

12. Regional Entrepreneurship in Hungary Based on the Regional Entrepreneurship and Development Index (REDI) Methodology

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This paper presents a regional application of the Global Entrepreneurship and Development Index (GEDI) methodology of Acs and his co-authors (2013) to examine the level of entrepreneurship across Hungary's seven NUTS-2 level regions. The Regional Entrepreneurship and Development Index (REDI) has been constructed for capturing the contextual features of entrepreneurship across regions. The REDI method builds on a Systems of Entrepreneurship Theory and provides a way to profile Regional Systems of Entrepreneurship. Important aspects of the REDI method including the Penalty for Bottleneck analysis, which helps identify constraining factors in Regional Systems of Entrepreneurship, and Policy Portfolio Optimization analysis, which helps policy-makers consider trade-offs between alternative policy scenarios and associated allocations of policy resources. The paper portrays the entrepreneurial disparities amongst Hungarian regions and provides public policy suggestions to improve the level of entrepreneurship and optimize resource allocation over the 14 pillars of entrepreneurship in the seven Hungarian regions.

Keywords: Entrepreneurship, Regional Development, Entrepreneurship policy, Hungary

1. Introduction

Entrepreneurship as a major driver for economic development, growth, competitiveness, employment, productivity and innovation has been gaining increasing importance over the last thirty some years. (Acs 2008, Acs et al. 2008, Carree – Thurik 2003, Braunerhjelm et al. 2009). However, the extent and the magnitude of its influence varies across countries and regions (Acs 2010, Audretsch – Fritsch 2002, Fritsch – Schmude 2006). The reasons behind that is start-up rates as well as post-entry firm performances are influenced by contextual institutional and regulatory features, input and product market structures and the quality of human capital. Furthermore, agglomeration factors such as clustering, proximity to vital infrastructures, connectivity to major markets shape further the entrepreneurial climate and innovation milieu of the regions (Audretsch – Feldman 1996, Boschma – Lambooy 1999, Andersson et al. 2005). The start-up rate of new businesses forms the industry composition and, hence, influences regional growth and contributes to regional disparities (Feldman – Audretsch 1999, Feldman 2001, Audrestch – Fritsch 2002, Acs – Varga 2005, Fritsch – Mueller 2004).

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Interestingly, even entrepreneurship has gained quick and ardent acceptance from practitioners in the policy agenda, since its appearance, entrepreneurship policy as quasi-independent field apart from public and small business policy has been emerging just recently (Lundström – Stevenson 2005). This policy evolution was mainly constrained and influenced by the availability of data². Although the role of entrepreneurship in economic development is gradually becoming clearer, the understanding of policies to harness the potential of entrepreneurship remains underdeveloped. This controversy is largely explained by the discrepancy between the definition and the measure of entrepreneurship. While the complex and multidimensional nature of entrepreneurship is widely accepted (Wennekers – Thurik 1999) major measures of entrepreneurship are still one-dimensional (Iversen et al. 2008). The most frequently used start-up, ownership and business density rates are problematic because they do not differentiate between the quality and the quantity aspects of entrepreneurship (Acs – Szerb 2012, Shane 2009). Therefore, the latest theoretical findings imply deviating from simple entrepreneurship measures to more complex indicators and indices that relate positively to economic development. Moreover, single measures also miss to identify the effect of national and contextual factors that could also very different according to the stages of economic development (OECD 2007).

The Global Entrepreneurship and Development Index (GEDI) project came to alive to provide a suitable measure of entrepreneurship based on the multidimensional definition of entrepreneurship and to present a useful platform for policy analysis and outreach. The distinguished features of GEDI are (1) the contextualization of individual-level data by a country's institutional conditions; (2) the use of 14 context-weighted measures of entrepreneurial Attitudes, Abilities and Aspirations; (3) the recognition that different pillars combine to produce system-level performance; and (4) the consequent recognition that national entrepreneurial performance may be held back by *bottleneck factors* - i.e. poorly performing pillars that may constrain system performance (Acs et al. 2013).

The first attempt to adapt the GEDI methodology to measure regional entrepreneurship, the *Regional Entrepreneurship and Development Index (REDI)* has been constructed for capturing the contextual features of entrepreneurship across NUTS-2 level Spanish regions

² Following earlier initiatives such as the Observatory of European SMEs, consistent data collection about new firm formation just started less than 15 years ago. One of the pioneers was the Global Entrepreneurship Monitor launched in 1998 (Reynolds et al. 2005). A measure of the regulatory and institutional framework of new firms is the World Bank's Ease of Doing Business index. In the mid-2000s, OECD launched an entrepreneurship measure program based on a comprehensive, multidimensional definition of entrepreneurship (Hoffman et al. 2006).

(Acs et al. 2012). In the present paper, we provide a further development of the GEDI and REDI methodologies and their application for measuring regional level entrepreneurship in seven NUTS-2 level Hungarian regions. As a result of the original GEDI methodology improvement, the amended technique makes possible to balance out and optimize the resource allocation of the 14 pillars of entrepreneurship. Similar to the Spanish regional analysis, this version is also capable to offer tailor-made policy suggestions for the seven Hungarian regions by identifying the weaknesses of the regional entrepreneurial climate and individual factors.

The structure of the paper is the following: the next section of the paper is about the regional adaption of the GEDI methodology including the new development. In section three, this is followed by the results of the analysis and policy discussion. Finally in section four, the paper concludes with a summary.

2. The Global Entrepreneurship and Development Index (GEDI)

GEDI views entrepreneurship as part of a National System of Entrepreneurship (Acs et al. 2013). As such entrepreneurship occurs in response to the dynamic, institutionally embedded interaction between entrepreneurial attitudes, abilities, and aspirations, by individuals, which drives the allocation of resources through the creation and operation of new ventures.

