REDI: The Regional Entrepreneurship and Development Index – Measuring regional entrepreneurship Final report

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The Regional Entrepreneurship and Development Index – Measuring regional entrepreneurship

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EXECUTIVE SUMMARY

From a Managed to an Entrepreneurial Economy

The shift from a 'managed' economy to an 'entrepreneurial' economy is among the most important challenges developed economies have faced over the last few decades. This challenge is closely coupled with the increasing importance of non-physical capital, such as human and intellectual capital for wealth creation. The most notable signs of this shift are the following:

1. knowledge is increasingly replacing physical capital and labor as the key driving force of economic growth;
2. individuals rather than large firms are the leading factor in new knowledge creation;
3. alongside with large conglomerates, new and small firms play a dominant role in translating newly created knowledge into marketable goods and services;
4. traditional industrial policy, with antitrust laws and small business protection, has been replaced by a much broader entrepreneurship policy aiming to promote entrepreneurial innovation and facilitate high-growth potential start-ups.

Entrepreneurship Policy

Three distinct foci can be identified in EU entrepreneurship policy, as it has evolved over time:

1. focus on SMEs;
2. focus on innovation through SMEs;
3. focus on high-growth SMEs.

These co-existing foci reflect evolution in the understanding of the varied roles that entrepreneurship can play in economic development. However, although each of these focus areas adds important elements to the European economic policy toolbox, none of them alone provides a definitive answers to the diverse and varied challenges that different European regions face, as they seek to implement policies to enhance regional dynamism and competitiveness.

The most recent evolution in entrepreneurship policy – an increasing emphasis on taking a more holistic and multi-pronged view of entrepreneurship, as advocated by the 'entrepreneurship support ecosystem' thinking – represents yet another evolution in European policy thinking. The focus on 'entrepreneurship ecosystems' calls attention to entrepreneurship support policies and initiatives over the entire lifecycle of the new venture, the key insight being that entrepreneurship support should be considered in a wider regional context.

Thus, this emphasis naturally shifts focus towards a regional level of analysis, consistent with the focus of this current report and its 'Systems of Entrepreneurship' approach. Yet, although similar on the surface, the two concepts are fundamentally different. Whereas the notion of 'Entrepreneurship Ecosystems' focuses on entrepreneurship *support* policies and initiatives from a policy perspective, the notion of 'Systems of Entrepreneurship' draws attention to the entrepreneurial dynamic that ultimately drives productivity growth in regions. The two approaches therefore complement one

another, and the REDI index should provide important guidance for the design of entrepreneurship support ecosystems.

Smart Specialization

In this report we argued that at the regional level, entrepreneurship should be treated as a systemic phenomenon, and it should be measured accordingly. Although entrepreneurial actions are ultimately undertaken by individuals, these individuals are always embedded in a given regional context. This context regulates who becomes an entrepreneur, what the ambition level of the entrepreneurial effort is, and what the consequences of entrepreneurial actions are. Because of this embeddedness and the regulating influence of context, we have chosen to develop a complex composite index that captures both individual-level actions as well as contextual influences.

The centrality of Smart Specialization Strategies is for EU competitiveness policy is highlighted by the fact that an explicit Smart Specialization Strategy will be a precondition for using the European Regional Development Fund (ERDF) funding to support investments in research and innovation in EU regions. To receive funding from ERDF and from EU Structural and Cohesion funds, EU regions need to be able to articulate their strategies for building on their distinctive regional strengths. This, for its part, makes it necessary for regions to recognize their strengths – as well as their weaknesses. Identifying these strengths and weaknesses will therefore be a priority, as EU moves towards implementing the 'Horizon 2020' strategy.

The first distinctive features of the REDI index – notably, its systemic approach and the Penalty for Bottleneck feature – can be leveraged to support Entrepreneurial Discovery processes in two distinct ways, as EU regions develop Smart Specialization Strategies. First, the index itself provides initial clues on whether a given region's strengths and weaknesses might be found. Second – and more importantly, the REDI index can be used as a platform that facilitates the design of effective policies to support Entrepreneurial Discovery. If used in a correct way, therefore, the REDI index can support the preconditions for creating Smart Specialization Strategies.

