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Article

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MEASURING ENTREPRENEURSHIP AND OPTIMIZING ENTREPRENEURSHIP POLICY EFFORTS IN THE EUROPEAN UNION¹

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BALÁZS PÁGER⁴



Abstract: In this article we provide a brief review of how entrepreneurship policies have evolved and which implied conceptions of entrepreneurship underlie attempts to measure the phenomenon. We propose that a major shortcoming in policy thinking is the insufficient recognition that entrepreneurship, at a country level, is a systemic phenomenon and should be approached as such. To address this gap, we propose the concept of National Systems of Entrepreneurship (NSE) that recognizes the systemic nature of country-level entrepreneurship, and also recognizes that, although embedded in a country-level context, entrepreneurial processes are fundamentally driven by individuals. We then explain how the Global Entrepreneurship Index methodology is designed to profile National Systems of Entrepreneurship. We apply the Penalty for Bottleneck (PFB) methodology to examine the entrepreneurial performance of the European Union (EU). Comparing the EU and US entrepreneurship scores, Europe is seemingly lagging behind the US. According to the GEI scores, the EU countries reveal considerable differences in their entrepreneurial performance. Moreover, in EU member countries even larger differences over the 14 pillars of entrepreneurship prevail. In addition to highlighting

bottleneck factors, the index also provides rough indications of how much a country should seek to alleviate a given bottleneck. While there are numerous ways to improve entrepreneurship in the EU and its member states, we analyze only one simple situation. An important implication of the analysis is that uniform policy does not work, and the EU member states should apply different policy mixes to achieve the same improvement in the GEI points.

Introduction

Policies to support entrepreneurship have evolved over the past 30-odd years, from encouraging the entry and operation of small- and medium-sized firms (SMEs) towards more qualitatively nuanced (in terms of the quality of entrepreneurial entries addressed), refined, and more accurately targeted policies. All of these policies are based, at best, on limited consideration of what entrepreneurship actually means as a country-level phenomenon and what the possible implications might be for the design and implementation of policies to support entrepreneurship. In this introduction, we begin by providing a brief review of how entrepreneurship policies have evolved and what implied conceptions of entrepreneurship underlie attempts to measure the phenomenon.

Although the role of entrepreneurship in economic development is progressively becoming clearer, our understanding of policies to develop the potential of entrepreneurship remains limited. This argument is largely explained by the *discrepancy between the definition and the measure of entrepreneurship*. While the complex and *multidimensional character* of entrepreneurship is extensively recognized (Verheul et al. 2001; Capello and Lenzi 2016), major measures of entrepreneurship are still being thwarted. Over the past decades, significant progress has been made in propelling the measurement of entrepreneurship. Despite this progress, there is a significant divide between *quantity type indices of entrepreneurial activity* and measures based on the *quality aspects of entrepreneurship*. Quantity type (or output) indicators track the incidence of business ownership (new firms) or self-employment entries within populations. In these measures, entrepreneurship is

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conceived of as the creation of a new business organization or an entry into self-employment. Examples of such output indicators include the Global Entrepreneurship Monitor's (GEM) Total Entrepreneurial Activity (TEA) index (Reynolds et al. 2005); the OECD-Eurostat's Entrepreneurship Indicators (e.g. Lunati, Meyer zu Schlochtern and Sargsayan 2010; OECD-Eurostat 2007); the World Bank's Entrepreneurship Survey (World Bank 2011); and the Flash Eurobarometer survey (Gallup 2009). Another indicator of entrepreneurship is the Kauffman Index of Entrepreneurial Activity (KIEA), which measures the adult non-business owner population that start a new business (Fairlie 2012). Examples of indices measuring population-level attitudes include the Eurobarometer survey (Gallup 2009); the World Values Survey, GEM, and the International Social Survey (ISSP 1997). The use of the attitude-related measures to proxy entrepreneurship is particularly problematic because the mechanism swaying the vaguely defined attitudes to business start-ups remains unclear (Acs, Autio and Szerb 2014).

Nevertheless, these still frequently used start-up, ownership and business density rates are problematic because these uni-dimensional indices do not consider only one side, the quality aspects of entrepreneurship (Acs and Szerb 2011; Shane 2009). Mann and Shideler (2015) emphasize that the problem with density type indices is that policy makers with their programs targeting economic growth may only increase the number of firms, rather than catalyzing the creative destruction process. Lenihan (2011) also demonstrates that traditional uni-dimensional indicators (such as jobs created or retained) are too narrow metrics to measure the impact of firm policy interventions, because these proxies focus exclusively on private firm impact, rather than on broader socioeconomic impacts. Thurik, Stam and Audretsch (2013) mention a shift in entrepreneurial policy that is related to the paradigm shift from a managed economy to an entrepreneurial economy. In their view, policies have to be created that focus on dynamic capitalism in which entrepreneurship plays a key role, instead of promoting more new firms. In their paper Guzman and Stern (2016) focus both on the role of entrepreneurial quantity and quality. The authors calculate measures on an annual basis for the 15 states of the United States for the period from 1988–2014. They create three composite indices to measure both changes in entrepreneurial potential and ecosystem: the *Entrepreneurial Quality Index* (EQI, measuring the average quality level among a group of start-ups within a given cohort), the *Regional Entrepreneurship Cohort Potential Index* (RECPI,

measuring the growth potential of firms founded within a given region and time period) and the *Regional Entrepreneurship Acceleration Index* (REAL, measuring the performance of a region over time in realizing the potential of firms founded there). According to their key finding, they observed a three to four-fold drop in the US entrepreneurial ecosystem performance while observing very little drop in overall entrepreneurial potential.

The target of entrepreneurship policy has become one of the most widely debated questions in recent decades, as well as the issue of whether promoting entrepreneurial activity and firms in general makes entrepreneurship policy successful. In their empirical research Fritsch and Schroeter (2009) point out that the marginal effect of new business formation on regional employment may decline with the increase in the number of start-ups; and that the marginal effect may even become negative. They therefore conclude that policy efforts should promote high-quality start-ups in order to create economic growth. Vivarelli (2012) noticed that policy makers have to take into consideration the heterogeneity of entrepreneurs, and their motivation for founding a new firm. Furthermore, entrepreneurial policies have to support firm entries whose activities are primarily based on technological renewal and economic growth. Stam et al. (2007) find that high-growth entrepreneurship have a higher influence on economic growth than entrepreneurial activity in general. Mason and Brown (2013) also stress the heterogeneity of high-growth firms. They claim that entrepreneurial policies also have to support start-ups, and not only high-growth firms, by applying better targeted policy interventions towards high-potential new firms. They also refer on the debate in the literature over which firms should be promoted if entrepreneurship policy does not support firms in general.

It is clear, however, that the quality of entrepreneurship cannot be measured by the number of firms or by the distinctive characteristics of entrepreneurs alone. Meanwhile a shift of entrepreneurship policy in thinking seems to have occurred from direct intervention increasing the number of firms towards creating a more *supportive environment or climate, namely an adequate ecosystem for entrepreneurs*. The entrepreneurial ecosystem approach thus examines the entrepreneurial individual instead (not the company itself), as well as emphasizes the role played by the entrepreneurship context.