GEDI is based on twenty-eight variables which make up fourteen pillars further divided into three sub-indices: *attitudes* (ATT), *abilities* (ABT) and *aspiration* (ASP). The abilities and aspiration sub-indices capture actual entrepreneurship activities as they relate to nascent and start-up businesses, while the entrepreneurial attitude (ATT) sub-index identifies the attitudes of a country's population as they relate to entrepreneurship. Each of the fourteen pillars contains an individual and institutional variable³ The GEDI index also applies the novel Penalty for Bottleneck (PFB) methodology which facilitates the identification of bottlenecks relevant for policy development⁴.

3. The Penalty for Bottleneck

We have defined entrepreneurship as the *dynamic* interaction of entrepreneurial attitudes, abilities, and aspirations and developed the Penalty for Bottleneck (PFB)

³ See Appendix 1, 2 and 3 for the complete GEDI framework.

⁴ For the description of the full methodology see Acs and Szerb (2011).

methodology⁵ for measuring and quantifying these interactions (Acs et al. 2013). Bottleneck is defined as the worst performing weakest link, or binding constraint in the system. With respect to entrepreneurship, by "bottleneck" we mean a shortage or the lowest level of a particular entrepreneurial indicator as compared to other indicators of the sub-index. This notion of bottleneck is important for policy purposes. Our model suggests that attitudes, ability and aspiration interact; if they are out of balance, entrepreneurship is inhibited.

The sub-indices are composed of four or five components, defined as indicators that should be adjusted in a way that takes this notion of balance into account. After normalizing the scores of all the indicators, the value of each indicator of a sub-index in a country is penalized by linking it to the score of the indicator with the weakest performance in that country. This simulates the notion of a bottleneck; if the weakest indicator were improved, the particular sub-index and ultimately the whole GEDI would show a significant improvement. Moreover, the penalty should be higher if differences are higher. Looking from either the configuration or the weakest link perspective it implies that stable and efficient sub-index configurations are those that are balanced (have about the same level) in all indicators.

Mathematically, we model the penalty for bottlenecks by modifying Casado-Tarabusi and Palazzi (2004) original function for our purposes. The penalty function is defined as:

$$h_{i,j} = y_{\min} + (1 - e^{-(y_{i,j} - y_{\min})}) \quad (1)$$

where $h_{i,j}$ is the modified, post-penalty value of index component j in country i

$y_{i,j}$ is the normalized value of index component j in country i

y_{\min} is the lowest value of $y_{i,j}$ for country i .

$i = 1, 2, \dots, m$ = the number of countries

$j = 1, 2, \dots, n$ = the number of index components

We suggest that this dynamic index construction is particularly useful for enhancing entrepreneurship in a particular country. There are two potential drawbacks of the PFB method. One is the arbitrary selection of the magnitude of the penalty. The other problem is that we cannot exclude fully the potential that a particularly good feature can have a positive effect on the weaker performing features. While this could also happen, most of the entrepreneurship policy experts hold that policy should focus on improving the weakest link in the system. Altogether, we claim that the PFB methodology is theoretically better than the

⁵ This methodological section is based on Acs and Szerb (2011, 2012).

arithmetic average calculation. However, the PFB adjusted GEDI is not necessary an optimal solution since the magnitude of the penalty is unknown.

4. The regional adaptation of the Global Entrepreneurship and Development Index

In order to use the GEDI index for a regional analysis, the data and variable used must be adapted to reflect regional conditions. The first attempt for such an adaption has been done by Acs and his co-authors (2012) using regional data for Spain. In this paper, we follow Acs and his co-authors (2012) for the creation of the 14 pillars but use an amended version of the GEDI methodology that adjusts the individual pillar averages before penalizing then.

The main concern for the individual variables used is the availability of a representative sample size for each of the seven Hungarian regions⁶. However, the adaption of institutional variables for regional analyses is more complicated. Ideally, we would use the same variables for the regional analyses as we do for the country level analysis. Unfortunately, most institutional variables are not available for specific regions. Several options exist to overcome this limitation. One possible solution is to use closely correlated regional proxies to substitute for a missing variable. Another possible solution is to simply use the same country level institutional variables for all regions. In these cases where this method is used, the pillar level value would correspond entirely to the variations in the individual level variable used. Though the institutional variance would be missing, it is likely that the variance of the institutional variables within a country is much lower than the variance between countries. In light of the lack of regional institutional level data for five GEDI pillars, we applied a mixed method, incorporating all three alternative approaches⁷. The idea behind the regional entrepreneurship index construction is to find regional level institutional data that are available also in the country level. If the regional institutional data are lacking then country level institutional data can be applied. Out of the 14 institutional variables, we apply for the entrepreneurship index construction 9 variables which are available in the NUTS-2 regional levels⁸. As a consequence, real Hungarian regional differences may be higher than our

⁶ While it was not a problem for Spain that had a regionally representative sample, we had to use a pooled data set of the GEM 2008-2012 Adult Population Survey reaching a sample of 10 000, in total. For a detailed discussion regarding the methodology used for GEDI country analyses see Acs et al. (2012).

⁷ The detailed description of all of the variables and sources can be found in Appendix 1 and Appendix 2.

⁸ Over the last decades, it has been an increasing movement in the European Union to collect institutional variables not only at the country, but also at the regional levels (NUTS-1, NUTS-2 and NUTS-3). This increasing data collection activity provides a unique opportunity to construct an entrepreneurship index similar to the national GEDI. See the Eurostat regional database: <http://epp.eurostat.ec.europa.eu>

analysis shows. The overall regional level entrepreneurship and development index for the Hungarian regions are calculated as benchmarking the country level pillars. While this combined methodology makes possible to contrast the entrepreneurial performance of the Hungarian regions to other countries, it is more appropriate to compare the regions to one another. For calculating the country and the regional level index values the following steps are applied.

