together with the interaction between them.

The Global Entrepreneurship Index (GEI) approach – which we intend to use here – is based on three important premises which provide an appropriate platform for analysing entrepreneurial ecosystems. Firstly, entrepreneurship is fundamentally action undertaken and driven by agents - and so individual level data is needed to show the dynamics of an entrepreneurial ecosystem. Secondly, individual action is controlled by an institutional framework for entrepreneurship – and so relevant institutional level data are also needed for the same purpose. Thirdly, such ecosystems are complex, multifaceted structures in which many elements interact to enable the systems to function, and so the index method needs to allow these elements to interact. This novel index building approach also makes it possible to identify the strengths and weaknesses of a particular geographical unit and to provide tailor-made rather than uniform solutions to the problems of how to develop entrepreneurship.

Recent research reinforces the view that the distribution of entrepreneurial activity and entrepreneurship are spatially unbalanced (Acs 2010, Audretsch and Fritsch 2002, Fritsch and Schmude 2006, Feldman 2001, Sternberg 2012). Our emphasis on the controlling influence of the institutional context implies that entrepreneurship is best studied at levels which transcend the individual decision to involve oneself in such activity. Whilst many rules and regulations may exist at national level, there are other related contexts such as human capital, finance, education, networking/clustering, innovation etc., in which a level below the national is more appropriate (Feldman 2001, Stam 2007, Sternberg 2012, Henrekson and Johansson 2011, Westlund and Bolton 2003, Kerr and Nanda 2009). The Regional Entrepreneurship and Development Index (REDI) methodology is based on the GEI, which measures entrepreneurship at country-level. This latter index has now been implemented for measuring the entrepreneurial performance of a mixture of 125 NUTS1 and NUTS2 EU regions, a process which includes changes to the environmental and institutional variables to reflect the regional forces of agglomeration, connectivity and clustering (Kömlösi et al. 2015).

This paper focuses on an examination of the entrepreneurial performance of the Central and East European (CEE) regions by applying the REDI Index. The relevance of the topic is highlighted by the fact that regional entrepreneurship has not yet, to the best of our knowledge, been seriously investigated in the CEE countries. Since regional disparities have drastically increased since the start of the transition in many CEE countries (Sokol 2001, Blažek and Netrdová 2012), it is worth investigating the connection between the differences in levels of development and of entrepreneurship. Since REDI is designed to explain development, we expect that CEE country and regional differences are also, at least partially, due to differences in entrepreneurial performance. We aim to compare CEE regions to other European regions by examining their entrepreneurial profile based on the fourteen pillars of entrepreneurship. Finally, we present an entrepreneurship policy portfolio for each CEE region, based on the assumption that the weakest performing elements of entrepreneurship should be improved in order to achieve maximal improvement in entrepreneurship ecosystems.

The study is structured in the following way. Firstly, in section 2, we offer a brief review of the development of entrepreneurship in the context of the politico-economic transition in the CEE countries, and in the following part we describe REDI methodology and the related measure procedures before examining the 29 Central and East European (CEE) regions. We next compare these CEE regions' REDI scores with those of the other EU regions in relation to their level of development, whilst the REDI scores and the three sub-indices are investigated in comparison with two other macro-regions (section 4). Our examination of the 'Fourteen Pillars' is based on a cluster analysis (section 5). We then present our concept of a 'tailor-made entrepreneurship policy optimization' as a separate section - immediately prior to the conclusion of the study.

2. Entrepreneurship in the CEE countries

The investigation of entrepreneurship in the transition context is relatively new, since private enterprises could only be freely established after the introduction of market economy institutions. Whilst some forms of private business existed even in the planned economy, their operations were closely monitored and strictly regulated (McMillan and Woodruff, 2002). After the transition the regulations and economic environment changed to provide a favourable environment for individuals to start their own business (Kornai 2006). The Czech Republic, Poland, Hungary and Slovenia played leading roles in this, and their economies performed better than other transition economies. Later, Slovakia and the three Baltic states

caught up to these countries (Szerb and Trumbull 2016). The 1990s saw an “entrepreneurial boom” in the CEE countries, fuelled by the high demand for normal consumer goods and by the increased supply of labour due to rising unemployment and the privatization of existing businesses (Kornai 1992, Tyson et al. 1994). Institutions, private and public agencies also played a role in supporting *de novo* business start-ups (Bateman 2000, Smallbone and Welter 2001), although many of these new businesses were unproductive or destructive (Sauka 2008). At the same time, innovative, productive entrepreneurship was lacking in all CEE countries (Smallbone and Welter 2001).

By the late 1990s the situation of the CEE transition countries had changed: Privatization had come to an end and basic market economy institutions were operating. Markets were quickly saturated as shortages disappeared. The further opening of the domestic market to foreign businesses intensified competition, resulting in shrinking local market opportunities and a declining rate of business activity (Szerb and Trumbull 2016). This change was further strengthened by EU Accession in 2004 and the related opening of the domestic markets. The lack of productive, entrepreneurial ventures became obvious, calling for further institutional changes and refinements (Chepurensko 2015, Estrin et al. 2006, Smallbone and Welter 2012). However, policy makers also had to take into account the fact that, besides formal institutions, informal institutions, attitudes, social norms and - in general - trust are also highly important factors in the development of entrepreneurship in these countries (Estrin and Mickiewicz 2011).

The economic crisis starting in 2007 exposed the weaknesses of small business and entrepreneurship development in the transition context. According to van der Zwan et al. (2011), European transitional country entrepreneurial progress was greatly hindered by perceived environmental constraints such as the administrative complexity of business start-ups. However, recovery has been very different in the CEE countries, underlining the fact that these transitional countries are not homogenous (Chepurensko 2015).

3. Measuring regional entrepreneurship: From definition to measure

Whilst Szerb and Trumbull (2016) examined country-level entrepreneurship in transitional countries, here we turn to regional-level analysis. Following Acs et al. (2014), we define the Systems of Entrepreneurship as follows: “A System of Entrepreneurship (SE) is the dynamic, institutionally embedded interaction between entrepreneurial attitudes, ability, and aspirations, by individuals, which drives the allocation of resources through the creation and operation of new ventures” (Acs et al. 2014, p. 119). REDI is created to measure SE in a regional context.