Several studies try to identify those factors determining (allowing or restricting) the level of entrepreneurship and offer different theoretical perspectives and frameworks for organizing a broad range of determinants that explain the level of high-quality entrepreneurship, including economic, social and cultural institutions (OECD 2008; Sternberg 2009; Feld 2012; Isenberg 2011, WEF 2013, Annoni and Dijkstra 2013; Stam 2015). Freytag and Noseleit (2009) find that the better a country's institutions are, the higher entrepreneurs' acceptance of them is. The difference in acceptance levels among entrepreneurs and non-entrepreneurs decreases as the quality of a country's institutions improves. The authors highlight the fact that small differences may also influence institutional acceptance. In his paper Rodríguez-Pose (2013) also discusses the importance of institutions in terms of European regional economic development. He notes that the EU needs to create institutional-based regional development strategies that are specifically tailor-made for the different local environments across European regions. However, the author also points out the difficulties in establishing the right mix of formal and informal institutions.

In their theoretical framework Verheul et al. (2001) distinguish between the demand and supply side of entrepreneurship. Here the demand side refers to the opportunities for entrepreneurship. According to the authors, the diversity in consumer demand is important, because the greater this diversity, the more leeway is created for entrepreneurs. In the model the supply side of entrepreneurship encompasses a range of different factors: industrial structure (sector structure, networking), also influenced by technological developments, government regulations, demographic composition, culture and formal institutions. In addition to environmental factors the authors consider in their model that the effect of the individual risk-reward profile "represents the process of weighing alternative types of employment and is based on opportunities (environmental characteristics), resources, ability, personality traits and preferences (individual characteristics)" (Verheul et al. 2001, 9). Audretsch and Belitski (2016) define the efficient entrepreneurial ecosystem as a complex system of interactions among individuals within the institutional, socioeconomic and informational context. They emphasize a holistic policy approach to the entrepreneurial ecosystem. Acs et al. (2016) focus on the public policy question regarding entrepreneurial policy, namely: "Does the environment allow the entrepreneur to complete the production function and fill in the missing input markets?". In their view, public policy

interventions should promote the creation of an enabling environment. The Dutch entrepreneurial ecosystem may serve as a European example, in which four main framework conditions of the entrepreneurial ecosystem could be identified: changing formal institutions to better support labor mobility; strengthening public demand for entrepreneurs by financing new knowledge creation and application; promoting a culture of entrepreneurship and developing physical infrastructure to upgrade knowledge circulation and networks (Stam 2014). Dilli and Elert (2016) analyze the present entrepreneurial climate across 21 EU member states and identify institutions that are potentially relevant to this climate. They highlight the presence of varieties of entrepreneurial regimes in Europe in terms of their climate. By identifying a number of potentially relevant entrepreneurship indicators, as well as potentially relevant formal and informal institutions, their findings also suggest that there is no one-size-fits-all approach to creating an entrepreneurial society in Europe.

The phenomenon of entrepreneurship has been extensively studied at both the individual and contextual levels, but the studies do not provide insight into how individuals interact with their systemic contexts, and *the complex recursive relationships between the two levels have not been paid much attention*. In this paper we propose that a major shortcoming in policy thinking is the insufficient recognition that entrepreneurship, at a country level, is a systemic phenomenon and should be approached as such. To address this gap, we propose the concept of National Systems of Entrepreneurship that recognizes the systemic character of country-level entrepreneurship, and also recognizes that, although embedded in a country-level context, entrepreneurial processes are fundamentally driven by individuals (Acs, Autio and Szerb 2014). We then explain how the GEI methodology is designed to profile National Systems of Entrepreneurship. Finally, using the European Union member countries, we illustrate how the GEI method enables policy makers to develop a better understanding of the systemic characteristics of country-level entrepreneurship and to identify priority areas for national and EU level entrepreneurship policy. This study is a significantly amended version of a previous paper on the measurement and examination of entrepreneurship policy in the EU countries by Szerb, Acs and Autio (2013). Changes include methodology, and the time frame and there has been a considerable alteration of the institutional variables that has resulted in a more sophisticated structure of the National System of Entrepreneurship. The evaluation of the results has changed in line with these alterations.

Entrepreneurship measurement and the Global Entrepreneurship Index (GEI) perspective

Based on the inconsistencies in terms of the definition, the measurement, and the policy domain of entrepreneurship, Acs and Szerb (2011, 2012) and Acs, Autio and Szerb (2014) developed the Global Entrepreneurship Index (GEI)⁵ that serves to measure country level entrepreneurship. The GEI takes into account that:

- entrepreneurship is a multifaceted phenomenon that requires a complex measure;
- a proper measure should be used to consider the quality aspects of entrepreneurship, instead of a quantity-based approach;
- both the individual efforts/capabilities and the environmental/institutional aspects of entrepreneurship are important;

- the different aspects/components of the entrepreneurship constitute a system where the interrelation of the elements is vital;
- entrepreneurship policy should be formulated from a system perspective by providing a tailor-made policy mix that fits to a particular country's entrepreneurial profile, rather than providing one size fits all universal suggestions.

GEI defines country level entrepreneurship as the National System of Entrepreneurship that: "...is 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" (Acs, Autio and Szerb 2014, 479). GEI proposes five levels of index building as the GEI super-index measuring entrepreneurship at the country level, the three sub-indexes (attitudes, abilities and aspirations), 14 pillars, 28 variables and 49 indicators. All pillars contain an individual and an institutional variable component. Viewed from a system perspective, GEI takes into account the

⁵ The GEI formerly was named as GEDI, Global Entrepreneurship and Development Index.

Table 1

The structure of the Global Entrepreneurship Index (GEI)

Sub-indexes	Pillars	Variables*
Attitudes sub-index	Opportunity perception	<i>Opportunity</i>
		Freedom and property
	Start-up skills	<i>Skill</i>
		Education
	Risk perception	<i>Risk acceptance</i>
		Country risk
Abilities sub-index	Networking	<i>Knowent</i>
		Connectivity
	Cultural support	<i>Carstat</i>
		Corruption
	Opportunity start-up	<i>Teaopport</i>
		Taxgovern
Aspiration sub-index	Technology absorption	<i>Techsect</i>
		Techabsorp
	Human capital	<i>Higheduc</i>
		Labor market
	Competition	<i>Compet</i>
		Compregulation
Aspiration sub-index	Product innovation	<i>Newp</i>
		Techtransfer
	Process innovation	<i>Newt</i>
		Science
	High growth	<i>Gazelle</i>
		Finance and strategy
	Internationalization	<i>Export</i>
		Economic complexity
Risk capital		<i>Infinv</i>
		Depth of capital market

*Individual variables are in italics, to be distinguished from institutional ones.

Source: The authors.

connection between the individual and the institutional factors as interacting variables. More recently, the institutional components of the GEI have been reviewed and changed. In this paper we present the amended, new version of GEI as presented in Table 1.

How, then, to define the basic building block of entrepreneurial attitudes, abilities, and aspirations? Entrepreneurial attitudes reflect people's attitudes toward entrepreneurship. It involves opportunity recognition, start-up skills, risk perception, networking, and cultural supports for entrepreneurs. Institutional embedding is expressed as in property rights and economic freedom, the quality of a country's education system, its riskiness, connectivity potential, and the prevalence of corruption.

Entrepreneurial abilities include some important characteristics of the entrepreneur that determine the extent to which new start-ups will have potential for growth, such as motivation based on opportunity as opposed to necessity, the potential technology-intensity of the start-up, the entrepreneur's level of education and the level of competition. These individual factors coincide with the proper institutional factors of taxation and the efficiency of government operation (Taxgovern), technology absorption capability, the freedom of the labor market and the extent of staff training (Labor Market), the dominance of powerful business groups, as well as the effectiveness of antimonopoly regulation (Compregregation).