First, after handling the outliers we normalize the pillar values:

$$x_{i,j} = \frac{z_{i,j}}{\max_i z_{i,j}} \quad (2)$$

for all $j= 1,..m$ the number of pillars

where $x_{i,j}$ is the normalized score value for country or region i and pillar j

$z_{i,j}$ is the original pillar value for country and region i and pillar j

$\max_i z_{i,j}$ is the maximum value for pillar j

Let's calculate the average of each of the 14 pillars as

$$\bar{x}_j = \frac{\sum_{i=1}^n x_{i,j}}{n} \quad \text{for all } j \quad (3)$$

where x_i is the normalized score for country or region i for a particular pillar.

\bar{x}_j is the arithmetic average of the pillar for number n countries and regions

The average of the 14 pillars average is the following:

$$\bar{y} = \frac{\sum_{j=1}^m \bar{x}_j}{m} \quad (4)$$

We want to transform the x_i values in such a way to preserve that the minimum value is 0 and the maximum value is 1 and the average of the transformed value \bar{y} ($0 < y_i \leq 1$).

The task can be divided into two non-trivial parts as:

- (a) $\bar{x} < \bar{y}$
- (b) $\bar{x} > \bar{y}$

In case (a) the average is higher and in case (b) the average is lower than the original pillar averages. If $\bar{x}_j = \bar{y}$ then the solution is trivial.

- (a) case: $\bar{x} < \bar{y}$

$$y_i = 1 - (1 - x_i) \frac{1 - \bar{y}}{1 - \bar{x}} \quad (5)$$

- (b) case: $\bar{x} > \bar{y}$

$$y_i = \begin{cases} 1 & \text{if } x_i = 1 \\ x_i \frac{\bar{y} - k/n}{\bar{x} - k/n} & \text{otherwise} \end{cases} \quad (6)$$

where k is the number of units having originally the value 1. After the transformation y_i cannot be smaller than k/n .

5. Hungary's regions compared at the GEDI aggregate level

The relative rankings of Hungary's seven regions based on their aggregate GEDI scores as compared to 83 other countries are shown in Table 1. The regional scores are quite heterogeneous, while the scores and rankings for them range from at the high end, 47.7 for Central Hungary which is ranked in 31st place to 36.1 at the low end for Southern Great Plain which is ranked in 63rd place. In terms of country comparisons, Central Hungary's score ranks it at a level similar to Latvia and Turkey, while Southern Great Plain's ranking is similar to Dominican Republic and Panama.

We can state that the GEDI rankings of the regions reflect roughly their well-known ranking relating to regional disparities. Only the position of Central Transdanubia deviates from the expected position. In terms of GDP per capita Central Transdanubia possess a better position, usually being placed directly after Western Transdanubia.

Table 1 The GEDI 2006-2011 ranking: Countries and Hungary's regions compared

Rank	Country/Region	Per capita GDP (PPP)	GEDI	Rank	Country/Region	Per capita GDP (PPP)	GEDI
1	United States	47 184	78.7	47	Greece	28 154	42.1
2	Denmark	39 558	76.4	48	Barbados	19 252	41.3
3	Sweden	38 947	75.2	49	Hungary 2008-2012		41.2
4	Australia	39 407	74.6	50	Western Transdanubia	18 775	39.8
5	Netherlands	42 475	73.2	51	South Africa	10 486	39.5
6	Canada	38 915	70.3	52	Macedonia	11 072	39.4
7	United Kingdom	35 860	68.6	53	Northern Hungary	12 246	39.3
8	Iceland	34 949	68.3	54	Southern Transdanubia	13 856	39.2
9	Norway	56 894	67.9	55	Mexico	14 566	39.0
10	Switzerland	46 215	66.9	56	Tunisia	8 524	38.1
11	France	33 820	66.8	57	Argentina	15 893	38.0
12	Taiwan	37 931	66.1	58	Central Transdanubia	16 726	37.0
13	Puerto Rico	16 300	65.0	59	China	7 536	37.0
14	Finland	36 660	63.1	60	Jordan	5 706	36.5
15	Belgium	37 448	62.8	61	Northern Great Plain	13 036	36.3
16	Germany	37 591	62.3	62	Dominican Republic	9 280	36.1
17	Austria	39 698	61.7	63	Southern Great Plain	13 307	36.1
18	Chile	15 044	61.7	64	Panama	13 877	34.9
19	Singapore	57 505	61.4	65	Thailand	8 490	33.8
20	Ireland	39 727	61.2	66	Trinidad and Tobago	25 539	33.0
21	Israel	28 546	59.2	67	Jamaica	7 839	32.8
22	United Arab Emirates	38 089	55.9	68	Russia	19 840	32.7
23	Slovenia	27 556	53.0	69	Kazakhstan	12 050	32.2
24	Poland	19 747	51.7	70	Serbia	11 488	32.1
25	Saudi Arabia	22 545	51.5	71	Nigeria	2 363	32.0
26	Czech	25 299	49.8	72	Syria	5 248	31.5
27	Hungary 2011	20 307	49.7	73	Brazil	11 127	31.3
28	Spain	32 070	49.1	74	Indonesia	4 293	31.2
29	Lithuania	18 184	48.6	75	Bosnia and Herzegovina	8 750	30.4
30	Latvia	16 312	47.8	76	Bolivia	4 816	30.3
31	Central Hungary	33 978	47.7	77	Egypt	6 281	30.1
32	Turkey	15 340	47.1	78	Ecuador	8 105	29.3
33	Uruguay	14 277	47.1	79	Philippines	3 940	29.0
34	Korea	29 004	46.7	80	Costa Rica	11 351	28.6
35	Italy	31 555	46.7	81	Iran	11 467	28.4
36	Hong Kong	46 157	46.2	82	Morocco	4 668	28.1
37	Colombia	9 392	45.9	83	Venezuela	11 956	27.8
38	Portugal	25 573	45.7	84	India	3 586	27.3
39	Croatia	19 516	45.6	85	Algeria	8 322	26.8
40	Japan	33 994	44.9	86	Zambia	1 550	24.6
41	Slovakia	23 897	44.8	87	Pakistan	2 674	23.4
	<i>Budapest*</i>	<i>30 095</i>	<i>44.6</i>	88	Rwanda	1 155	23.1
42	Hungary 2010		44.4	89	Ghana	1 625	22.7
43	Peru	9 470	43.6	90	Guatemala	4 740	22.7
44	Romania	14 287	43.5	91	Angola	6 035	22.7
45	Lebanon	13 948	42.2	92	Uganda	1 263	22.4
46	Montenegro	12 676	42.1	93	Bangladesh	1 643	18.1