This definition implies that REDI conceptualizes entrepreneurship as a trial-and-error process of knowledge spillovers and resource allocation which is driven by individuals and regulated by context and which drives the allocation of resources towards productive use in the economy (Qian et al. 2013).

With the creation of the REDI index, our main objectives were (1) to identify the crucial regional drivers of the entrepreneurial “discovery” process, (2) to emphasize the system-characteristics of these identified drivers, (3) to find adequate regional (or country-level) variables and proxies, and (4) to provide a useful tool to analyse alternative entrepreneurship policy scenarios. This is why the REDI index was designed to incorporate fourteen different pillars, each created as a product of individual- and institutional-level data. A careful scrutiny of the relative differences between individual pillars, both within a given region and across benchmark regions, should provide good initial guidance for the search for prospective strengths and weaknesses across regions.

The GEI indicators, which use country-level institutional and individual (survey) data, should be modified to reflect regional conditions, and so, in addition to country-level data, the indicators now include regional institutional and individual variables also. Regional level variables show the local spillover effects of agglomeration (size of region, market potential), connectivity, networking/clustering, social capital, education systems, human capital, the effects of knowledge spillover and innovation, the role of regulation, the quality of governance and also of finance.

We propose a six-level index-building process: (1) sub-indicators, (2) indicators, (3) variables, (4) pillars, (5) sub-indices, and, finally, (6) the super-index. The most important building blocks are the fourteen pillars which contain, simultaneously, regional individual, regional and country-level institutional variables. These pillars comprise three sub-indices: Entrepreneurial Attitudes (5 pillars), Abilities (4 pillars), and Aspirations (5 pillars). Regional and country-level variables are drawn from different database and the variables from 40 indicators. Some institutional indicators are complex creations in themselves, comprising 76 sub-indicators in total. (For more detail see Szerb et al. 2014).

Figure 1

The structure of the Regional Entrepreneurship and Development Index

Structure of the GEDI 3 Sub-indices 14 Pillars		National and regional institution variables	Regional level individual variables
Entrepreneurial <i>Aspiration</i> Sub-index	Financing	FINANCIAL INSTITUTIONS	INFORMAL INVESTMENT
	Globalization	CONNECTIVITY	EXPORT
	High growth	CLUSTERING	GAZELLE
	Process innovation	TECHNOLOGY DEVELOPMENT	NEW TECHNOLOGY
	Product innovation	TECHNOLOGY TRANSFER	NEW PRODUCT
Entrepreneurial <i>Ability</i> Sub-index	Competition	BUSINESS STRATEGY	COMPETITORS
	Human capital	EDUCATION & TRAINING	EDUCATION LEVEL
	Technology sector	ABSORPTIVE CAPACITY	TECHNOLOGY LEVEL
	Opportunity start-up	BUSINESS ENVIRONMENT	OPPORTUNITY MOTIVATION
Entrepreneurial <i>Attitudes</i> Sub-index	Cultural support	OPEN SOCIETY	CARRIER STATUS
	Networking	SOCIAL CAPITAL	KN OW ENTREPRENEURS
	Risk acceptance	BUSINESS RISK	BUSINESS ACCEPTANCE
	Startup skills	QUALITY OF EDUCATION	SKILL PERCEPTION
	Opportunity perception	MARKET AGGLOMERATION	OPPORTUNITY RECOGNITION

Source: authors' own construction.

The entrepreneurial attitude (ATT) sub-index aims to identify the attitudes of a region's population as they relate to entrepreneurship. The entrepreneurial abilities (ABT) sub-index is principally concerned with measuring certain important characteristics of both entrepreneur and start-up with high growth potential. The entrepreneurial aspiration (ASP) sub-index refers to the distinctive, qualitative, strategy-related nature of entrepreneurial start-up activity.³

REDI provides serious guidance for creating conditions in which a region's entrepreneurial dynamics function efficiently and can be used as a platform which *facilitates the design of effective tailor-made development policies* in EU regions. However, any regional System of Entrepreneurship would necessarily be much more complex than an index such as the REDI could fully capture.

Our index incorporates both individual-level and institutional variables. The former are based on indicators from the Global Entrepreneurship Monitor (GEM) Adult Population Survey dataset, and for present purposes we have used the 2007-2011 pooled GEM data. Since the GEM dataset lacks the necessary institutional variables, we complemented it for the index with other widely-used and relevant data derived from a variety of sources available as at December 31st 2013.

³ A more detailed description of the pillars can be found: Szerb et al. (2014): REDI: The Regional Entrepreneurship and Development Index – Measuring regional entrepreneurship. Final report. European Commission, Directorate-General for Regional and Urban policy, Luxembourg. (Appendix A and C) http://ec.europa.eu/regional_policy/information/studies/index_en.cfm#1 (September 25, 2014)

4. Entrepreneurial performance and economic development in the CEE regions

According to the REDI methodology⁴ described in Appendix, we have calculated the REDI scores for 125 regions of 24 EU countries (Table 1).