Entrepreneurial aspiration refers to the distinctive, qualitative, strategy-related nature of entrepreneurial activ-

Table 2

Description of the GEI index pillars	
Pillar name	Description
Opportunity Perception	Opportunity Perception refers to the entrepreneurial opportunity perception potential of the population and weights this against the freedom of the country and property rights.
Start-up Skill	Start-up Skill captures the perception of start-up skills in the population and weights this aspect with the quality of education.
Risk Acceptance	Risk Acceptance captures the inhibiting effect of fear of failure of the population on entrepreneurial action combined with a measure of the country's risk.
Networking	This pillar combines two aspects of Networking: (1) a proxy of the ability of potential and active entrepreneurs to access and mobilize opportunities and resources and (2) the ease of access to reach each other.
Cultural Support	The Cultural Support pillar combines how positively a given country's inhabitants view entrepreneurs in terms of status and career choice and how the level of corruption in that country affects this view.
Opportunity Start-up	The Opportunity Start-up pillar captures the prevalence of individuals who pursue potentially better quality opportunity-driven start-ups (as opposed to necessity-driven start-ups) weighted with the combined effect of taxation and government quality of services.
Technology Absorption	The Technology Absorption pillar reflects the technology-intensity of a country's start-up activity combined with a country's capacity for firm-level technology absorption.
Human Capital	The Human Capital pillar captures the quality of entrepreneurs as weighting the percentage of start-ups founded by individuals with higher than secondary education with a qualitative measure of the propensity of firms in a given country to train their staff combined with the freedom of the labor market.
Competition	The Competition pillar measures the level of the product or market uniqueness of start-ups combined with the market power of existing businesses and business groups as well as with the effectiveness of competitive regulation.
Product Innovation	The Product Innovation pillar captures the tendency of entrepreneurial firms to create new products weighted by the technology transfer capacity of a country.
Process Innovation	The Process Innovation pillar captures the use of new technologies by start-ups combined with the Gross Domestic Expenditure on Research and Development (GERD) and the potential of a country to conduct applied research.
High Growth	The High Growth pillar is a combined measure of (1) the percentage of high-growth businesses that intend to employ at least ten people and plan to grow more than 50 percent in five years (2) the availability of venture capital and (3) business strategy sophistication.
Internationalization	The Internationalization pillar captures the degree to which a country's entrepreneurs are internationalized, as measured by businesses' exporting potential weighted by the level of economic complexity of the country.
Risk Capital	The Risk Capital pillar combines two measures of finance: informal investment in start-ups and a measure of the depth of the capital market. Availability of risk capital is to fulfill growth aspirations.

Source: The authors.

ity. The individual and institutional factors of product and process innovation such as technology transfer, the applied research potential of science, high growth expectations, venture capital availability and strategy sophistication (Finance and Strategy), internationalization and the availability of risk financing constitute entrepreneurial aspirations (Acs, Autio and Szerb 2014). A full, brief description of the pillars is shown in Table 2. For more details and a description of the variables see Appendix 1A and 1B.

It is important to note here that the GEI three sub-indices of attitudes, abilities and aspiration, their 14 pillars, 28 variables and 49 indicators only partially capture the National System of Entrepreneurship, which limits its general use for policy purposes.

While the holistic view of entrepreneurship has had a long history (Audretsch and Belitski 2016, Hofer and Bygrave 1992, Park 2005) the identification and the interrelation of the elements of the system of entrepreneurship is less elaborate. For example, recent developments in the literature on the entrepreneurship ecosystem (Isenberg 2011, Mason and Brown 2014, Stam 2015, Stangler and Bell-Masterson 2015) focus on identifying the elements of the system, but neglect to examine the connection amongst these elements. Reflecting on this gap, Acs, Autio and Szerb (2014) developed the Penalty for Bottleneck (PFB) methodology that views the 14 pillars of entrepreneurship in interaction with one another. In line with Miller's configuration theory (Miller 1986, 1996), we assert that entrepreneurial performance is more a function of the harmonization of the pillars than it is of the strength of individual pillars themselves. Thus, optimal entrepreneurial performance requires that the normalized and adjusted values of the 14 pillars are equal.

An important characteristic of the PFB methodology is the identification of the weakest link in the system of entrepreneurship (Goldratt 1994, Tol and Yohe 2006). Practically it means that the lowest-value pillar constitutes a bottleneck in the system impeding all the other better performing pillars. As a result, the better performing pillars should be penalized because of the distortion. The size of the penalty depends on the magnitude of the bottleneck: The larger the difference between a particular pillar and the bottleneck pillar, the larger the penalty is. The PFB methodology is summarized in the following equation by assuming an exponential penalty function of Casadio Tarabusi and Palazzi (2012):

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

(1)

where $h_{i,j}$ is the modified, after penalty value of the entrepreneurship feature j of country i

$y_{i,j}$ is the normalized value of the original entrepreneurship feature j of country i

$\min y_{i,j}$ is the minimum, normalized value of the original entrepreneurship feature j of country i

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

$j = 1, 2, \dots, n$ (the number of entrepreneurial features)

The pillars are the basic building blocks of the sub-indices: entrepreneurial attitudes, entrepreneurial abilities, and entrepreneurial aspirations. The value of a sub-index for any country is the arithmetic average of its PFB-adjusted pillars for that sub-index multiplied by 100. The maximum value of the sub-indices is 100 and the potential minimum is 0, both of which reflect the relative position of a country in a particular sub-index.

$$ATT_i = 100 \sum_{j=1}^5 h_j \quad (2a)$$

$$ABT_i = 100 \sum_{j=6}^9 h_j \quad (2b)$$

$$ASP_i = 100 \sum_{j=10}^{14} h_j \quad (2c)$$

The super-index, the Global Entrepreneurship Index, is simply the average of the three sub-indices. Since 100 represents the theoretically available limit, the GEI points can also be interpreted as a measure of the efficiency of the entrepreneurship resources.

$$GEI_i = \frac{1}{3} (ATT_i + ABT_i + ASP_i) \quad (3)$$

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

For the detailed description of the methodology we refer to Acs, Szerb and Autio (2016, p. 71–91).

There are some important policy-related consequences of the PFB methodology. Firstly, the different pillars cannot be fully substituted for each other. In other words, the performance of the better performing pillar only partially compensates for the bad performance of the bottleneck pillar. Secondly, the whole GEI index can be improved the most by increasing the bottleneck pillar. The magnitude of the enhancement depends on the relative size of the bottleneck as compared to the other pillars. Thirdly, for policy makers it means that the enhancement of the worst performing bottleneck pillar is the most important priority for entrepreneurship policy.

Measuring and comparing the level of entrepreneurship in the European Union member states

We have data for 26 out of the 28 EU member countries, except for Cyprus and Malta. The individual data are from the 2011 and 2015 cycles of the Global Entrepreneurship Monitor Adult Population Survey (APS). There are various sources of the applied institutional data representing the same years as the individual data (Appendix 1A, 1B). In order to decrease measurement error and maximize the number of investigated countries, we use the average of the 2011–2015 five years' time period (Table 3).