Source: authors' own construction

Note: *Hungary's ranking is shown in bold and Hungary's regional rankings are shaded.

However, according to the latest report of the Hungarian Central Statistical Office, Central Transdanubia's position has worsened lately. For example, both the FDI and the attracted overall domestic investment to the region seriously decreased in 2011 (KSH 2012).

In order to better understand the numbers behind the overall ranking, we provide Hungary's regional rankings for the three GEDI sub-indices, shown in Table 2 *Entrepreneurial Attitudes (ATT)*, *Entrepreneurial Abilities (ABT)* and *Entrepreneurial Aspirations (ASP)*.

Table 2 Hungarian regions relative position: sub-index level and GEDI

	ATT		ABT		ASB		GEDI	
	Rank	Value	Rank	Value	Rank	Value	Rank	Value
Central Hungary		51.33		43.36		48.55		47.74
Central Transdanubia	5	33.41	6	38.23	6	39.28	5	36.98
Western Transdanubia	2	35.54	2	42.96	5	41.02	2	39.84
Southern Transdanubia	3	33.98	3	39.83	3	43.93	4	39.25
Northern Hungary	4	33.68	4	38.42	2	45.75	3	39.28
Northern Great Plain	6	32.53	5	38.26	7	38.23	6	36.34
Southern Great Plain	7	31.36	7	35.49	4	41.44	7	36.10
<i>Budapest</i>		42.47		43.68		47.77		44.64
Hungary 2011		45.59		53.40		50.21		49.70
Hungary 2010		43.95		46.35		42.91		44.40
Hungary 2008-2012		37.93		42.25		43.45		41.21

Source: authors' own construction

These sub-indices make up the overall GEDI score and address specific issues regarding entrepreneurship development. As depicted in Table 2, regional differences are the highest for the Entrepreneurial Attitudes. If we look at the top 3 ranking regions for all three sub-indices, we find that *Central Hungary (including Budapest)*, *Western Transdanubia* and *Southern Transdanubia* hold the positions for Entrepreneurial Attitudes (ATT) and for Entrepreneurial Abilities (ABT). In the case of Entrepreneurial Aspiration (ASP), *Central Hungary (including Budapest)* takes the 1st place, while *Northern Hungary* holds the 2nd and *Southern Transdanubia* the 3rd.

6. Hungary's regions compared at GEDI's pillar level

In this section, we focus on the analysis of Hungary's 7 regions at the pillar level. Table 3 shows the pillar values for Hungary's regions and includes two additional useful benchmarks: the average pillar values for the most advanced innovation driven economies⁹

⁹ Innovation driven economies are defined according to the World Competitiveness Survey categorization (Porter – Schwab 2008).

and the average value of Hungary's 7 regions. We also identify the most favorable and the least favorable pillar value for each region and benchmark.

The least overall regional pillar variance (0.01) was found in the case of the pillar capturing the regional entrepreneurial culture (cultural support), implying a relatively equal acceptance and recognition of the role of entrepreneurs throughout the 7 regions. While the overall regional pillar variance in the case of the pillar relating to the start-up skills (startup skills) appears to be quite large (0.25), since it ranges from 0.27 (Central Transdanubia) to 1.00 (Central Hungary). Examining the least favorable indicators, we see the difficulties facing Hungarian businesses across the regions to recognize and utilize good business opportunities and ideas exemplified by the *opportunity perception* pillar which is the weakest pillar in all regions. Since *opportunity perception* belongs to the ATT sub-index, it explains the generally weak performance of Hungary and the Hungarian regions in entrepreneurial attitudes. While *opportunity perception* appears to be the weakest pillar of the innovation-driven economies as well, but the difference is substantial. The innovation-driven country average is 0.53, and the Hungarian regional average is 0.19 (Hungary 2008-2012).