Table 1

The REDI ranking and REDI scores of the 125 European Union regions*

Rank	Code	Region	REDI	Rank	Code	Region	RED I	Rank	Code	Region	REDI
1	DK01	Hovedstaden	82.2	42	UKF	East Midlands (UK)	55.3	83	ES41	Castilla y León	36.8
2	UKI	London	79.9	43	DEA	Nordrhein-Westfalen	55.0	84	ES62	Región de Murcia	36.7
3	FR1	Île de France	79.2	44	DEC	Saarland	54.9	85	ES13	Cantabria	36.5
4	SE11	Stockholm	73.8	45-46	UKL	Wales	54.7	86-88	ITH	Nord-Est	36.1
5	SE12	Östra Mellansverige	72.7	45-46	ES30	Comunidad de Madrid	54.7	86-88	PL5	Region Poludniowo-Zachodni	36.1
6	SE23	Vastsverige	72.2	47	DE6	Hamburg	54.3	86-88	PL1	Region Centralny	36.1
7-8	IE02	Southern and Eastern	72.0	48	AT2	Südösterreich	52.0	89	DE8	Mecklenburg-Vorpommern	35.6
7-8	DK05	Nordjylland	72.0	49	FR5	Ouest (FR)	51.8	90	ES70	Canarias (ES)	35.5
9	UKJ	South East (UK)	69.5	50	DE9	Niedersachsen	51.6	91	LT	Lithuania	35.2
10	SE22	Sydsverige	67.3	51	SI02	Zahodna Slovenija	51.3	92	PL2	Region Poludniowy	34.1
11	DE3	Berlin	67.2	52	FI1D	Pohjois- ja Ita-Suomi	51.2	93	LV	Latvia	33.8
12	DK03	Syddanmark	65.1	53	NL1	Noord-Nederland	51.1	94	PL6	Region Północny	33.2
13	BE1	Région de Bruxelles-Capitale	64.9	54	FR2	Bassin Parisien	50.9	95	ES24	Aragón	32.6
14	SE33	Övre Norrland	64.7	55	AT3	Westösterreich	50.3	96	PL4	Region Północno-Zachodni	32.3
15	NL3	West-Nederland	64.4	56	DED	Sachsen	50.0	97	ES42	Castilla-la Mancha	32.1
16	DK04	Midtjylland	64.3	57	SE21	Smaland med öarna	49.9	98	HR03	Jadranska Hrvatska	32.0
17	FR7	Centre-Est (FR)	64.2	58	FR4	Est (FR)	49.7	99	HU10	Közép-Magyarország	31.4
18	IE01	Border, Midland and Western	63.4	59	UKC	North East (UK)	48.9	100	EL3	Attiki	31.3
19	DE7	Hessen	63.3	60	FR3	Nord - Pas-de-Calais	48.8	101	PT15	Algarve	30.9
20	FI1B	Helsinki-Uusimaa	62.2	61	DE4	Brandenburg	48.5	102	ES43	Extremadura	30.3
21	BE2	Vlaams Gewest	62.1	62	DE5	Bremen	48.4	103	HR04	Kontinentalna Hrvatska	29.9
22	UKH	East of England	61.5	63	SE32	Mellersta Norrland	48.2	104	PT18	Alentejo	29.4
23-25	DK02	Sjælland	60.7	64	EE	Estonia	45.9	105-106	PL3	Region Wschodni	29.2
23-25	UKK	South West (UK)	60.7	65	ES21	País Vasco	45.6	105-106	PT11	Norte	29.2
23-25	AT1	Ostösterreich	60.7	66	SI01	Vzhodna Slovenija	45.3	107-108	PT16	Centro (PT)	27.6
26	BE3	Région wallonne	60.1	67	PT17	Lisboa	44.6	107-108	ITG	Isole	27.6
27	FR8	Méditerranée	59.4	68	SK01	Bratislavský kraj	44.0	109	ITF	Sud	27.3
28-29	UKD	North West (UK)	59.0	69	DEF	Schleswig-Holstein	43.6	110	SK02	Západné Slovensko	25.8
28-29	UKM	Scotland	59.0	70-72	ES12	Principado de Asturias	42.3	111	SK03	Stredné Slovensko	24.9
30-31	FI1C	Etelä-Suomi	58.9	70-72	ES51	Cataluna	42.3	112	SK04	Vychodné Slovensko	24.5

⁴ Detailed description of the REDI methodology can be found: Szerb et al. (2014): REDI: The Regional Entrepreneurship and Development Index – Measuring regional entrepreneurship. Final report. European Commission, Directorate-General for Regional and Urban policy, Luxembourg, p. 30-46. http://ec.europa.eu/regional_policy/information/studies/index_en.cfm#1 (September 25, 2014)

Rank	Code	Region	REDI	Rank	Code	Region	RED I	Rank	Code	Region	REDI
30-31	FR6	Sud-Ouest (FR)	58.9	70-72	DEE	Sachsen-Anhalt	41.3	113	HU23	Dél-Dunántúl	23.8
32	FI19	Länsi-Suomi	58.7	73	ITC	Nord-Ovest	40.4	114	EL1	Voreia Ellada	22.7
33	UKG	West Midlands (UK)	58.6	74	ES22	Comunidad Foral de Navarra	39.0	115	HU31	Észak-Magyarország	22.4
34	DE1	Baden-Württemberg	58.1	75	ES52	Comunidad Valenciana	38.1	116	RO3	Macroregiunea trei	22.1
35	UKN	Northern Ireland (UK)	58.0	76	ES53	Illes Balears	37.7	117	HU21	Közép-Dunántúl	22.0
36	SE31	Norra Mellansverige	57.7	77	ES23	La Rioja	37.6	118	HU22	Nyugat-Dunántúl	21.5
37	DE2	Bayern	57.3	78	DEG	Thüringen	37.2	119-120	HU32	Észak-Alföld	21.4
38	NL4	Zuid-Nederland	57.0	79	ES61	Andalucía	37.1	119-120	EL4	Nisia Aigaiou, Kriti	21.4
39	NL2	Oost-Nederland	56.5	80	CZ	Czech Republic	37.0	121	HU33	Dél-Alföld	21.0
40	UKE	Yorkshire and The Humber	56.4	81-82	ITI	Centro (IT)	36.9	122	RO4	Macroregiunea patru	19.7
41	DEB	Rheinland-Pfalz	56.2	81-82	ES11	Galicia	36.9	123	EL2	Kentriki Ellada	19.5
								124	RO1	Macroregiunea unu	19.4
								125	RO2	Macroregiunea doi	18.4