While we have data for a total of 93 countries in the 2011–2015 time period, we focus mainly on the 26 EU member countries. Table 4 presents the overall GEI

scores ranking of all the 93 countries. The EU member countries rank from 2nd to 70th place. The entrepreneurial performance of the EU member countries varies significantly from 77.2 to 22.7: the second ranked Sweden has a score that is more than triple that of 70th ranked Bulgaria. However, there are only two EU countries, Sweden and Denmark, in the top five. Anglo-Saxon countries, namely the US, Australia, Canada, UK and the Nordic countries, dominate the top spots in the index ranking. There are ten EU countries situated in the first 15 places: Sweden, Canada, Switzerland, Denmark, Australia, United Kingdom, Netherlands, Ireland, Finland, France, Belgium, Germany and Austria. While the difference between the number one ranked US and second-place Sweden is only 4.6 percent, this gap is 13 percent between the US and the seventh ranked UK; and 21.6 percent between the US and Austria, which ranks 14 in the index. In the four Southern European countries, Portugal, Spain, Italy, and Greece, entrepreneurial performance is below the level which could be expected given their economic development. More specifically, the fact that Italy and Greece rank below many developing EU and non-EU countries is disappointing.

The best new member state Estonia ranks 21st with a solid performance of 55.2 GEI points. Slovenia, Poland, and Lithuania have relatively high GEI point scores in terms of their development. The Czech Republic, the Slovak Republic and Hungary also perform acceptably. The three most poorly developed EU member countries, Romania, Croatia and Bulgaria, are at the bottom of the EU GEI rank.

Table 3

The examined European Union countries and years of data availability

Country	Years	Country	Years
Austria	2012, 2014	Italy	2012–2015
Belgium	2011–2015	Latvia	2011–2013, 2015
Bulgaria	2015	Lithuania	2011–2014
Croatia	2011–2015	Luxembourg	2013–2015
Czech Republic	2011, 2013	Netherlands	2011–2015
Denmark	2011, 2012, 2014	Poland	2011–2015
Estonia	2012–2015	Portugal	2011–2015
Finland	2011–2015	Romania	2011–2015
France	2011–2014	Slovak Republic	2011–2015
Germany	2011–2015	Slovenia	2011–2015
Greece	2011–2015	Spain	2011–2015
Hungary	2011–2015	Sweden	2011–2015
Ireland	2011–2015	United Kingdom	2011–2015

Source: The authors.

Table 4

The Global Entrepreneurship Index Rank of the 93 countries, 2011–2015

Rank	Country	GDP*	GEI	Rank	Country	GDP	GEI	Rank	Country	GDP	GEI
1	United States	50756	80.9	32	Turkey	17634	43.8	63	Trinidad & Tobago	29155	24.5
2	Sweden	43927	77.2	33	<i>Czech Republic</i>	28075	43.5	64	Philippines	6796	23.9
3	Canada	41846	76.5	34	Bolivia	5934	42.6	65	Argentina	17636	23.7
4	Switzerland	54387	76.3	35	<i>Slovak Republic</i>	25659	42.3	66	El Salvador	7515	23.5
5	Denmark	42428	76.2	36	<i>Latvia</i>	20080	41.2	67	Belize	8215	23.1
6	Australia	42103	74.5	37	<i>Hungary</i>	22624	40.6	68	Ghana	3668	23.0
7	United Kingdom	36806	70.5	38	Tunisia	10232	38.9	69	Egypt	9807	22.7
8	Netherlands	45733	69.7	39	Colombia	11621	38.7	70	<i>Bulgaria</i>	16022	22.7
9	Ireland	44234	68.6	40	Uruguay	18123	36.6	71	Algeria	12626	22.5
10	Finland	39318	67.6	41	<i>Italy</i>	34605	36.5	72	Vietnam	5043	22.2
11	France	37112	65.8	42	Malaysia	21930	36.5	73	Nigeria	5207	22.1
12	Belgium	40913	64.8	43	<i>Greece</i>	26097	35.7	74	Indonesia	9278	21.2
13	Germany	42868	63.9	44	China	10822	35.1	75	Brazil	14416	21.0
14	Austria	44308	63.5	45	<i>Romania</i>	17731	34.6	76	Iran	15812	20.9
15	Taiwan	38122	63.1	46	Botswana	14779	34.2	77	Jamaica	8499	20.6
16	Norway	62907	60.1	47	Barbados	15247	33.7	78	Zambia	3678	20.6
17	Chile	20687	59.1	48	South Africa	11967	33.5	79	Ecuador	10333	20.6
18	Israel	30617	59.0	49	<i>Croatia</i>	20033	32.2	80	Bosnia and Herzegovina	9232	20.0
19	Luxembourg	79718	58.7	50	Costa Rica	13431	31.1	81	Senegal	2198	19.7
20	Qatar	127562	57.6	51	Kazakhstan	21089	30.1	82	Guatemala	6953	17.9
21	Estonia	24852	55.2	52	Namibia	8995	29.8	83	Suriname	15556	17.8
22	Singapore	74314	52.2	53	Lebanon	16777	29.6	84	Ethiopia	1 427	17.8
23	Slovenia	28180	51.8	54	Macedonia	11519	28.9	85	Libya	23032	17.2
24	United Arab Emirates	57380	49.7	55	Peru	10719	28.5	86	Malawi	740	16.5
25	Korea	31890	49.4	56	Thailand	13495	28.1	87	Pakistan	4261	16.0
26	Japan	34872	49.2	57	Panama	16836	27.4	88	Cameroon	2810	14.7
27	Portugal	26171	46.0	58	Mexico	15958	27.0	89	Uganda	1345	13.8
28	Spain	32132	45.7	59	India	5220	25.9	90	Angola	7271	13.8
29	Poland	22390	45.1	60	Morocco	6958	25.7	91	Venezuela	16537	13.0
30	Lithuania	22713	44.2	61	Russia	22795	24.8	92	Burkina Faso	1530	11.9
31	Puerto Rico	31426	44.0	62	Georgia	6946	24.6	93	Bangladesh	2459	11.6

* GDP per capita in international \$ World Bank, average over the 2011–2015 time period.

In italics: European Union member states.

Source: The authors.

Comparing the EU to the US highlights the superiority of the US: The EU average GEI is 56.6 while that of the US is 80.9, marking a 31 percent difference! Dividing the EU-member countries into the Old (pre-2004 members) and the New (the countries that joined in 2004 and 2007), there is a significant difference in the entrepreneurial performance: The Old members' GEI average is 60.7 while the New member states' GEI average is only 41.2.

The entrepreneurial strengths and weaknesses of European Union member states

To analyze the entrepreneurial strengths and weaknesses of EU countries, we need to decompose the GEI index. While it is possible to investigate entrepreneurship related to the three sub-indexes and GEI scores, here we focus on the analysis of the 14 pillars. Table 5 shows the 14 pillars, the three sub-indices and the GEI values for each of the 26 European Union member states and the US, as a benchmarking country.

The pillar scores in Table 5 are calculated as the normalized and adjusted points of the pillars including all the 93 countries, where the worst country receives the lowest score and the best country receives a point 1. While the overall pillar scores of the EU averages are relatively balanced, EU member countries seem to score high in the aspiration-related pillars of Internationalization, Process Innovation and Risk Capital, and in ability-related pillars of Opportunity Start-up and Technology Absorption. By contrast, EU countries score relatively low in the attitude-related pillars like Networking, Opportunity Perception, Risk Acceptance and Cultural Support.

Comparing the old member states, the new member states, and the US, the US outperforms the old EU member states in 12 out of the 14 pillars. The old EU member countries are only better than the US in Networking and Opportunity Start-up. The dominance of the US becomes clear when the new EU member states are compared to the US; the US outperforms the old EU member states in each of the 14 pillars. The whole EU is lagging way behind the US, which is perhaps one reason for the growing differences between the US and the EU. When the old and the new EU member states are compared, the new member states are only better than the old ones in two pillars (High Growth and Internationalization). Out of the remaining 12 pillars, the differences are the largest in Opportunity Perception and Competition.