Entrepreneurial dynamics in regions are complex, and an understanding of them requires a holistic approach. This is why the REDI index was designed to incorporate 14 different pillars, each created as a product of individual-level and system-level data. A careful scrutiny of the relative differences between individual pillars, both within a given region and across benchmark regions, should provide good initial guidance for the search of prospective strengths and weaknesses within regions. From a policy perspective, it is important to recognize that the portfolio of policy measures to address regional are likely to be equally complex and intertwined as is the system itself.

Second, and as a more important aspect, the REDI index should assist regions in creating conditions for effective Entrepreneurial Discovery – i.e., in creating conditions in which the region's entrepreneurial dynamic operates efficiently. Achieving this requires a deep understanding of how the region's System of Entrepreneurship works, what the most important bottlenecks are, and how these could be alleviated. To achieve this understanding, it is important to go beyond the 'hard' numbers, as suggested by the REDI index. Any System of Entrepreneurship will be infinitely more complex than what an index like the REDI index can capture.

Therefore, in order to gain an understanding of how a given region's System of Entrepreneurship works, it is important to complement the REDI index with a stakeholder engagement process that is

designed to draw out 'soft' insights from various policy stakeholders on what makes the Regional System of Entrepreneurship really work. A suggested approach could work as follows:

1. conduct a REDI analysis of the region, creating a preliminary list of regional strengths and weaknesses, as suggested by the REDI index;
2. invite regional entrepreneurship policy stakeholders into a Stakeholder Engagement Workshop that debates the REDI analysis;
3. draw on the stakeholders' varied perspectives and insights to enrich the REDI analysis and complement REDI data with stakeholders' experience-based insights on the regional realities and entrepreneurial dynamics;
4. collect additional data to further analyze the region's entrepreneurial strengths and weaknesses;
5. conduct further workshops to identify policy actions that can alleviate regional bottlenecks and further improve regional strengths;
6. design an implementation plan to improve the dynamic of the Regional System of Entrepreneurship.

Used this way, the REDI index should provide a platform that can be leveraged for the design and facilitation of Smart Specialization Strategies in EU regions.

Finally, the REDI index can be used to identify regional policy priorities through an Entrepreneurship Policy Portfolio Optimization Exercise. An important implication of the REDI analysis is that reducing the differences between the pillars is the best way to increase the value of the REDI index. In order to reduce the differences between the pillars the most straightforward way of doing it is by enhancing the weakest REDI pillar. However, another pillar may become the weakest link constraining the performance in the overall entrepreneurship activity. This system dynamics leads to the problem of "optimal" allocation of the additional resources. In other words, if a particular region were to allocate additional resources to improving its REDI Index performance, how should this additional effort be allocated to achieve an "optimal"[1] outcome?

Simulations Results

In the following we are presenting the result of a simulation aiming to increase the REDI points by optimizing the additional resource allocation. We have conducted the simulation for all the 125 regions but analyze the outcome shortly for country level regional policy implications. The policy analysis is based on the assumption to increase the REDI score of a region by 10 points. 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 then the further available resources should be distributed to improve the next most binding pillar for all the 125 regions of the 24 EU countries.

An important note is that the following simulation has a limited potential for interpreting as a policy recommendation, because it relies on important assumptions restraining its practical application:

[1]'Optimal' is interpreted in the sense of maximizing the REDI value.

1. the applied 14 pillars of REDI only partially reflect the regional system of entrepreneurship. Consequently, maximizing the REDI index of a particular region does not mean maximizing the whole entrepreneurship system of a particular region;

2. we assume that all REDI pillars require roughly the same effort to improve by the same magnitude. While we use the average adjustment method to balance out the different average values of the 14 pillar this might well not be realistic;

3. we assume that the costs of the resources to improve the 14 pillars are about the same. In fact, these costs may vary significantly over pillars;

4. we set aside the differences in region size by presuming that the same effort is necessary to improve the REDI over all the regions. Of course, the cost of an improvement of a pillar in larger region like London could be considerable higher than in a smaller region like Dél Dunántúl in Hungary.

For entrepreneurship policy implementation the percentage of the resources are applied. We categorize the pillars and classify the policy actions for each region according to their percentage increase of the required resources and the percentage of the affected regions of a particular country into four categories as top priority, medium priority, low priority and watching list.