*CEE countries are shown in grey

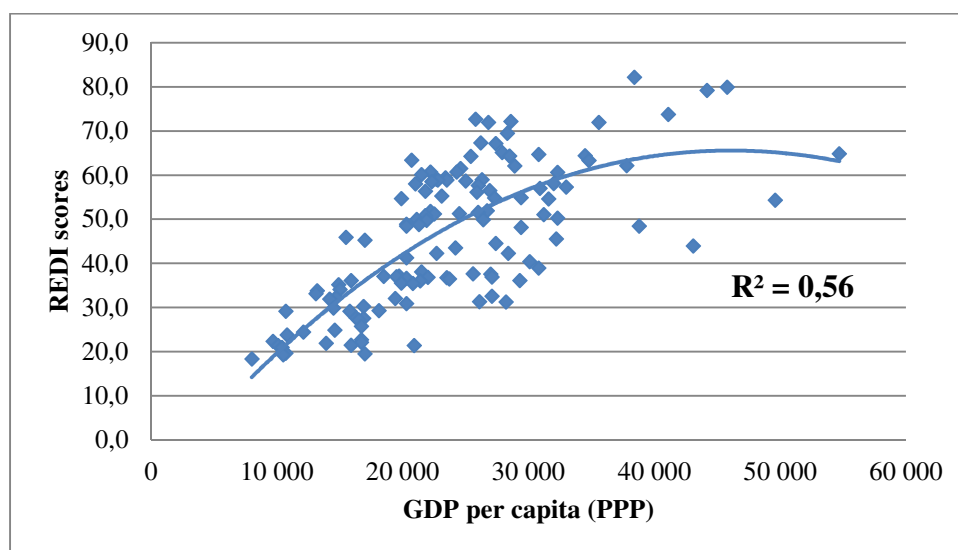
Source: authors' own construction.

The REDI scores can vary from zero to a hypothetical maximum of 100. In our case, REDI scores range from 18.4 to 82.2. According to Table 1, the variations in entrepreneurship over the 125 regions are substantial – more than four-fold. The top performing regions in Europe are located in the Scandinavia and in Western Europe. The REDI scores confirm that European capital cities and highly urbanized regions show outstanding entrepreneurial performance. Among the best performing regions there are only a few which do not include a capital, and even these regions have important national functions.

As mentioned previously, the REDI index is designed to examine the role of entrepreneurship in economic development. According to Figure 2, there is a close connection between entrepreneurship and regional development (measured by GDP per capita). The third-degree polynomial adjustment explains 56% of the variations between entrepreneurship and economic development, showing a moderately strong connection between the REDI and per capita GDP.

Figure 2

The connection between REDI scores and economic development



Notes: Third degree of polynomial adjustment. Number of observations=125
Source: authors' own construction.

Table 2 show the REDI scores, the development implied REDI scores (calculated from the third degree polynomial equation) and the deviation between the actual and the development implied REDI scores for the 29 CEE regions.

Table 2

The REDI scores, the development implied REDI scores and the REDI differences for the CEE country regions

Region	GDP	REDI	Implied REDI	Dif.*	Region	GDP	REDI	Implied REDI	Dif.*
Közép-Magyarország	26 100	31.4	51.9	-20.5	Lithuania	14 900	35.2	31.3	3.9
Közép-Dunántúl	13 900	22.0	29.0	-7.0	Latvia	13 200	33.8	27.4	6.4
Nyugat-Dunántúl	15 900	21.5	33.5	-12.0	Estonia	15 500	45.9	32.6	13.3
Dél-Dunántúl	10 800	23.8	21.5	2.4	Jadranska Hrvatska	14 200	32.0	29.7	2.2
Észak-Magyarország	9 700	22.4	18.6	3.8	Kontinentalna Hrvatska	14 500	29.9	30.4	-0.5
Észak-Alföld	10 100	21.4	19.7	1.8	Vzhodna Slovenija	17 000	45.3	35.9	9.5
Dél-Alföld	10 400	21.0	20.4	0.6	Zahodna Slovenija	24 500	51.3	49.5	1.8
Macroregiunea unu	10 500	19.4	20.7	-1.3	Czech Republic	19 500	37.0	40.9	-3.8
Macroregiunea doi	8 000	18.4	14.0	4.4	Bratislavsky kraj	43 100	44.0	66.4	-22.4
Macroregiunea trei	16 700	22.1	35.2	-13.1	Západné Slovensko	16 700	25.8	35.2	-9.4
Macroregiunea patru	10 700	19.7	21.2	-1.5	Stredné Slovensko	14 600	24.9	30.6	-5.7
Region Centralny	21 400	36.1	44.4	-8.3	Východné Slovensko	12 100	24.5	24.7	-0.2
Region Poludniowy	15 000	34.1	31.5	2.6	CEE average	15 634	30.1	31.3	-1.2
Region Wschodni	10 700	29.2	21.2	8.0	All other region average	26 342	50.9	50.5	0.4
Region Północno-Zachodni	14 700	32.3	30.9	1.4					
Region Poludniowo-Zachodni	15 900	36.1	33.5	2.6					
Region Północny	13 100	33.2	27.1	6.0					

Legend: Dif*.:= the difference between actual and the development implied REDI scores

Table 2 provides us a more nuanced picture of the level of entrepreneurship in the CEE country regions as compared to the rest of the EU. Whilst the average deviation from the

development implied trend line is -1.2 for the 29 CEE regions, it is +0.4 for the other EU regions. This means that CEE regions' entrepreneurial performance is, on average, below the development implied trend line as compared to the other 94 EU regions. Whilst more developed, mainly capital city, regions in the CEE countries have higher REDI scores than less developed regions, their actual REDI scores are still further below the development implied trend line as compared to less developed CEE regions. For example, Bratislavsky kraj, with the highest 43 100 Euro per capita GDP in the CEE region, should have a 66.4 REDI score rather than the actual 44.0 value. At the same time, Estonia has a 45.9 REDI score, whilst it is only 32.6 which we should expect based on the development of the country-region.

5. Sub-index and pillar level analysis

For further analysis, we created three macro-regions. The Northern and Western Europe (NWE) macro-region consists of Scandinavian, United Kingdom, Irish, German, Dutch, Belgian and French regions (65 regions). The Southern Europe (SE) macro-region contains Spanish, Portuguese, Italian and Greek regions (31 regions), whilst Central and Eastern Europe (CEE) includes 29 regions. Besides these three macro-regions, we also present the best and the worst entrepreneurial regions, which are the Danish Hovedstaden Central region with 82.2 REDI points and the Romanian Macroregiunea doi with only 18.4 points (Table 3). The average REDI score of the NWE regions is 58.5, which is significantly higher than the SE (average 34.7) and CEE regions' (average 30.1).