Improving entrepreneurship in the European Union: A simulation

In the previous section we described and analyzed the entrepreneurial performance of the European Union compared to its main competitor and benchmark country, the United States. On the one hand, it is clear that the US outperforms the EU member countries. In this sense GEI merely reinforces what other researchers have already found. However, the GEI analysis highlighted the significant differences in entrepreneurial performance across EU member countries. There are considerable deviations among the Old member states and the New member states, as well as among the Nordic countries and the Southern European countries. At the same time, the main administrative and decision-making bodies of the EU have been trying to provide general, uniform policies and guidelines for their member states. According to the GEI, one size does not fit all, and we need tailor-made policies that fit the specific needs of each country.

An important note is that the following simulation has a limited potential for interpretation as a policy recommendation, because it relies on important assumptions restraining its practical application. Firstly, the applied 14 pillars of GEI only partially reflect the national system of entrepreneurship. Consequently, maximizing the GEI index of a particular country does not mean maximizing the whole NSE of a particular country. Secondly, we assume that all GEI pillars require roughly the same effort to improve by the same magnitude, which may not be realistic. Thirdly, we assume that the costs of the resources required to improve the 14 pillars are about the same. In fact, these costs may vary significantly over pillars (Acs, Autio and Szerb 2014). Fourthly, we set aside the differences in country size by presuming that the same effort is necessary to improve the GEI over the 26 EU countries. Of course, the cost of improving a pillar in a larger country like Germany could be considerably higher than that of doing so in a smaller country like Slovenia.

An important implication of the GEI analysis is that the best way to increase the GEI is to reduce the differences between the pillars by enhancing the weakest GEI pillar. However, another pillar may become the weakest link, thus constraining performance in entrepreneurship. This system dynamic leads to the problem of the "optimal" allocation of additional resources. In other words, if a particular EU country were to allocate additional resources to improving its GEI Index performance, how should this

Table 5

The normalized score values of the 14 pillars, the three sub-indices and the GEI scores of entrepreneurship in the European Union member countries and the US																		
Country	1	2	3	4	5	6	7	8	9	10	11	12	13	14	ATT	ABT	ASP	GEI
Austria	0.78	0.86	0.69	0.60	0.61	0.82	0.91	0.53	0.81	0.75	0.71	0.33	0.84	0.59	64.0	67.7	58.6	63.5
Belgium	0.70	0.67	0.60	0.43	0.59	0.64	0.62	0.82	0.82	0.70	0.88	0.52	0.84	0.72	57.9	68.2	68.4	64.8
Denmark	<i>1.00</i>	0.63	0.73	0.70	<i>0.94</i>	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	0.75	0.60	0.43	<i>1.00</i>	73.3	<i>86.4</i>	68.9	76.2
Finland	<i>1.00</i>	<i>0.96</i>	0.79	<i>1.00</i>	<i>0.96</i>	<i>0.93</i>	0.66	0.39	0.50	0.84	0.94	0.60	0.57	0.51	<i>81.0</i>	57.7	64.1	67.6
France	0.56	0.44	0.67	0.75	0.69	0.64	<i>1.00</i>	0.55	0.71	0.83	0.89	0.59	0.71	0.71	59.9	67.4	69.9	65.8
Germany	0.74	0.50	0.59	0.41	0.80	0.75	0.85	0.41	0.88	0.67	0.81	0.62	0.77	0.72	58.1	66.5	67.2	63.9
Greece	0.18	0.77	0.22	0.34	0.26	0.48	0.52	0.44	0.33	0.28	0.47	0.14	0.50	0.63	31.4	39.7	36.0	35.7
Ireland	0.62	0.85	0.72	0.41	0.71	0.88	0.87	0.92	0.84	0.72	0.69	0.70	0.76	0.57	62.4	78.4	65.1	68.6
Italy	0.28	0.32	0.39	0.22	0.32	0.36	0.54	0.17	0.31	0.87	0.67	0.18	0.52	0.59	29.7	32.3	47.5	36.5
Luxembourg	0.75	0.16	0.56	0.76	0.65	<i>1.00</i>	<i>0.98</i>	0.57	<i>0.95</i>	<i>1.00</i>	0.63	0.49	<i>1.00</i>	0.84	48.3	66.0	61.7	58.7
Netherlands	0.79	0.87	0.81	0.77	<i>1.00</i>	<i>0.99</i>	0.68	0.45	0.87	0.72	0.72	0.50	0.58	0.73	77.6	69.1	62.5	69.7
Portugal	0.37	0.61	0.58	0.35	0.57	0.59	0.48	0.29	0.41	0.36	0.66	0.35	0.74	0.49	47.2	42.5	48.4	46.0
Spain	0.32	0.70	0.59	0.58	0.43	0.58	0.74	0.40	0.51	0.32	0.56	0.25	0.25	0.61	48.4	50.9	37.7	45.7
Sweden	<i>1.00</i>	0.61	0.79	0.80	0.90	<i>0.96</i>	<i>1.00</i>	0.61	0.79	0.74	<i>0.94</i>	0.59	0.77	0.68	78.8	80.2	72.7	77.2
United Kingdom	0.77	0.58	0.77	0.52	0.82	0.88	0.88	0.76	<i>0.94</i>	0.66	0.68	0.65	0.65	0.56	67.2	<i>81.0</i>	63.3	70.5
Old EU member states	0.66	0.63	0.63	0.57	0.68	0.77	0.78	0.55	0.71	0.70	0.73	0.47	0.66	0.66	59.0	63.6	59.5	60.7
Bulgaria	0.13	0.38	0.19	0.40	0.28	0.28	0.29	0.24	0.16	0.05	0.46	0.18	0.25	0.20	24.7	22.6	20.8	22.7
Croatia	0.17	0.43	0.10	0.24	0.25	0.41	0.54	0.21	0.34	0.18	0.49	0.45	0.86	0.48	22.5	33.4	40.8	32.2
Czech Republic	0.33	0.49	0.75	0.32	0.13	0.42	0.64	0.34	0.42	0.61	0.77	0.55	<i>1.00</i>	0.51	35.6	40.2	54.8	43.5
Estonia	0.81	0.63	0.61	0.53	0.53	0.56	0.61	0.48	0.61	0.56	0.70	0.57	0.71	0.33	57.9	53.8	54.0	55.2
Hungary	0.29	0.35	0.52	0.35	0.37	0.42	0.56	0.45	0.30	0.30	0.45	0.44	0.74	0.32	37.0	41.9	42.8	40.6
Latvia	0.37	0.55	0.17	0.35	0.33	0.54	0.58	0.50	0.41	0.40	0.28	0.73	0.69	0.45	33.2	45.5	44.8	41.2
Lithuania	0.41	0.50	0.24	0.40	0.40	0.47	0.54	0.69	0.29	0.33	0.45	0.59	0.73	0.57	37.8	45.9	48.9	44.2
Poland	0.35	0.67	0.37	0.34	0.48	0.35	0.37	0.42	0.39	0.66	0.38	0.49	0.81	0.54	43.0	38.1	54.1	45.1
Romania	0.30	0.39	0.18	0.16	0.35	0.22	0.41	0.43	0.31	0.31	0.33	0.61	0.73	0.58	26.8	32.2	44.8	34.6
Slovak Republic	0.25	0.37	0.66	0.34	0.28	0.36	0.53	0.36	0.26	0.40	0.46	0.54	<i>0.96</i>	0.69	36.4	36.7	53.8	42.3
Slovenia	0.29	0.84	0.77	0.36	0.47	0.60	0.77	0.42	0.43	0.52	0.73	0.40	0.85	0.44	49.9	51.7	53.9	51.8
New EU member states	0.34	0.51	0.41	0.34	0.35	0.42	0.53	0.41	0.36	0.39	0.50	0.50	0.76	0.47	36.8	40.2	46.7	41.2
European Union	0.51	0.59	0.51	0.47	0.52	0.61	0.69	0.50	0.54	0.55	0.70	0.52	0.71	0.61	51.9	57.6	60.3	56.6
United States	0.83	<i>1.00</i>	0.91	0.50	0.83	0.72	0.80	<i>1.00</i>	<i>0.97</i>	0.85	0.92	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	75.8	<i>80.5</i>	<i>86.5</i>	<i>80.9</i>
Legend: 1. Opportunity Perception (ATT), 2. Start-up Skills (ATT), 3. Risk Acceptance (ATT), 4. Networking (ATT), 5. Cultural Support (ATT), 6. Opportunity Start-up (ABT), 7. Technology Absorption (ABT), 8. Human Capital (ABT), 9. Competition (ABT), 10. Product Innovation (ASP), 11. Process Innovation (ASP), 12. High Growth (ASP), 13. Internationalization (ASP), 14. Risk Capital (ASP) Note: Numbers in bold indicate a relatively disadvantageous position, numbers in italics a relatively favorable one.																		