Table 3 Hungarian regions relative position: pillar level

Regions	1	2	3**	4	5	6**	7	8	9*	10	11	12	13**	14**	Less favorable*	Most favorable
Central Hungary	0.30	1.00	0.42	0.69	0.44	0.54	0.42	0.50	0.33	0.33	0.47	0.54	0.61	0.61	OPPORTUNITY PERCEPTION	STARTUP SKILLS
Central Transdanubia	0.15	0.27	0.42	0.52	0.45	0.61	0.26	0.39	0.43	0.37	0.37	0.49	0.50	0.42	OPPORTUNITY PERCEPTION	OPPORTUNITY STARTUP
Western Transdanubia	0.17	0.34	0.44	0.50	0.45	0.65	0.36	0.48	0.40	0.33	0.34	0.40	0.76	0.44	OPPORTUNITY PERCEPTION	INTERNATIONALIZATION
Southern Transdanubia	0.11	0.42	0.43	0.51	0.44	0.55	0.54	0.33	0.41	0.42	0.33	0.66	0.77	0.44	OPPORTUNITY PERCEPTION	INTERNATIONALIZATION
Northern Hungary	0.14	0.33	0.48	0.45	0.43	0.54	0.37	0.31	0.46	0.46	0.36	0.94	0.49	0.45	OPPORTUNITY PERCEPTION	HIGH GROWTH
Northern Great Plains	0.10	0.36	0.46	0.46	0.44	0.50	0.40	0.39	0.44	0.34	0.46	0.38	0.53	0.45	OPPORTUNITY PERCEPTION	RISK CAPITAL
Southern Great Plain	0.09	0.33	0.45	0.44	0.44	0.57	0.38	0.25	0.41	0.41	0.41	0.39	0.64	0.57	OPPORTUNITY PERCEPTION	INTERNATIONALIZATION
<i>Budapest</i>	<i>0.19</i>	<i>0.90</i>	<i>0.36</i>	<i>0.60</i>	<i>0.38</i>	<i>0.59</i>	<i>0.50</i>	<i>0.46</i>	<i>0.35</i>	<i>0.36</i>	<i>0.45</i>	<i>0.66</i>	<i>0.56</i>	<i>0.66</i>	<i>OPPORTUNITY PERCEPTION</i>	<i>STARTUP SKILLS</i>
<i>Hungarian Regional Average</i>	<i>0.15</i>	<i>0.44</i>	<i>0.44</i>	<i>0.51</i>	<i>0.44</i>	<i>0.57</i>	<i>0.39</i>	<i>0.38</i>	<i>0.41</i>	<i>0.38</i>	<i>0.39</i>	<i>0.54</i>	<i>0.61</i>	<i>0.48</i>	<i>OPPORTUNITY PERCEPTION</i>	<i>INTERNATIONALIZATION</i>
Hungary 2011	0.30	0.55	0.54	0.55	0.45	0.55	0.84	0.43	0.49	0.41	0.44	0.68	0.76	0.39	OPPORTUNITY PERCEPTION	TECHNOLOGY SECTOR
Hungary 2010	0.24	0.58	0.58	0.55	0.42	0.56	0.56	0.50	0.36	0.32	0.39	0.51	0.63	0.43	OPPORTUNITY PERCEPTION	INTERNATIONALIZATION
Hungary 2008-2012	0.19	0.54	0.43	0.50	0.37	0.55	0.41	0.43	0.43	0.36	0.30	0.57	0.63	0.53	OPPORTUNITY PERCEPTION	OPPORTUNITY STARTUP
<i>Innovation-driven countries</i>	<i>0.50</i>	<i>0.68</i>	<i>0.85</i>	<i>0.73</i>	<i>0.79</i>	<i>0.83</i>	<i>0.60</i>	<i>0.67</i>	<i>0.78</i>	<i>0.71</i>	<i>0.61</i>	<i>0.58</i>	<i>0.72</i>	<i>0.57</i>	<i>OPPORTUNITY PERCEPTION</i>	<i>NON-FEAR OF FAILURE</i>

Source: authors' own construction.

*Opportunity Perception (1); Startup Skills (2); Non-fear of Failure (3); Networking (4); Cultural Support (5); Opportunity Startup (6); Tech sector (7); Quality of Human Resources (8); Competition (9); Product Innovation (10); Process Innovation (11); High Growth Firm (12); Internationalization (13); Risk Capital (14). Innovation-driven countries: Source: The Global Competitiveness Report 2010-2011, page 11. List of innovation-driven countries: *Australia, Austria, Belgium, Canada, Cyprus, Czech Rep., Denmark, Finland, France, Germany, Greece, Hong Kong, Iceland, Ireland, Israel, Italy, Japan, Korea Rep., Luxemburg, Malta, Netherland, New Zealand, Norway, Portugal, Singapore, Slovenia, Spain, Sweden, Switzerland, United Arab Emirates, United Kingdom, United States.* GEDI 2010 country scores are available only for countries in italics.

**Pillars where the institutional variable used is the same for all 7 regions.

7. A simulation on how to improve entrepreneurship in the Hungarian regions

An important implication of the GEDI is related on how to improve of the entrepreneurship scores. According to the PFB methodology the best progress can be achieved by abolishing the bottleneck, the weakest performing pillar. However, we should remember that the National System of Entrepreneurship is a dynamic system: if you alleviate one bottleneck, another factor soon becomes the most binding constraint for system performance. This raises the question of 'optimal' allocation of policy effort.

We simulated a situation in which all the Hungarian regions increased their allocation of entrepreneurship policy resources in an effort to gain 1% improvement in their entrepreneurial performance, as captured by the GEDI Index. The Penalty for Bottleneck method used in the GEDI index calculation implies that the greatest performance enhancement will be achieved when additional resources are always allocated to alleviating the most constraining bottleneck. Once the bottleneck pillar has improved sufficiently so as to no longer constitute the most important constraint to system performance, further resource additions need to be allocated to the next most severe bottleneck. We iterated this procedure until an overall GEDI Index performance of 1% in every country had been achieved. This simulation is based on two important assumptions: (1) we allocate additional resources over current resource allocation; and (2) the cost of improving performance is equal for all pillars. The result of the simulation is shown in Table 4.

This simulation produces a more nuanced picture of the required allocation of policy effort, if policy were to be optimized to maximize the GEDI index value. We can see that to improve the 2008-2012 Hungary's GEDI index score by 1%, an 'optimal' effort allocation would call for a 31% improvement in the *opportunity perception pillar*, a 20% in the *process innovation pillar* a 13% in the *opportunity perception pillar* and 12% in the *cultural support pillar*. Of the remaining effort, our simulation suggests that 8% should be allocated to tech sector and 6% to competition. Less than 5% new effort is necessary to enhance *non-fear of failure pillar* and *quality of human resources pillar*.