Table 3

Comparison of REDI and sub-index scores of the three European macro-regions

Region	Entrepreneurial Attitudes (ATT)	Entrepreneurial Abilities (ABT)	Entrepreneurial Aspirations (ASP)	REDI
DK01, Hovedstaden	79.7	89.6	77.2	82.2
Northern and Western European regions (NWE)	59.5	61.6	54.5	58.5
Southern European regions (SE)	33.8	35.4	35.0	34.7
Central and Eastern European regions (CEE)	29.5	23.3	37.6	30.1
RO2, Macroregiunea doi	19.7	10.3	25.2	18.4

Source: authors' own calculation.

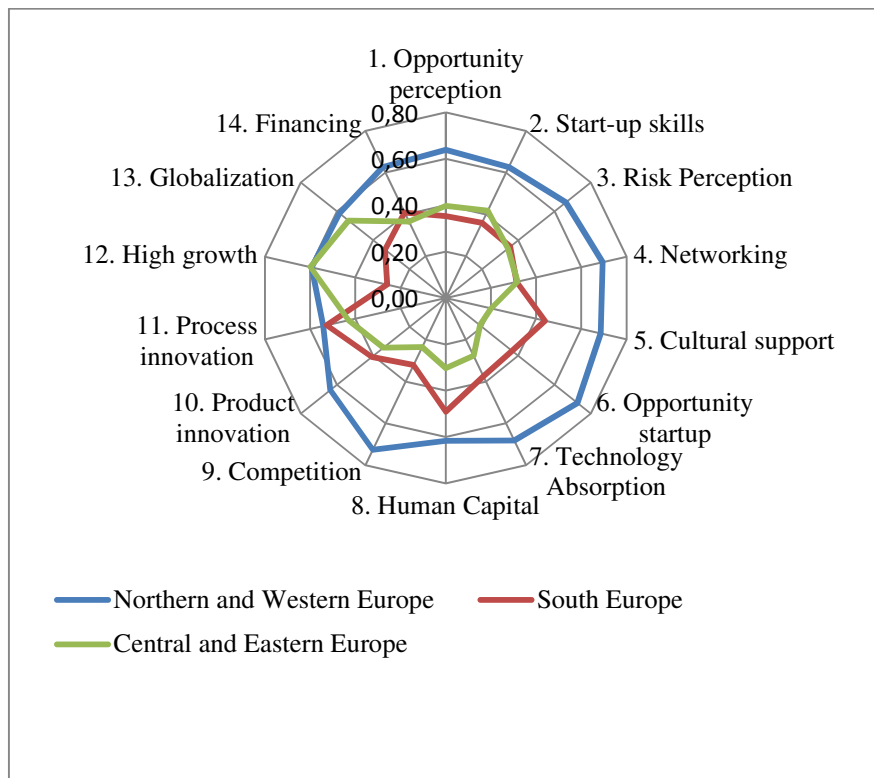
Whilst aggregated index scores can illustrate the overall differences amongst the particular country groups they tell us nothing about the strong and the weak constituents of the performance. This is the reason why we have to examine the components of the REDI

scores - the sub-indices and the pillars. According to Table 3, the SE and CEE regions lag behind the NWE regional average in all three sub-indices, although the NWE and SE regions have similar scores in all three. At the same time, however, the CEE regions are less balanced. CEE countries have the lowest scores in entrepreneurial abilities (23.3) but their average entrepreneurial aspirations score (37.6) is higher than that of the SE countries. The leading Danish capital city region (DK01) has an outstanding performance in almost all of the sub-indices. Similarly to the CEE averages, the Romanian region (RO2) performs relatively well only in Entrepreneurial Aspiration, but it lags behind the CEE regional averages in all three sub-indices.

Figure 3 shows the pillar values of the three macro-regions. These reinforce the fact that the NWE macro-region generally performs better than the SE or CEE regions. The NWE region's superiority regarding pillars related to Entrepreneurial Attitude and Ability is fairly clear. A narrower gap between the macro-regions can only be seen in some pillars of Entrepreneurial Aspiration. For example, SE regions are close to NWE regions regarding the Process Innovation pillar, whilst CEE regions have marginally better (High Growth) or similar (Globalization) performance than NWE regions in two cases. Whilst the REDI average scores of the SE and CEE countries do not differ too much, their entrepreneurial profiles are not similar in terms of the fourteen pillars. The Entrepreneurial Attitudes pillar scores – except for the Cultural Support pillar – are near to each other with slightly better performances of the SE countries. However, SE countries are clearly better than CEE countries in all Entrepreneurial Abilities pillars (Opportunity Start-up, Technology Absorption, Human Capital and Competition) and the two innovation pillars belonging to the Entrepreneurial Aspiration sub-index (Product Innovation and Process Innovation). At the same time CEE countries have higher scores in High Growth and Globalization than SE countries. Both groups have nearly equal pillar scores in Finance.