Source: The authors.

additional effort be allocated to achieve an “optimal”⁶ outcome? While optimality is relatively clear on a country level, it is more complicated at the EU level. How should the efforts to increase entrepreneurship be divided among the member states? There are several possible scenarios. We mention only three and examine only one case with simulation. Let us assume that we would like to increase the average GEI index by five, from an average of 56.6 to 61.6, closing the 31.3 percent gap to the US by 6.4 percent. The first possibility is to increase the GEI by five in each country. The second possibility could be to try to close the more than threefold differences among the member states and to allocate the resources to the least entrepreneurial countries. The third possibility is to try to optimize across all countries and allocate the additional resources in such a way as to increase the average EU GEI index point the most. Here, we only deal with the first, simplest case.

In the following, we simulate a situation in which each of the investigated EU member countries increases its allocation of entrepreneurship policy resources in an effort to achieve a five point improvement in the GEI Index. As described earlier, the PFB method calculation implies that the greatest improvement can be achieved by alleviating the weakest performing pillar. Once the binding constraint has been eliminated, the further available resources should be distributed to improve the next most binding pillar. We iterated this procedure until an overall GEI Index performance of five in every country had been achieved. The result of the simulation is shown in Table 6.

We can see that to improve the EU average GEI index score by five, an “optimal” effort allocation would call for a 19 percent improvement in the Networking pillar, a 16 percent in the Human Capital pillar, and a 13 percent in the Opportunity Recognition, Risk Acceptance and High Growth pillars. Of the remaining effort, our simulation suggests that eight percent should be allocated to Competition, six percent to Product Innovation, and two percent to Start-up Skills.

However, looking at Table 6 it is apparent that the ‘optimal’ policy mix is different for the 26 EU member countries. There are not even two EU member countries with the same policy mix to improve the GEI score by five. Old EU member states seem to be relatively weak in High Growth, with the exception of Denmark, Finland, Germany, Ireland and Luxemburg. Human capital is also a weak pillar in many developed EU countries. New

EU member states are particularly fragile in the attitude-related pillars of Opportunity Perception and Risk Acceptance. These weaknesses could be related to their heritage of a socialist system.

Countries also differ in the amount of additional new resources required: Luxembourg needs only 0.11 (1.1 percent) of new resources, while Hungary requires 0.60 (10.3 percent). All the other EU countries are situated somewhere between these two extremes. It is relatively easier to improve the GEI score if the country has only one weak pillar (Luxembourg, Austria, Denmark, Czech Republic) as compared to those countries that have a more balanced entrepreneurial profile and require more pillars to improve their GEI score: Poland needs to enhance eight pillars, Hungary and the Slovak Republic seven pillars, while Bulgaria, Slovenia, Romania and the UK need to improve six pillars. All of these findings underlie the importance of differentiated entrepreneurship policy in the EU member states.

Summary and conclusion

The main purpose of this paper is to present the potential public policy applicability of the Global Entrepreneurship Index approach for the European Union and its member countries. Based on the multidimensional view of entrepreneurship, we introduce the concept of the National System of Entrepreneurship. While previous entrepreneurship measures incorporate only individual data, the GEI combines individual data with contextual institutional factors. GEI also holds that the building blocks, called pillars, of the NSE interact with one another. The Penalty for Bottleneck methodology quantifies the system view by stating that the performance of the NSE is determined by the country’s worst performing pillar. In addition, the PFB also assumes the partial substitutability of the pillars of entrepreneurship. However, the exact size and magnitude of the substitution is not known.

We apply the GEI approach to examine the entrepreneurial performance of the European Union and 26 of its 28 member countries. The outcome of the analysis is underlined by three factors. Firstly, the EU has been lagging behind its main competitor, the US, in all aspects of entrepreneurship. Secondly, the relatively low level of entrepreneurship is one of the main reasons for the EU’s relative stagnation. The less entrepreneurial Southern European countries are struggling and suffering the most in this respect. Thirdly, the EU recognized its lagging position, but its ambitious aims described in the

⁶ ‘Optimal’ in the sense of maximizing the GEI index value.

Table 6

Simulation of 'optimal' policy allocation to increase the GEI score by 5 in the EU member countries