1 INTRODUCTION

The Europe 2020 economic growth strategy emphasizes the role of Regional Policy in unlocking the growth potential of EU regions. Through Smart Specialization and, in particular, the flagship initiative, "Innovation Union," the European Commission promotes innovation in all regions while ensuring complementarity between EU-, national-, and regional-level support for innovation, R&D, ICT, and entrepreneurship. To effectively implement Smart Specialisation policies, reliable and relevant metrics are needed to track regional strengths and weaknesses in innovation and entrepreneurship. While metrics to track innovation are well established due to the long-standing focus of EU economic policy on innovation, measures to track entrepreneurship in EU regions are relatively less varied. It is the objective of this report to develop a systemic index – called the Regional Entrepreneurship and Development Index (hereinafter called REDI for short) – to strengthen the portfolio of entrepreneurship at the regional level in the EU.

The REDI index developed in this report presents a fresh approach to measuring entrepreneurship in EU regions. Although the systemic approach is long established in Innovation Policy – as encapsulated in the National (and Regional) Systems of Innovation theory, a systemic understanding of entrepreneurship dynamics in countries and regions remains in its infancy. Although entrepreneurship scholars have long since recognized the regulating importance of context on entrepreneurship, the great bulk of both theorizing and empirical research on entrepreneurship has focused on the individual and the firm and ignored the study of the context within which these are embedded. This in spite of the widespread recognition that entrepreneurs do not operate in isolation from their contexts: Instead, the context exercises a decisive influence on who starts new firms, with what level of quality and ambition, and with what outcomes. This report builds on recent theoretical developments towards a systemic perspective to entrepreneurship in regions to develop an empirical and normative elaboration of the 'Systems of Entrepreneurship' phenomenon. This report argues that a systemic approach to understanding the economic potential of entrepreneurship in EU regions is particularly important for policy, because policy initiatives address typically system-level gaps and shortcomings.

The gap in a systemic understanding of regional entrepreneurial dynamics is pointedly highlighted by the observation that the entrepreneur is almost completely absent in theories concerning National and Regional Systems of Innovation. In these frameworks, the institutional structure predominates: it is the country's or region's research organizations, funding mechanisms and similar structures that somehow produce innovation outcomes. However, individual-level agency, such as opportunity pursuit and resource mobilization decisions and activities by enterprising individuals, is given virtually no attention in this literature. In consequence, this report argues that the entrepreneur remains relatively poorly integrated in innovation policy, and a systems perspective to regional entrepreneurship policy is similarly under-developed. One manifestation of this gap is that most measures of entrepreneurship in countries and regions are uni-dimensional measures, typically aggregates of new firm entry counts normalized by population size. Such measures tend to ignore, for example, the quality of the ventures created, and also, fail to consider who actually starts new firms.

Although the systemic perspective to understanding entrepreneurship in regions remains deficient, this is not to say that research would have been ignorant about salient externalities that impact entrepreneurship in regions (see, e.g., Stenberg, 2009). Indeed, externalities such as regional agglomeration

benefits were first highlighted by Alfred Marshall back in the 1890s (Marshall, 1920). However, what has been missing is an integrated treatment which considers both individual-level attitudes, ability, and aspirations and integrates these with system-level factors that regulate entrepreneurship processes in the region. This report draws extensively on regional entrepreneurship literature to build the REDI index.

The next section of this report reviews literature on regional entrepreneurship. It starts with an introduction to the systems approach to policy and explains why a systemic approach provides a useful perspective to think about entrepreneurship in regions. It next examines the drivers of regional entrepreneurship: spatial externalities; clustering, networks and social capital; education, human capital and creativity; protection of property rights, corruption, and size of government, savings and wealth creation and labor market regulations.

The third section presents the data used in the Regional Entrepreneurship and Development index. While some researchers insist on simple and uni-dimensional entrepreneurship indicators, none of the previously applied measures has been able to explain the role of entrepreneurship in economic development. The two main data sources for the REDI index are the GEM survey, which provides aggregated individual-level data for EU regions, and institutional-level data drawn from a variety of sources within the EU and elsewhere.