Table 4 Simulation of ‘optimal’ policy allocation to increase the GEDI score by 1% in the Hungarian regions

Region		1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total effort
Central Hungary	A	0.23	0	0.11	0	0.09	0	0.12	0.03	0.2	0.2	0.07	0	0	0	1.05
	B	22%	0%	10%	0%	9%	0%	11%	3%	19%	19%	7%	0%	0%	0%	
Central Transdanubia	A	0.3	0.17	0.03	0	0	0	0.19	0.06	0.02	0.07	0.08	0	0	0.03	0.95
	B	32%	18%	3%	0%	0%	0%	20%	6%	2%	7%	8%	0%	0%	3%	
Western Transdanubia	A	0.29	0.13	0.02	0	0.01	0	0.1	0	0.06	0.13	0.13	0.06	0	0.02	0.95
	B	31%	14%	2%	0%	1%	0%	11%	0%	6%	14%	14%	6%	0%	2%	
Southern Transdanubia	A	0.33	0.02	0.01	0	0	0	0	0.11	0.03	0.02	0.11	0	0	0	0.63
	B	52%	3%	2%	0%	0%	0%	0%	17%	5%	3%	17%	0%	0%	0%	
Northern Hungary	A	0.31	0.13	0	0.01	0.03	0	0.08	0.17	0	0	0.1	0	0	0.01	0.84
	B	38%	16%	0%	1%	4%	0%	10%	17%	0%	0%	12%	0%	0%	1%	
Northern Great Plains	A	0.35	0.1	0	0	0.01	0	0.06	0.06	0.01	0.11	0	0.07	0	0	0.77
	B	45%	13%	0%	0%	1%	0%	8%	8%	1%	14%	0%	9%	0%	0%	
Southern Great Plain	A	0.33	0.09	0	0	0	0	0.04	0.17	0.02	0.01	0.01	0.04	0	0	0.71
	B	46%	13%	0%	0%	0%	0%	6%	24%	3%	1%	1%	6%	0%	0%	
	A	0.29	0	0.12	0	0.1	0	0	0.02	0.12	0.12	0.03	0	0	0	0.8
Budapest	B	36%	0%	15%	0%	13%	0%	0%	3%	15%	15%	4%	0%	0%	0%	
Hungary 2011	A	0.26	0.01	0.02	0.01	0.11	0	0	0.13	0.06	0.15	0.11	0	0	0.17	1.03
	B	25%	1%	2%	1%	11%	0%	0%	13%	6%	15%	11%	0%	0%	17%	
Hungary 2010	A	0.28	0	0	0	0.11	0	0	0.02	0.16	0.2	0.13	0.01	0	0.1	1.01
	B	28%	0%	0%	0%	11%	0%	0%	2%	16%	20%	13%	1%	0%	10%	
Hungary 2008-2012	A	0.29	0	0.05	0	0.11	0	0.08	0.05	0.06	0.12	0.19	0	0	0	0.95
	B	31%	0%	5%	0%	12%	0%	8%	5%	6%	13%	20%	0%	0%	0%	

Source: authors' own construction

Note: *A: Required increase in pillar; B: Percentage of total effort.

Variables from 1 to 14 are the same as in Table 3.

Although, looking at Table 4 it is apparent that the ‘optimal’ policy mix is different for the 7 regions of Hungary, all regions need to improve the *opportunity perception pillar*: for example, for Central Hungary there is necessary to focus only the 22% of new resources on this pillar, while for South Transdanubia requires the 52%, all the other regions are between these two extremes. The regions are also differing regarding their required total efforts to improve their GEDI score by 1%: for Southern Transdanubia there are only 0.63 new resources necessary, while for Central Hungary 1.05.

8. Conclusion

Over recent years, increasing attention has been paid to the role that regional level factors play in driving entrepreneurship and thereby regional and national development. Within the EU an important aim is to decrease regional inequalities. Despite enormous efforts,

regional disparities in many countries have been increasing. The examination of the drivers of entrepreneurship at the regional level may explain some of the reasons for these continuing regional inequalities.

In this paper, we adapted the GEDI Index to a regional analysis of Hungary's 7 regions. While the Hungary's regional GEDI values are calculated in the same way as would be those of independent countries, our analysis focuses on comparing the Hungarian regions to each other. The Hungarian regions are investigated in terms of the GEDI, the sub-index as well as in the pillar level. According to the regional GEDI scores, Central Hungary has a relative better position, while the remaining 6 regions do not differ from each other regarding their entrepreneurial attitudes, abilities or aspirations to a great extent.

The Hungarian regions are found to be *particularly weak in the entrepreneurial attitudes and aspiration related pillars*. On the one hand, the results show that Hungarian firms exhibit *reduced levels of innovation activity*. Some of the causes can be found in the economic structure of Hungarian firms which are focused mainly in services and also the lags in their incorporation of new technologies. Taken together, these all have a negative effect on the productivity and growth of firms. Approximately 2/3 of the R&D expenditures were concentrated in the Central Hungarian region in 2011. Considerable research activity can be found in Northern Great Plain and Southern Great Plain as well, due to their quite large research bases relating to traditional sectors (e.g. agriculture) (KSH 2012).

Finally, the analysis based on the individual characteristics of Hungarian entrepreneurs (potential entrepreneurs) shows that Hungarian entrepreneurs *lack of start-up skills* and generally also *exhibit a negative attitude towards the potential economic or business opportunities*. The number of existing firms is one of the most important indicators of economic performance. The expansion of firms compared to the last year is quite modest (only 2.7%). Central Hungary can be characterized by the highest firm density, while the expansion in the number of existing firm in Northern Hungary, Southern Hungary and Central Transdanubia was restrained (KSH 2012).