Country		1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total Effort
Austria	A	-	-	-	-	-	-	-	-	-	-	-	0.16	-	-	0.16
	B	-	-	-	-	-	-	-	-	-	-	-	100%	-	-	1.6%
Belgium	A	-	-	0.02	0.19	0.03	-	-	-	-	-	-	0.10	-	-	0.34
	B	-	-	6%	56%	9%	-	-	-	-	-	-	29%	-	-	3.6%
Denmark	A	-	-	-	-	-	-	-	-	-	-	-	-	0.15	-	0.15
	B	-	-	-	-	-	-	-	-	-	-	-	-	100%	-	1.3%
Finland	A	-	-	-	-	-	-	-	0.15	0.03	-	-	-	-	0.02	0.20
	B	-	-	-	-	-	-	-	0.75	0.15	-	-	-	-	0.10	0.02
France	A	0.05	0.18	-	-	-	-	-	0.07	-	-	-	0.03	-	-	0.33
	B	15%	55%	-	-	-	-	-	21%	-	-	-	9%	-	-	3.4%
Germany	A	-	0.05	-	0.14	-	-	-	0.14	-	-	-	-	-	-	0.33
	B	-	15%	-	42%	-	-	-	42%	-	-	-	-	-	-	3.5%
Greece	A	0.12	-	0.07	-	0.03	-	-	-	-	0.01	-	0.15	-	-	0.38
	B	32%	-	18%	-	8%	-	-	-	-	3%	-	39%	-	-	6.8%
Ireland	A	-	-	-	0.18	-	-	-	-	-	-	-	-	-	0.01	0.19
	B	-	-	-	95%	-	-	-	-	-	-	-	-	-	5%	1.8%
Italy	A	0.03	-	-	0.09	-	-	-	0.14	-	-	-	0.14	-	-	0.40
	B	8%	-	-	23%	-	-	-	35%	-	-	-	35%	-	-	7.0%
Luxembourg	A	-	0.11	-	-	-	-	-	-	-	-	-	-	-	-	0.11
	B	-	100%	-	-	-	-	-	-	-	-	-	-	-	-	1.1%
Netherlands	A	-	-	-	-	-	-	-	0.15	-	-	-	0.10	0.03	-	0.28
	B	-	-	-	-	-	-	-	54%	-	-	-	36%	11%	-	2.7%
Portugal	A	0.06	-	-	0.08	-	-	-	0.14	0.03	0.07	-	0.08	-	-	0.46
	B	13%	-	-	17%	-	-	-	30%	7%	15%	-	17%	-	-	6.7%
Spain	A	0.07	-	-	-	-	-	-	-	-	0.08	-	0.14	0.14	-	0.43
	B	16%	-	-	-	-	-	-	-	-	19%	-	33%	33%	-	6.3%
Sweden	A	-	0.12	-	-	-	-	-	0.12	-	-	-	0.14	-	0.06	0.44
	B	-	27%	-	-	-	-	-	27%	-	-	-	32%	-	14%	3.9%
United Kingdom	A	-	0.10	-	0.16	-	-	-	-	-	0.02	-	0.02	0.03	0.12	0.45
	B	-	22%	-	36%	-	-	-	-	-	4%	-	4%	7%	27%	4.4%
Bulgaria	A	0.10	-	0.04	-	-	-	-	-	0.07	0.17	-	0.05	-	0.03	0.46
	B	22%	-	9%	-	-	-	-	-	15%	37%	-	11%	-	7%	13.2%
Croatia	A	0.08	-	0.15	0.01	-	-	-	0.05	-	0.07	-	-	-	-	0.36
	B	22%	-	42%	3%	-	-	-	14%	-	19%	-	-	-	-	7.0%
Czech Republic	A	-	-	-	-	0.16	-	-	-	-	-	-	-	-	-	0.16
	B	-	-	-	-	100%	-	-	-	-	-	-	-	-	-	2.2%
Estonia	A	-	-	-	0.02	0.01	-	-	0.06	-	-	-	-	-	0.21	0.30
	B	-	-	-	7%	3%	-	-	20%	-	-	-	-	-	70%	3.6%
Hungary	A	0.12	0.06	-	0.06	0.04	-	-	-	0.12	0.11	-	-	-	0.09	0.60
	B	20%	10%	-	10%	7%	-	-	-	20%	18%	-	-	-	15%	10.3%
Latvia	A	-	-	0.18	-	0.03	-	-	-	-	-	0.07	-	-	-	0.28
	B	-	-	64%	-	11%	-	-	-	-	-	25%	-	-	-	4.4%
Lithuania	A	-	-	0.17	0.01	-	-	-	-	0.12	0.07	-	-	-	-	0.37
	B	-	-	46%	3%	-	-	-	-	32%	19%	-	-	-	-	5.6%
Poland	A	0.10	-	0.07	0.10	-	0.09	0.07	0.03	0.05	-	0.07	-	-	-	0.58
	B	17%	-	12%	17%	-	16%	12%	5%	9%	-	12%	-	-	-	8.8%
Romania	A	0.02	-	0.13	0.16	-	0.10	-	-	0.01	0.01	-	-	-	-	0.43
	B	5%	-	30%	37%	-	23%	-	-	2%	2%	-	-	-	-	8.1%
Slovak Republic	A	0.13	0.01	-	0.05	0.11	0.02	-	0.03	0.12	-	-	-	-	-	0.47
	B	28%	2%	-	11%	23%	4%	-	6%	26%	-	-	-	-	-	7.3%
Slovenia	A	0.16	-	-	0.09	-	-	-	0.03	0.02	-	-	0.05	-	-	0.35
	B	46%	-	-	26%	-	-	-	9%	6%	-	-	14%	-	-	4.4%
European Union	A	0.08	0.01	0.08	0.12	0.07	-	-	0.10	0.05	0.04	-	0.08	-	-	0.63
	B	13%	2%	13%	19%	11%	-	-	16%	8%	6%	-	13%	-	-	7.9%

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

Legend: 1. Opportunity Perception (ATT), 2. Start-up Skills (ATT), 3. Risk Acceptance (ATT), 4. Networking (ATT), 5. Cultural Support (ATT), 6. Opportunity Start-up (ABT), 7. Technology Absorption (ABT), 8. Human Capital (ABT), 9. Competition (ABT), 10. Product Innovation (ASP), 11. Process Innovation (ASP), 12. High Growth (ASP), 13. Internationalization (ASP), 14. Risk Capital (ASP).

Note: Numbers in bold indicate a relatively large increase in the pillar and hence a high percentage of the total effort. Dash corresponds to zero.

Source: The authors.

2000 Lisboa Agenda do not seem to have been achieved. On the contrary, the differences between the EU and the US have increased, calling for a new approach.

The example of the EU member nations highlights the usefulness of the GEI method in analyzing the entrepreneurial profiles of countries from a system perspective. According to the GEI index, the EU countries differ considerably in their entrepreneurial performances. Moreover, even larger differences exist over the 14 pillars in the country levels. In addition to highlighting the most binding bottleneck factors of entrepreneurial performance, the GEI methodology also provides rough indications on how much a country should invest to alleviate a given bottleneck.

The unique feature of GEI's Penalty for Bottleneck methodology is that it is possible to begin simulating alternative policy scenarios and their possible effects at the system level. While numerous potential policy mixes exist, we analyze only one situation in which the GEI scores were improved by all 26 EU member countries by five points, or roughly nine percent. This simplest simulation is based on four important binding assumptions that limit the practical applicability of the results. One of the most important implications of the analysis is that uniform policy does not work, and the EU member states should apply different policy mixes to achieve the same improvement in the GEI. Despite the fact that the GEI framework does not offer a panacea for policy makers, it does provide a useful learning device as a starting point for further policy analysis.

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Appendix 1a

The description of the individual variables used in the GEI

Individual variable	Description
Opportunity Recognition	The percentage of the 18–64 aged population recognizing good conditions to start business next 6 months in area he/she lives.
Skill Perception	The percentage of the 18–64 aged population claiming to possess the required knowledge/skills to start business.
Risk Acceptance	The percentage of the 18–64 aged population stating that the fear of failure would not prevent starting a business.
Know Entrepreneurs	The percentage of the 18–64 aged population knowing someone who started a business in the past 2 years.
Career	The percentage of the 18–64 aged population saying that people consider starting business as good career choice.
Status	The percentage of the 18–64 aged population thinking that people attach high status to successful entrepreneurs.
Career Status	The status and respect of entrepreneurs calculated as the average of Career and Status.
Opportunity Motivation	Percentage of the TEA businesses initiated because of opportunity start-up motive.
Technology Level	Percentage of the TEA businesses that are active in technology sectors (high or medium).
Educational Level	Percentage of the TEA businesses owner/managers having participated over secondary education.
Competitors	Percentage of the TEA businesses started in those markets where not many businesses offer the same product.
New Product	Percentage of the TEA businesses offering products that are new to at least some of the customers.
New Tech	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 country (over 1%).
Informal Investment Mean	The mean amount of 3 year informal investment.
Business Angel	The percentage of the 18–64 aged population who provided funds for new business in past 3 years excluding stocks & funds, average.
Informal Investment	The amount of informal investment calculated as $INFINVMEAN * BUSANG$.

Source: The authors.