The REDI index consists of three sub-indices, 14 pillars, and 28 variables. While the individual variables are mainly uni-dimensional, the institutional indicators are mostly composites. Altogether we have used 40 institutional indicators. Our index-building logic differs from other widely applied indices in three respects. First, it combines individual-level variables with institutional variables to capture contextual influences. Second, it equates the 14 pillar values by equalizing their marginal effects. Third, it allows index pillars to 'co-produce' system performance by applying a 'Penalty for Bottleneck' algorithm. These features set the REDI index apart from simple summative indices that assume full substitutability between system components, making it uniquely suited to profiling Regional Systems of Entrepreneurship in EU regions.

The fourth section presents the results of the REDI analysis at the NUTS II level in EU countries. The Nomenclature of Territorial Units for Statistics (NUTS) was developed at the beginning of the 1970s by the Statistical Office of the European Communities (Eurostat) in close collaboration with the national statistical institutes of the EU Member States. The NUTS ensures uniform statistical classification of the territorial units of the EU Member States to support comparable, harmonized regional statistics for socio-economic analyses. Since the 1970s, the NUTS classification has been changed several times to reflect administrative changes of the Member States.

The policy applications of the REDI are discussed in the fifth section. Three distinct foci are identified in EU entrepreneurship policy, as it has evolved over time: (1) focus on SMEs; (2) focus on innovation through SMEs; and (3) focus on high-growth SMEs. These co-existing foci reflect evolution in the understanding of the varied roles that entrepreneurship can play in economic development. However, although each of these focus areas adds important elements to the European regional policy toolbox, - none of them alone provides definitive answers to the diverse and varied challenges that different European regions face, as they seek to implement policies to enhance regional dynamism and competitiveness.

The most recent evolution in entrepreneurship policy – an increasing emphasis on taking a more holistic and multi-pronged view of entrepreneurship, as advocated by the 'entrepreneurship support

ecosystem' thinking – represents yet another evolution in European policy thinking. The focus on 'entrepreneurship ecosystems' calls attention to entrepreneurship support policies and initiatives over the entire lifecycle of the new venture, the key insight being that entrepreneurship support should be considered in a wider regional context. Thus, this emphasis naturally shifts focus towards a regional level of analysis, consistent with the focus of this current report and its 'Systems of Entrepreneurship' approach.

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2 REGIONAL ENTREPRENEURSHIP: REVIEW OF THE LITERATURE

2.1 Entrepreneurship in Regions

Entrepreneurship is widely seen as an important driver of economic development and employment and productivity growth. This belief is informed by a large literature that addresses both the determinants and outcomes of entrepreneurship at different levels of analysis. In this literature, it is recognized that entrepreneurship is a complex phenomenon that is driven by individuals but embedded in a wider economic and societal context. In other words, it is recognized that although actions by individuals drive the entrepreneurial process in regions, the wider regional context regulates the quality and outcomes of this process (*Acs et al.*, 2013a). Herein lies an important gap, however: while the phenomenon of entrepreneurship has been extensively studied at both the individual and contextual levels, respectively, the complex recursive relationships *between* the two levels have not received much attention. This is a major shortcoming, since it is the interaction between individuals and their contexts that ultimately determines the magnitude of economic and societal benefits delivered through entrepreneurship. It is our objective in this report to address this gap by developing a complex index of regional entrepreneurship – the REDI index – that incorporates both individual and regional levels of analysis.

While there is no generally accepted definition of entrepreneurship that covers all levels of analysis, there is broad agreement that entrepreneurial behaviors and actions comprise multiple dimensions, such as opportunity recognition, risk taking, resource mobilization, innovation, and the creation of new organizations. The impacts of such behaviors and actions are equally varied and can include value creation, job creation, knowledge spillovers, and 'creative destruction' (*Autio* 2005, 2007; *Praag – Versloot*, 2007).

From the perspective of economic development, the range of different activities and outcomes associated with entrepreneurship suggests that a multidimensional definition of entrepreneurship is probably more suited to understanding the economic and societal benefits generated by entrepreneurs. This is in contrast with most empirical investigations, which tend to rely on a simple, one-dimensional operationalization of entrepreneurship, such as self-employment rate, small business ownership rate, or new venture creation rate. Most such indices are uni-dimensional and identify the percentage of population that is engaged or willing to engage in "entrepreneurial" activity (about self-employment, see *Acs et al*,1994; *Blanchflower et al*., 2001; *Grilo – Thurik*, 2008; about business-ownership rate see *Carree et al.*, 2002, *Cooper – Dunkelberg*, 1986; about new venture creation, see *Gartner* 1985; *Reynolds et al.*, 2005; about the Total Early-stage Entrepreneurship Activity Index see *Acs et al.*, 2005 or *Bosma et al.*, 2009).