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Appendix 1 A description of the regional-level individual variables used

Individual variable	Description
OPPORTUNITY	The percentage of the 18-64 aged population recognizing good conditions to start business next 6 months in area he/she lives,
SKILL	The percentage of the 18-64 aged population claiming to possess the required knowledge/skills to start business
NONFAIRFAIL	The percentage of the 18-64 aged population stating that the fear of failure would not prevent starting a business
KNOWENT	The percentage of the 18-64 aged population knowing someone who started a business in the past 2 years
NBGOODAV	The percentage of the 18-64 aged population saying that people consider starting business as good career choice
NBSTATAV	The percentage of the 18-64 aged population thinking that people attach high status to successful entrepreneurs
CARSTAT	The status and respect of entrepreneurs calculated as the average of NBGOODAV and NBSTATAV
TEAOPPORT	Percentage of the TEA* businesses initiated because of opportunity start-up motive
TECHSECT	Percentage of the TEA businesses that are active in technology sectors (high or medium)
HIGHEDUC	Percentage of the TEA businesses owner/managers having participated over secondary education
COMPET	Percentage of the TEA businesses started in those markets where not many businesses offer the same product
NEWP	Percentage of the TEA businesses offering products that are new to at least some of the customers
NEWT	Percentage of the TEA businesses using new technology that is less than 5 years old average (including 1 year)
GAZELLE	Percentage of the TEA businesses having high job expectation average (over 10 more employees and 50% in 5 years)
EXPORT	Percentage of the TEA businesses where at least some customers are outside of the country (over 1%)
INFINVMEAN	The mean amount of 3 year informal investment
BUSANG	The percentage of the 18-64 aged population who provided funds for new business in past 3 years excluding stocks & funds, average
INFINV	The amount of informal investment calculated as INFINVMEAN* BUSANG

Source: authors' own construction

Note: *TEA (Total Entrepreneurial Activity) = the proportion of the 18-64 year aged working population who are in the process of business start-up and/or having an operating young venture.

Appendix 2 A description of GEDI's national and regional institutional variables used

Institutional variable	Description	Source of data	Data availability
MARKETDOM	Country level: Domestic market size that is the sum of gross domestic product plus value of imports of goods and services, minus value of exports of goods and services, Data are from 2012.	World Economic Forum	The Global Competitiveness Report 2012-2013, p. 496. http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf
	Hungary's regional data: calculation based on the EU regional competitiveness market size calculation, rescaling the variable to a 7 point Likert scale (calculation method in Appendix A-3).	EU Regional competitiveness 2010	Based on: EU Regional Competitiveness Index 2010, p. 154.
URBANIZATION	Country level: Urbanization that is the percentage of the population living in urban areas, data are from the Population Division of the United Nations, 2011.	United Nations, World Urbanization Prospects: The 2011 Revision	Percentage of population residing in urban areas, 1950-2050 http://esa.un.org/unpd/wup/CD-ROM/Urban-Rural-Population.htm
	Hungary's regional data: same as above. Data are from 2000-2001.	OECD Regional Typology	OECD Regional Typology, Directorate for Public Governance and Territorial Development, 22 February 2010, p. 21. OECD, StatExtracts http://stats.oecd.org
MARKETAGGLOM	The size of the market: A combined measure of the domestic market size and the urbanization that later measures the potential agglomeration effect. Calculated as MARKETDOM*URBANIZATION.	Own calculation	-
EDUCPOSTSEC	Country level: Gross enrolment ratio in tertiary education, 2010.	UNESCO Institute for Statistics	World dataBank, World Development Indicators (WDI) http://data.worldbank.org/indicator/SE.TER.ENRR/countries?display=default
	Hungary's regional data same as above. Data are from 2011.	Eurostat, Education indicators by NUTS 2 regions	http://appsso.eurostat.ec.europa.eu/nui/setupModifyTableLayout.do
BUSINESS RISK	Country and regional level data source is the same: The business climate rate “assesses the overall business environment quality in a country... “.The alphabetical rating is turned to a seven point Likert scale from 1 (“D” rating) to 7 (A1 rating). 30. Data are from 2008 except 2009 countries that are from 2009.	Coface	Business Climate Assessment, Coface Country Risk and Economic Research, January, 2013 http://www.coface.com/CofacePortal/COM_en_EN/pages/home/risks_home/business_climate
INTERNETUSAGE	Country level data: The number Internet users in a particular country per 100 inhabitants, 2010.	International Telecommunication Union	ICT Statistics, ITU ICT Eye http://www.itu.int/ITU-D/ICTEYE/Default.aspx
	Hungary's regional data: same as above. Data are from 2011.	Eurostat, Regional information society	http://appsso.eurostat.ec.europa.eu/nui/show.do

		statistics	
CORRUPTION	Country level data: The Corruption Perceptions Index (CPI) measures the perceived level of public-sector corruption in a country. “ Data are from 2012.	Transparency International	http://cpi.transparency.org/cpi2012/in_detail/
	Hungary's regional data based on a standardized variable combining education, health, and general public corruption in addition to law enforcements and bribe payment. Calculation is based on Charron et al (2011) , rescaling it to a 10 point scale (see A-3 Appendix for details). Data are from 2009.	Charron et al (2011)	EU QoG Corruption Index (EQI) http://www.qog.pol.gu.se/data/datadownloads/qogeuregionaldata/
FREEDOM	Country and regional level data source is the same: “Business freedom is a quantitative measure of the ability to start, operate, and close a business that represents the overall burden of regulation, as well as the efficiency of government in the regulatory process. Data are from 2013.	Heritage Foundation/ World Bank	2013 Index of Economic Freedom http://www.heritage.org/index/visualize
TECHABSORP	Country level data: Firm level technology absorption capability: “Companies in your country are (1 = not able to absorb new technology, 7 = aggressive in absorbing new technology)”. Data are 2011-2012 weighted average.	World Economic Forum	The Global Competitiveness Report 2012-2013, p. 489. http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf
	Hungary's regional data proxied by the technological readiness data from the EU regional competitiveness index and rescaling it to the original 7 point scale (see A-3 Appendix for details).	EU Regional competitiveness 2010	Based on: EU Regional competitiveness 2010, p. 176
STAFFTRAIN	Country level data: The extent of staff training: “To what extent do companies in your country invest in training and employee development? (1 = hardly at all; 7 = to a great extent)”. Data are 2011-2012 weighted average.	World Economic Forum	The Global Competitiveness Report 2012-2013, p. 447. http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf
	Hungary's regional data proxied by the Higher education and life long learning sub-index data from the EU regional competitiveness index and rescaling it to the original 7 point scale (see A-3 Appendix for details).	EU Regional competitiveness 2010	Based on: EU Regional competitiveness 2010, p. 126.
MARKDOM	Country and regional level data sources are the same: Extent of market dominance: “Corporate activity in your country is (1 = dominated by a few business groups, 7 = spread among many firms)”. Data are 2011-2012 weighted average.	World Economic Forum	The Global Competitiveness Report 2012-2013, p. 451. http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf
TECHTRANSFER	Country level data: These are the innovation index points from GCI: a complex measure of innovation. Data are 2011-2012 weighted average.	World Economic Forum	The Global Competitiveness Report 2012-2013, p. 20. http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf
	Hungary's regional data proxied by the Innovation sub-index data from the EU regional competitiveness index and rescaling it to the original 7 point scale (see A-3 Appendix for details).	EU Regional competitiveness 2010	Based on: EU Regional competitiveness 2010, p. 204.
	Country level data: Gross domestic expenditure on Research & Development	UNESCO Institute	http://stats.uis.unesco.org/unesco/ReportF