Figure 3

Comparison of the entrepreneurial profile of the three macro-regions



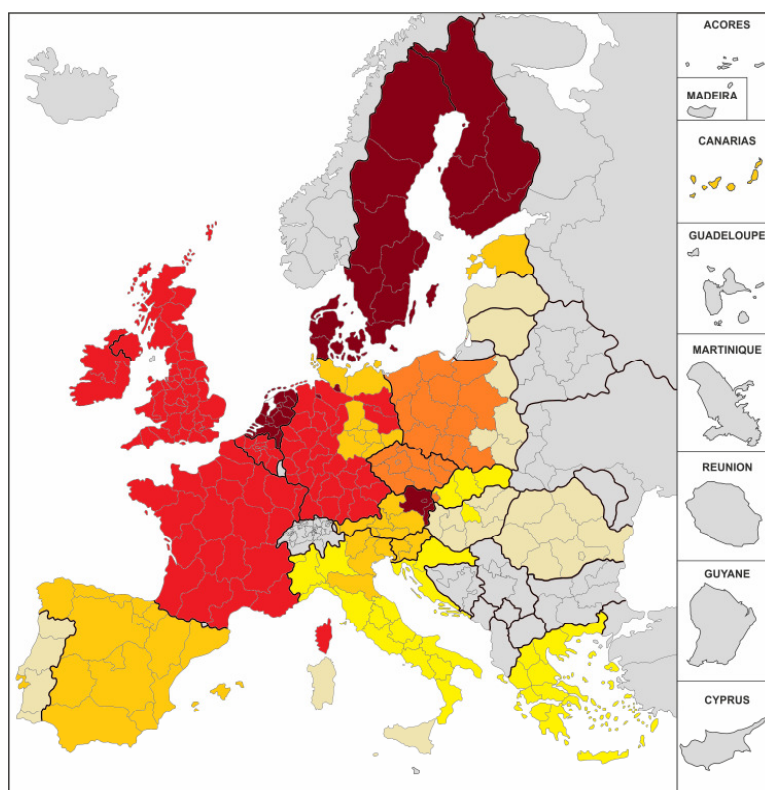
Source: EU authors' own construction.

As shown, the overall entrepreneurial performance of the CEE regions is below that of the other two macro-regions. The differences increase if we examine the three sub-indices of the three macro-regions. We expect even more substantial differences amongst the 29 CEE regions if the examination is based on the fourteen pillars. In order to examine these deviations within the CEE country group, we conducted a K-means clustering exercise. Figure 4 shows all the EU regions' clusters in six groups based on the fourteen REDI pillars.⁵ In addition, Table 4 shows the pillar values and the REDI scores for all six clusters.

⁵ We tried several versions, but for our purposes the six cluster version proved to be the best. The ANOVA table confirmed that all 14 pillars are significant elements of the k-means clustering.

Figure 4

The clusters of the European Union regions based on the fourteen pillars (K-means cluster)



Note: The darker colours show high performance regions and the lighter colours lower performance.

Source: authors' own editing.

Table 4

The pillar values and the REDI scores of the six EU clusters

Clusters/pillars	1	2	3	4	5	6
Opportunity perception	0.88	0.53	0.38	0.52	0.35	0.31
Strat-up skills	0.73	0.57	0.45	0.55	0.37	0.30
Risk Perception	0.59	0.77	0.37	0.37	0.20	0.42
Networking	0.92	0.56	0.42	0.45	0.28	0.21
Cultural support	0.82	0.61	0.56	0.26	0.13	0.21
Opportunity start-up	0.89	0.64	0.46	0.12	0.19	0.23
Technology Absorption	0.67	0.71	0.48	0.22	0.34	0.22
Human Capital	0.72	0.60	0.56	0.26	0.25	0.28
Competition	0.66	0.81	0.39	0.22	0.28	0.24
Product innovation	0.74	0.60	0.46	0.75	0.33	0.16
Process innovation	0.53	0.58	0.49	0.52	0.52	0.40
High growth	0.50	0.73	0.29	0.75	0.43	0.45
Globalization	0.48	0.64	0.40	0.77	0.43	0.46
Finance	0.68	0.58	0.47	0.59	0.54	0.17
REDI score	61.4	59.4	40.9	36.1	28.3	25.3
Number of regions	24	34	29	7	13	18

Source: authors' own calculation

According to Figure 4 and Table 4, the most developed regions of the Nordic countries, Belgium, the Netherlands, France, (West) Germany, Ireland and the UK, with their high REDI scores, comprise the first two clusters. The CEE country regions – with their lower scores - belong to the remaining four clusters. The three leading CEE regions, (Zahodna Slovenija, Vzhodna Slovenija and Estonia) form a cluster together with former East Germany and Spanish regions. The regions of this group - Cluster 3 - are relatively strong in Cultural Support (0.56) and Human Capital (0.56), but weak in High Growth (0.29). The average REDI score is 40.9, substantially lower than Cluster 1 (61.4) and Cluster 2 (59.4).

Cluster 4 consists only of CEE regions (Czech Republic, Bratislavsky kraj and five Polish regions). These CEE regions show a somewhat contradictory picture as they are very weak in Opportunity Start-up (0.12) and Competition (0.22) but very good in Globalization (0.76), High growth (0.75) and Product innovation (0.75). Croatian, Slovakian regions and the Hungarian Közép-Magyarország belong to cluster 5, together with most Greek and two Italian regions. Cultural support (0.13), Opportunity start-up (0.19) and Risk Perception (0.20) are their weak pillars. Surprisingly, Finance (0.54) is the highest score of these thirteen regions. The least developed Hungarian and Romanian regions, Latvia and Lithuania are found in the lowest REDI value group, similar to most Portuguese and an Italian region (Cluster 6). Product Innovation (0.16) and Finance (0.17) are the weakest pillars of Cluster 6, whilst the Globalization (0.46) and High Growth (0.45) scores are relatively high.

From these observations we can draw four clear inferences. Firstly, CEE regions show a wide range of entrepreneurial profiles based on the fourteen pillars. Secondly, most CEE regions match other EU regions' entrepreneurial profiles as only seven regions, which form cluster 4, seem to deviate slightly from other EU regions. Thirdly, a country's own regions tend to cluster, implying that cross-border differences are greater than deviations within the same country. Fourthly, CEE regions, except for the three with the highest REDI scores, have entrepreneurial profiles similar to those of the South European regions of Greece, Italy and Portugal.

6. Tailor-made regional entrepreneurship policy recommendations

As detailed above, REDI is a useful tool to measure regional entrepreneurship taking into account many elements of the entrepreneurial ecosystem. Earlier in this paper we examined the regional entrepreneurship differences of CEE country regions, based on REDI scores, the three sub-indices and the fourteen pillars. We concluded that differences are substantial

amongst the 125 EU regions and also amongst the 29 CEE regions. These differences in the entrepreneurial profile call for tailor-made entrepreneurship policy, unique to each region, as opposed to a highly uniform, 'one-size-fits-all' policy.