A major shortcoming of uni-dimensional measures that the majority of them do not capture differences in the *quality* of entrepreneurial activity, such as creativity, innovation, knowledge and technology intensity, value creation, or orientation and potential for high growth. Moreover, uni-dimensional measures do not take different environmental factors into account, although the efficiency and quality of an institutional set-up can have a major influence on the quality of entrepreneurship and on the economic and societal impact eventually realized through entrepreneurial action.

For a more complete understanding of how entrepreneurship contributes to economic and societal development, it is important to recognize the *contextually embedded quality of entrepreneurial actions and behaviors in national, regional, and city-level contexts*. In our analysis, the focus is on regions. This is a useful level of analysis for three reasons. First, most entrepreneurial businesses operate locally or regionally and are therefore subject to local or regional contextual influences. Second, particularly in larger countries there can exist significant variation in industry structure and economic base across regions, emphasizing the importance of regional focus. Third, as a practical issue, the EU systematically collects harmonized data across EU regions.

Our focus on regions also resonates with a substantial body of literature in the intersection of regional economic development and entrepreneurship. As a particularly salient development a series of papers have come out in recent years with a focus on characterizing [mostly national] Systems of Entrepreneurship (*Acs – Szerb* 2009, 2010, 2011; *Acs et al*, 2013a, 2013b). This literature provides useful basis to guide the development of an index to characterize and profile Regional Systems of Entrepreneurship in a way that informs the economic development potential of a given region. In this literature, systems of entrepreneurship are defined as resource allocation systems that are brought to life by individuals who perceive opportunities and mobilize resources for their pursuit in a trial-and-error fashion. Conditioned by system-level institutional and economic factors, the net outcome of this process is the allocation of resources towards productive uses, implying that well-functioning systems of entrepreneurship should contribute to enhanced total factor productivity. We will review salient aspects of this literature in the remainder of this chapter. To foreshadow our conclusions from this review for our index development effort, we find that an *index of regional entrepreneurship* should: (1) acknowledge the complex nature of the system, (2) include both quantity and quality indicators, and (3) include both individual-level and system level variables. It should also recognize that entrepreneurship is distinct from small businesses, self-employment, craftsmanship, and is not a phenomenon associated with buyouts, change of ownership, or management succession.

2.2 Importance of Context

In line with the intense debate that has characterized the literature on agglomeration externalities, theories about regional clusters and regional systems of innovation have been widely adopted in recent years, in both research and policy circles. Many of these theories have been inspired by *Michael* Porter's (1990) argument regarding determinants of competitive advantage in firms and nations, and by regional theories on localization advantages and industrial districts.

Porter's (1990) Diamond model argues that the most important factors that shape the competitive advantages of nations and regions are:

1. The presence of related and supporting industries
2. The availability and quality of factors of production
3. The domestic demand conditions (demanding customers within the domestic market are assumed to push businesses to upgrade their competitiveness, making them well prepared for entry into foreign markets)
4. The structure of the economy in terms of the level of inter-firm cooperation versus intra-industry rivalry, as well as the broader economic landscape of the national or regional economy

Porter's Diamond model was originally developed to explain competitive advantage of nations relative to other nations. More recently, it has also been used as a framework to analyze regional economic structures. In this theoretical conversation, interest has mostly been on a combination of the Marshallian agglomeration externalities (labor pool, collaboration with companies with similar production and collaboration along the value chain) and dynamic externalities (learning and knowledge spill-overs), rather than the explicit evaluation of the various dimensions of Porter's Diamond.

The general point of Porter's argument is that one needs to look beyond individual industry sectors (as defined by industry classification codes) in order to fully explain regional economic dynamics: interactions between sectors matter for regional economic growth. This idea is reflected in Porter's definition of clusters as "… *geographic concentrations of interconnected companies, specialized suppliers, services providers, firms in related industries, and associated institutions (e.g. universities, standards agencies or trade associations) in a particular field that compete but also cooperate*." (*Porter*, 2000, 15). This perspective to national and regional economic dynamics thus emphasizes the creation and exploitation potential synergy effects between industry sectors that are generated by various cross-sector interactions such as knowledge spill-overs, scale effects, manufacturing synergies, and learning effects.