GERD	(GERD) as a percentage of GDP. Data are from 2010.	for Statistics	olders/ReportFolders.aspx?IF_ActivePath=P,54
	Hungary's regional data: same content, regional level application	Eurostat Regional Database, R&D expenditure and personnel	http://appsso.eurostat.ec.europa.eu/nui/show.do
BUSS STRATEGY	Country level data: Refers to the ability of companies to pursue distinctive strategies, which involves differentiated positioning and innovative means of production and service delivery. Data are 2011-2012 weighted average.	World Economic Forum	The Global Competitiveness Report 2012-2013, p. 20. http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf
	Hungary's regional data proxied by the Business strategy sophistication sub-index data from the EU regional competitiveness index and rescaling it to the original 7 point scale (see A-3 Appendix for details).	EU Regional competitiveness 2010	Based on: EU Regional competitiveness 2010, p. 188.
GLOB	Country and regional level data sources are the same: A part of the Globalization Index measuring the economic dimension of globalization. Data are from the 2012 report and based on the 2009 survey.	KOF Swiss Economic Institute	Dreher, Axel (2006): Does Globalization Affect Growth? Evidence from a new Index of Globalization, <i>Applied Economics</i> 38, 10: 1091-1110. http://globalization.kof.ethz.ch/
DCM	Country and regional level data sources are the same: The Depth of Capital Market is one of the six sub-indices of the Venture Capital and Private Equity index.	EMLYON Business School France and IESE Business School, Barcelona, Spain	Groh, A, H.Liechtenstein and K. Lieser 2012 The Global Venture Capital and Private Equity Country Attractiveness Index 2012 Annual, http://blog.iese.edu/vcpeindex/about/

Source: authors' own construction

Appendix 3 Structure of the Global Entrepreneurship and Development Index

GLOBAL ENTREPRENEURSHIP AND DEVELOPMENT INDEX																																								
Entrepreneurial Attitudes Sub-Index				Entrepreneurial Ability Sub-Index				Entrepreneurial Aspirations Sub-Index																																
OPPORTUNITY PERCEPTION	STARTUP SKILLS	NONFEAR OF FAILURE	NETWORKING	CULTURAL SUPPORT	OPPORTUNITY STARTUP	TECHNOLOGY SECTOR	QUALITY OF HUMAN RESOURCES	COMPETITION	NEW PRODUCT	NEW TECH	HIGH GROWTH	INTERNATIONALIZATION	RISK CAPITAL	<i>MARKETAGGLOM</i>	<i>OPPORTUNITY</i>	<i>SKILL</i>	<i>BUSINESS RISK</i>	<i>NONFEAR</i>	<i>INTERNETUSAGE</i>	<i>KNOWENT</i>	<i>CORRUPTION</i>	<i>CARSTAT</i>	<i>FREEDOM</i>	<i>TEAOPPORT</i>	<i>TECHABSORP</i>	<i>TECHSECT</i>	<i>STAFFTRAIN</i>	<i>HIGHEDUC</i>	<i>MARKDOM</i>	<i>COMPET</i>	<i>TECHTRANSFER</i>	<i>NEWP</i>	<i>GERD</i>	<i>NEWT</i>	<i>BUSS STRATEGY</i>	<i>GAZELLE</i>	<i>EXPORT</i>	<i>GLOB</i>	<i>DCM</i>	<i>INFINV</i>

Source: author's own construction based on Ács – Szerb (2010)

Note: *The GEDI is a super-index made up of three sub-indexes, each of which is composed of several pillars. Each pillar consists of an institutional variable (denoted in *bold*) and an individual variable (denoted in *bold italic*). The data values for each variable are gathered from wide ranging sources.

Appendix 4 The rescaling of the regional variables for the level and range of the country level variable

Example: MARKETSIZE

MARKETSIZE = Hungary's average market size from World Economic Forum = 3.9

Maximum MARKETSIZE = 7 Country maximum market size from WEF

MARKETSIZE_j = the applied market size variable for the jth Hungarian region

REGMARKETSIZE_j = jth region market size from Regional Competitiveness score j =

1,.....k, k is the number of region in Hungary

Maximum REGMARKETSIZE_j = 100

AVREGAMARKETSIZE = regional average market size as the average of a country regional market size values

MARKETSIZE_j = MARKETSIZE +

(REGMARKETSIZE_j – AVREGAMARKETSIZE)(7 – 3.9) / (100 –

AVREGAMARKETSIZE