Unlike other composite indicators, REDI is able to provide distinctive entrepreneurship policy recommendations for enhancing regional entrepreneurial performance and optimizing policy efforts. The Penalty for Bottleneck (PFB) methodology implies that the greatest improvement in the entrepreneurship system performance can be achieved by mitigating the weakest performing pillar – the Bottleneck Pillar. The basic assumption is that a system with some weaknesses cannot fully utilize its strengths. This means that weakly performing pillars hold back system performance in situations where pillars co-produce system performance. Following this logic, instead of further strengthening a strong point of the system, it would be more effective to alleviate the identified bottleneck pillars which prevent the system from fully exploiting its strengths. The System of Entrepreneurship is also a dynamic system - which means that, if we alleviate one bottleneck, another pillar soon may become the most binding constraint for system performance. This raises the question of the 'optimal' allocation of additional resources. A region's System of Entrepreneurship is optimized if all the fourteen pillars have the same value. In this hypothetical case improvement can be achieved by increasing simultaneously all pillars.

The following simulation seeks to identify the 'most efficient' allocation of additional resources which seeks to increase the REDI index score by 5 points. In order to do this, each Bottleneck Pillar is alleviated to a point where it ceases to be a bottleneck. At this point, any further effort is allocated together to the first and the second most binding constraints within the system, again to a point where these constraints are no longer the most binding constraints within the system. This exercise is continued until the desired aim, currently the five-point increase in the REDI score, has been achieved. We have conducted a series of simulations for all 125 European regions, but here we show and analyse only the outcomes of the CEE regions. This simulation is based on two important assumptions: (1) We allocate additional resources over the current resource allocation; and (2) the cost of improving performance is equal for all pillars. Even if the assumptions are restrictive and should be so regarded, the policy portfolio simulation offers many benefits which go above and beyond what traditional indices can offer.

Table 5

Simulation – Optimal allocation of additional resources in CEE regions to increase the REDI scores by five points

Code	Opportunity Perception	Start-up Skills	Risk Perception	Networking	Cultural Support	Opportunity Start-up	Technology Absorption	Human Capital	Competition	Product Innovation	Process Innovation	High Growth	Globalization	Finance	Total Effort	Total Effort (%)
CZ	0%	0%	32%	0%	11%	19%	0%	31%	8%	0%	0%	0%	0%	0%	0.38	13.5%
EE	0%	0%	0%	5%	38%	5%	0%	0%	0%	0%	0%	0%	0%	52%	0.32	10.9%
HR03	0%	0%	63%	2%	4%	0%	0%	21%	0%	10%	0%	0%	0%	0%	0.26	15.7%
HR04	0%	0%	53%	13%	5%	0%	0%	15%	0%	15%	0%	0%	0%	0%	0.31	16.8%
HU10	0%	0%	24%	0%	51%	25%	0%	0%	0%	0%	0%	0%	0%	0%	0.30	15.9%
HU21	4%	0%	16%	0%	10%	0%	0%	0%	2%	29%	0%	0%	0%	39%	0.47	22.8%
HU22	0%	0%	14%	0%	7%	0%	0%	0%	8%	36%	12%	0%	0%	24%	0.46	23.3%
HU23	5%	0%	20%	0%	15%	0%	0%	0%	12%	9%	3%	0%	0%	35%	0.50	21.1%
HU31	1%	0%	19%	1%	13%	0%	0%	0%	0%	32%	0%	0%	4%	30%	0.50	22.4%
HU32	15%	0%	17%	5%	12%	0%	0%	3%	5%	17%	0%	0%	0%	25%	0.58	23.3%
HU33	14%	0%	16%	5%	14%	2%	2%	9%	9%	7%	0%	0%	0%	21%	0.61	23.8%
LT	0%	0%	0%	14%	15%	31%	7%	0%	15%	17%	0%	0%	0%	0%	0.42	14.3%
LV	0%	0%	0%	19%	22%	26%	1%	0%	0%	23%	7%	0%	0%	1%	0.49	14.9%
PL1	0%	0%	0%	0%	0%	59%	41%	0%	0%	0%	0%	0%	0%	0%	0.22	14.0%
PL2	0%	0%	0%	0%	0%	69%	10%	0%	0%	0%	21%	0%	0%	0%	0.21	14.7%
PL3	0%	0%	0%	0%	0%	39%	36%	14%	7%	0%	0%	0%	0%	4%	0.35	17.3%
PL4	0%	0%	0%	0%	0%	46%	25%	9%	21%	0%	0%	0%	0%	0%	0.29	15.6%
PL5	0%	0%	0%	0%	0%	48%	31%	0%	21%	0%	0%	0%	0%	0%	0.29	13.9%
PL6	0%	0%	0%	0%	0%	30%	29%	24%	17%	0%	0%	0%	0%	0%	0.35	15.2%
RO1	0%	26%	0%	17%	5%	18%	6%	0%	0%	28%	0%	0%	0%	0%	0.48	26.0%
RO2	0%	25%	0%	17%	19%	28%	11%	0%	0%	0%	0%	0%	0%	0%	0.47	27.4%
RO3	0%	23%	0%	10%	24%	32%	0%	0%	0%	10%	0%	0%	0%	1%	0.40	22.6%
RO4	0%	22%	0%	13%	10%	24%	0%	0%	0%	22%	0%	0%	0%	9%	0.49	25.6%
SI01	1%	0%	54%	0%	0%	11%	0%	0%	33%	0%	0%	0%	0%	0%	0.36	11.1%
SI02	0%	0%	59%	0%	0%	16%	0%	0%	4%	0%	0%	0%	0%	21%	0.28	9.8%
SK01	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.13	11.6%

SK02	0%	0%	0%	0%	34%	8%	0%	16%	20%	23%	0%	0%	0%	0%	0.40	19.5%
SK03	5%	0%	0%	0%	33%	9%	0%	12%	16%	26%	0%	0%	0%	0%	0.43	20.2%
SK04	0%	0%	0%	0%	38%	14%	8%	22%	18%	0%	0%	0%	0%	0.39	20.5%	