Cross-industry synergies are only one type of positive externalities that can arise in national and regional economies. From the perspective of understanding regional entrepreneurial dynamics, the question then arises: which type of regional externalities are most important for entrepreneurship and development, and how is the balance set between various advantages and disadvantages? This question has attracted increasing attention by entrepreneurship scholars. Advocating a systemic approach to entrepreneurship, *Acs et al.* (2013a) maintain that the role of the entrepreneur's context goes far beyond being merely a passive supplier of opportunities (as has been the traditional 'Kirznerian' (1997) approach). Perhaps more importantly, they suggest, the entrepreneur's context regulates the *outcomes* of entrepreneurial action – i.e., what the consequences will be when someone decides to pursue a given opportunity. To pursue opportunities successfully, a young company needs to obtain access to a number of vital resources such as capital, customers, distribution channels, human capital, specialized skills and support services, and so on. To obtain any of these resources, the entrepreneurial company must approach and link to specialized resources such as people, companies and institutions. The specialized resources offer entrepreneurs support within a variety of areas and are sometimes collectively referred to as *entrepreneurship ecosystems*[2]. Examples of well-known entrepreneurship ecosystems include Silicon Valley and Boston in the US and Cambridge, Copenhagen and Helsinki in Europe. The strength of the ecosystem depends on the range and comprehensiveness of specialized resources and support that entrepreneurs can access within it.

Entrepreneurial companies may benefit from different types of externalities depending on their situation and the industry they operate in. The main point is that the impact of different types of externalities seems to change with the development phase of the industry. Localization externalities seem more important for mature and well-established industries, while Jacob's externalities – the variety of the economy – are more important for young industries in dynamic development stages.

[2] So far the only attempt in the literature to benchmark entrepreneurship ecosystems across regions due to non-existing internationally-comparable data can be found in The Nordic Growth Entrepreneurship Review 2012.

Finally, policy based on lessons taken from the literature on clusters has a clearly stated focus on innovation and transformation, but there are often problems with how the approach is interpreted and used. Unclear general knowledge and a vague idea of the region's conditions risk leading the regional innovation and transformation policy to be imprecise and ineffective. An effective policy requires a nuanced understanding of the theoretical basis underpinning the policy and a clearly worded description of the policy's goals.

2.3 Systems of Entrepreneurship

Although there exists a big literature on Systems of Innovation, the popularity of this literature in informing policy design appears to have been waning during recent years. One likely reason for this is the rather static and descriptive nature of the Systems of Innovation (SI) literature (*Acs et al.*, 2013a). In the Systems of Innovation literature, the focus has been overwhelmingly on structure: it is the country's (or region's or industry's) institutional structure that creates and disseminates new knowledge and channels it to efficient uses. In this perspective, individual action (i.e., entrepreneurship) is either not considered or is supposed to happen automatically. Tellingly, the foundational writings of the Systems of Innovation literature, the term: 'entrepreneurship' is virtually absent, and certainly not incorporated into the theoretical structure (*Freeman*, 1988; *Lundvall*, 1992; *Nelson*, 1993; *Edquist – Johnson*, 1997; *Malerba – Breschi*, 1997). This in spite of the fact that the literature draws heavily on Schumpeter's later work for intellectual inspiration.

The neglect of the entrepreneur – or individual-level agency – by the Systems of Innovation literature has effectively reduced the scope of emergence and exploration to nearly zero in the SI frameworks (*Gustafsson – Autio*, 2011; *Hung – Whittington*, 2011). Institutional structures (e.g., the legal and regulatory framework; the set-up of key organizations in the country; prevailing norms and practices) tend to be path dependent and self-reinforcing in countries and regions: it is rare for this set-up to change suddenly. This means that although the Systems of Innovation literature has been well suited to understanding persistent differences in the long-run innovation performance of countries and regions, it has been less suited to address the discovery of new paths and the development of new national and regional strengths. Breaking out of established development trajectories requires out-of-the-box thinking and challenges to established ways of doing things. This is something the static institutional structure cannot easily provide, but entrepreneurs can. For this reason, some scholars have recently started exploring ways to integrate the entrepreneur more productively into 'systems of innovation' frameworks (*Radosevic*, 2007; *Acs et al.*, 2013a).