Appendix 1b

The description and source of the institutional variables used in the GEI

Institutional variable	Description	Source of data	Data availability*
Economic Freedom	"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. The business freedom score for each country is a number between 0 and 100, with 100 equaling the freest business environment. The score is based on 10 factors, all weighted equally, using data from the World Bank's <i>Doing Business</i> study". (http://www.heritage.org/Index/pdf/Index09_Methodology.pdf). Data are collected from 2015.	Heritage Foundation/ World Bank	1
Property Rights	"The property rights component is an assessment of the ability of individuals to accumulate private property, secured by clear laws that are fully enforced by the state. It measures the degree to which a country's laws protect private property rights and the degree to which its government enforces those laws. It also assesses the likelihood that private property will be expropriated and analyzes the independence of the judiciary, the existence of corruption within the judiciary, and the ability of individuals and businesses to enforce contracts." (http://www.heritage.org/index/property-rights)	Heritage Foundation/ World Bank	2
Freedom and Property	Economic Freedom * Property Rights	Authors' calculation	
Tertiary Education	Gross enrolment ratio in tertiary education, 2015 or latest available data.	World Bank	3
Quality of Education	Answers to the question: "In your country, how do you assess the quality of math and science education? [1 = extremely poor—among the worst in the world; 7 = excellent—among the best in the world]"		The Global Competitiveness Report 2015–2016, p. 377
Education	Tertiary Education * Quality of Education	Authors' calculation	
Country Risk	The country risk classifications are meant to reflect country risk. Under the Participants' system, country risk is composed of transfer and convertibility risk (i.e. the risk a government imposes capital or exchange controls that prevent an entity from converting local currency into foreign currency and/or transferring funds to creditors located outside the country) and cases of force majeure (e.g. war, expropriation, revolution, civil disturbance, floods, earthquakes).	OECD	4
Urbanization	Urbanization that is the percentage of the population living in urban areas, data are from the Population Division of the United Nations, 2010 estimate	United Nations	5
Infrastructure	Pillar 2, Infrastructure and connectivity in the World Competitiveness Report: "... in addition to assessing the quality of the transport infrastructure, the pillar also measures the quality of domestic and international transport networks."	World Economic Forum	The Global Competitiveness Report 2015–2016, p. 47
Connectivity	Urbanization * Infrastructure	Authors' calculation	
Corruption	The Corruption Perceptions Index (CPI) measures the perceived level of public-sector corruption in a country. "The CPI is a "survey of surveys", based on 13 different expert and business surveys." (http://www.transparency.org/policy_research/surveys_indices/cpi/2009) Overall performance is measured on a ten point Likert scale. Data are collected over the last 24 months.	Transparency International	6

Appendix 1b continued

Taxation	Paying taxes scores, “...addresses the taxes and mandatory contributions that a medium-size company must pay or withhold in a given year, as well as measures the administrative burden in paying taxes.” (http://www.doingbusiness.org/data/exploretopics/paying-taxes)	World Bank	7
Good Governance	The effectiveness of the government “the capacity of the government to effectively formulate and implement sound policies” (http://info.worldbank.org/governance/wgi/#home)	World Bank	8
Taxgovern	Measures the effectiveness of using the taxes by combining together the level of the tax by the quality of government services, Taxation* Good Governance	Authors’ calculation	
Tech Absorption	Firm level technology absorption capability: “Companies in your country are (1 = not able to absorb new technology, 7 = aggressive in absorbing new technology)”.	World Economic Forum	The Global Competitiveness Report 2015–2016, p. 379
Labor Freedom	Measures the freedom of the labor as “...that considers various aspects of the legal and regulatory framework of a country’s labor market, including regulations concerning minimum wages, laws inhibiting layoffs, severance requirements, and measurable regulatory restraints on hiring and hours worked.” (http://www.heritage.org/index/labor-freedom)	Heritage Foundation	9
Staff Training	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)”.	World Economic Forum	The Global Competitiveness Report 2015–2016, p. 377
Labor Market	Labor Freedom * Staff Training		
Regulation	Effectiveness of anti-monopoly policy, answering to the question: “In your country, how effective are anti-monopoly policies at ensuring fair competition? [1 = not effective at all; 7 = extremely effective]”	World Economic Forum	The Global Competitiveness Report 2015–2016, p. 395
Market Dominance	Extent of market dominance: “Corporate activity in your country is (1 = dominated by a few business groups, 7 = spread among many firms)”.	World Economic Forum	The Global Competitiveness Report 2015–2016, p. 471
Compregrulation	Regulation * Market Dominance		
Technology Transfer	These are the innovation index points from GCI: a complex measure of innovation including investment in research and development (R&D) by the private sector, the presence of high-quality scientific research institutions, the collaboration in research between universities and industry, and the protection of intellectual property.	World Economic Forum	The Global Competitiveness Report 2015–2016, p. 22
GERD	Gross domestic expenditure on Research & Development (GERD) as a percentage of GDP, year 2014 or latest available data, Puerto Rico, Dominican Republic, and United Arab Emirates are estimated	UNESCO	10
Scientific Institutions	Quality of scientific research institutions. Answering to the question: “In your country, how do you assess the quality of scientific research institutions? [1 = extremely poor—among the worst in the world; 7 = extremely good—among the best in the world]”	World Economic Forum	The Global Competitiveness Report 2015–2016, p. 381
Availability of Scientist	Availability of scientists and engineers. Answering to the question: “In your country, to what extent are scientists and engineers available? [1 = not at all; 7 = widely available]”	World Economic Forum	The Global Competitiveness Report 2015–2016, p. 381
Science	GERD* Average of Scientific Institutions and Availability of Scientist	Authors’ calculation	
Venture Capital	Venture capital availability. Answering to the question: “In your country, how easy is it for start-up entrepreneurs with innovative but risky projects to obtain equity funding? [1 = extremely difficult; 7 = extremely easy]”	World Economic Forum	The Global Competitiveness Report 2015–2016, p. 379
Business Strategy	Refers to the ability of companies to pursue distinctive strategies, which involves differentiated positioning and innovative means of production and service delivery	World Economic Forum	The Global Competitiveness Report 2015–2016, p. 22
Finance and Strategy	Venture Capital Business Strategy	Authors’ calculation	
Economic complexity	“The complexity of an economy is related to the multiplicity of useful knowledge embedded in it. Because individuals are limited in what they know, the only way societies can expand their knowledge base is by facilitating the interaction of individuals in increasingly complex networks in order to make products. We can measure economic complexity by the mix of these products that countries are able to make.” (http://atlas.media.mit.edu/en/resources/economic_complexity/)	Observatory of Economic Complexity	11
Depth of Capital Market	The Depth of Capital Market is one of the six sub-indices of the Venture Capital and Private Equity index. This variable is a complex measure of the size and liquidity of the stock market, level of IPO, M&A and debt and credit market activity. Note that there were some methodological changes over the 2006–2015 time period so previous years comparison is not perfect.	EMLYON Business School France and IESE Business School, Barcelona, Spain	12

Source: The authors.

* Links Data availability:

- 1 <http://www.heritage.org/index/explore.aspx>
- 2 <http://www.heritage.org/index/explore.aspx>
- 3 <http://data.worldbank.org/indicator/SE.TER.ENRR>
- 4 <http://www.oecd.org/tad/xcred/crc.htm>
- 5 <http://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS>
- 6 http://files.transparency.org/content/download/702/3015/file/CPI2013_DataBundle.zip
- 7 <http://www.doingbusiness.org/data/distance-to-frontier>
- 8 <http://qog.pol.gu.se/data/datadownloads/qogbasicdata>
- 9 <http://www.heritage.org/index/download>
- 10 <http://stats.uis.unesco.org/unesco/TableViewer/tableView.aspx?ReportId=2656>
- 11 <http://atlas.media.mit.edu/en/resources/data/>
- 12 <http://blog.iese.edu/vcpeindex>