Notes: HU10 Közép-Magyarország, HU21Közép-Dunántúl, HU22 Nyugat-Dunántúl, HU23Dél-Dunántúl, HU31Észak-Magyarország, HU32Észak-Alföld, HU33 Dél-Alföld, RO1 Macroregiunea unu, RO2 Macroregiunea doi, RO3 Macroregiunea trei, RO4 Macroregiunea patru, PL1Region Centralny, PL2 Region Poludniowy, PL3 Region Wschodni, PL4 Region Północno-Zachodni, PL5 Region Poludniowo-Zachodni, PL6 Region Północny, LT Lithuania, LV Latvia, EE Estonia, HR03 Jadranska Hrvatska, HR04 Kontinentalna Hrvatska, SI01 Vzhodna Slovenija, SI02 Zahodna Slovenija, CZ Czech Republic, SK01Bratislavsky kraj, SK02 Západné Slovensko, SK03Stredné Slovensko, SK04 Vychodné Slovensko

Source: own calculation.

Table 5 shows the result of this optimization exercise for all 29 CEE regions. The numbers in any row represents the percentages of resources necessary to add to the particular pillar value in order to reach the required alleviation of the bottleneck pillar. Zero value indicates that the pillar is currently not a binding constraint for that region. The total effort column provides the overall sum of the required resources. Larger numbers indicate that more resources are necessary for overall performance improvement in a given region. In the last column we show the percentage increase of the total resources (the sum of the fourteen pillars) necessary for the 5-point increase of the REDI scores, assuming optimal resource allocation.

The simulation produces a more nuanced picture of the required allocation of policy effort. Different regions require different policy efforts depending on the size and the magnitude of the bottleneck. Bratislavsky Kraj (SK01) has only one bottleneck (Cultural support) and a 0.13 unit (11.6%) increase of the resources would boost Bratislava's REDI scores from 44.0 to 49.0. At the other end, the Hungarian Dél-Alföld (HU32) needs 0.61 units (23.8%) for the same five-point REDI score increase. In order to achieve this goal, Dél-Alföld should improve ten of its fourteen pillars.

Whilst all regions have their unique entrepreneurship profile, there are some notable similarities. In general, Globalization, High Growth and Process Innovation do not represent bottlenecks for the CEE regions. This does not imply that these pillars are at a high level, but it means that they do not constrain the system of entrepreneurship as compared to other more binding pillars. Finance is the weak point of Estonia and of Hungarian regions except for the Budapest-centred Közép-Magyarország. Opportunity Perception is also relatively weak in most Hungarian regions. The lack of Start-up Skills characterizes the four Romanian regions. Networking is low in two Hungarian and in the four Romanian regions. Risk Perception severely limits the Croatian, the Czech Republic, the Hungarian, and the Slovenian regions. Human Capital is relatively weak in Slovakia, in the Czech Republic, Croatia and in some Polish regions. High Competition characterizes the Hungarian, the Slovakian, the Polish regions and the Czech Republic. The low level of Product Innovation constrains mainly the lower developed regions of Croatia, Hungary, Latvia, Lithuania, Romania, and Slovakia. Cultural Support and Opportunity Start-up are lacking in many CEE regions. These pillars can be viewed as general CEE macro-regional constraints of entrepreneurship.

7. Summary and conclusion

Whilst entrepreneurship is believed to have a positive influence on national and regional economic development, traditional, start-up or self-employment based entrepreneurship measures failed to reinforce this effect. A recently created new composite indicator, the Global Entrepreneurship Index (GEI) was the first measure of entrepreneurship to incorporate the influence of environmental factors on individual entrepreneurial initiative in a single setup. REDI is an amended version of GEI, measuring the entrepreneurship system of a region.

North and West European, mainly highly urbanized national regions, have the best entrepreneurial performance, and CEE regions can be found only in the lower half of the rankings. There are few CEE regions which reach the European regional average of pillar values. We have suggested that entrepreneurship plays a relatively small role in regional development in the CEE regions since their REDI scores are generally below the development implied trend line. The deviation between the actual and the implied REDI scores is highest - in absolute terms - in the most developed, capital city dominated CEE regions. These central, highly urbanized regions should have a much higher level of entrepreneurship than they actually do.

We have demonstrated that the overall entrepreneurial performance of the CEE regions is below that of the other two, SE and the NWE macro-regions. The SE and CEE regions lag behind the NWE regional average in all three sub-indices. This finding simply reinforces previous study results regarding transitional country development paths. However, the NWE and the SE regions have similar scores in all three sub-indices. At the same time, the CEE regions are less balanced. To clarify the differences and similarities further, we used a cluster analysis technique based on the fourteen pillars and representing the entrepreneurship ecosystem. We found that CEE country regions tend to cluster together – as do SE and former East German regions. One cluster comprises only CEE regions including Polish regions, the Czech Republic and Bratislavsky kraj.

Besides notable similarities, CEE country regions differ significantly in terms of the configuration of their fourteen pillars. In general, CEE regions are relatively strong in Entrepreneurial Aspirations related pillars (High Growth, Globalization and Process Innovation), although there are some problems in the Entrepreneurship Abilities (mainly in Opportunity Start-up, and Competition). In fact, the high ratio of necessity motivated start-ups could explain the low level of the most problematic pillar - that is, Opportunity Start-up.

History related factors, the heritage of the old socialist system, could be responsible for the generally low level of Entrepreneurial Attitudes. In particular, Start-up Skills are low in many CEE regions and culture does not really support entrepreneurs.

Looking more closely at the 29 CEE regions' entrepreneurial profiles, we can confirm that each region requires a unique tailor-made policy instead of a uniform, 'one-size-fits-all' approach. Our policy suggestions are based on the assumption that system performance can be improved most effectively by alleviating system-constraining bottlenecks. A simulation aiming to improve the REDI scores by five points produced an optimal allocation of additional resources over the fourteen pillars of entrepreneurship for each of the 29 CEE regions. We should stress, however, that the results of this exercise should not be used directly as entrepreneurship policy recommendation. In fact, this simulation is only a starting point for a much more comprehensive examination and facilitation process (Autio and Levie 2015, Estonia report 2015).

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