The 'Systems of Entrepreneurship' thinking seeks to re-integrate the entrepreneur into theories of knowledge- and innovation-driven economic development. It does so by re-introducing individual-level agency – notably, entrepreneurial search and discovery by individuals – into the center stage of economic processes. Central to this thinking is the idea that established institutions and organizations will always find it difficult to radically alter established development paths, for fear that doing so would cannibalize their current activities. As a rule, established organizations and institutions are first and foremost interested in defending the established status quo and their position within it. This effectively inhibits exploration that seeks to alter established trajectories (*Gustafsson – Autio*, 2011). In contrast, enterprising individuals have little to win defending the established status quo but a lot win challenging it. This means that it is individuals, rather than established institutions and organizations, that are likely to be the key source of radical innovation that re-define a given region's strengths and

weaknesses (*Hung – Whittington*, 2011; *Gustafsson – Autio*, 2011). Most often, this challenge is operationalized through new ventures.

An important aspect of this potentially trajectory-altering challenge is that it often takes place in the vicinity of established development paths. This is the space where established organizations will find it most difficult to innovate in ways that radically challenge the established status quo, for fear of cannibalizing current business. For example, the business model of Skype radically challenged the business models of established telephony operators by introducing a free telephony service that exploited the freely available internet infrastructure. Although Skype was established in Sweden (subsequently migrating its headquarters to Tallinn, Estonia), the service could not conceivably have been introduced by the country's traditionally strong telecommunications operators – as would have been implied by traditional Systems of Innovation thinking. Instead, Skype's founders were able to leverage their telecommunications experience in a new venture. Thus, Skype built on Sweden's strengths in telecommunications (one of the two founders having previously worked for Ericsson), but the trajectory-altering potential of a radically new business model was only realized when a new venture was created. This example highlights the important interaction between context and individual initiative that traditional Systems of Innovation theories have failed to appreciate.

An important aspect of individual initiative is that individuals do not react to the way things are, objectively speaking, but rather, their actions are based on the individual's *perceptions* of the feasibility and desirability of a given opportunity. This is important, because the existence of entrepreneurial opportunities can never be conclusively established *ex ante* (unlike often implicitly assumed in received theorizing on entrepreneurial opportunity). To conclusively validate an entrepreneurial opportunity, it is always necessary to try it, by mobilizing resources for its pursuit. This *ex ante* uncertainty means that entrepreneurial opportunity validation is always a trial-and-error process: the entrepreneur cannot really know whether the opportunity exists before (s)he has tried to pursue it. To pursue opportunity, entrepreneurs experiment with different resource configurations. This aspect reinforces the exploratory and emergent nature of entrepreneurial discovery – as well as its potential to discover completely new strengths in a given region or country.

An important system-level outcome of the trial-and-error resource mobilization is a process of "entrepreneurial churn" (*Reynolds et al.*, 2005), which drives resource allocation to productive uses (*Bartelsman et al.*, 2004). This is because resources allocated towards opportunities that turn out to be productive will stick in those uses, whereas resources allocated towards unproductive opportunities will soon be released towards alternative uses. Therefore, the net outcome of this "entrepreneurial churn" is the gradual allocation of resources towards increasingly productive uses, which will eventually drive up total factor productivity. If this resource allocation process is to operate efficiently – that is, allocate resources to the most productive uses – three conditions need to be satisfied: first, the right individuals need to form conjectures that entrepreneurial action is desirable and feasible; second, the right individuals need to act and initiate new firm attempts that are likely to channel resources to productive uses; and third, that the new firm attempts are allowed to realize their full potential. Consequently, *Acs et al.* (2013a) propose the following definition of Systems of Entrepreneurship:

> *A System of Entrepreneurship is the dynamic, institutionally embedded interaction between entrepreneurial attitudes, ability, and aspirations, by individuals, which drives the allocation of resources through the creation and operation of new ventures.*

This definition makes two important contributions to received research. First, as is clear from the above, we extend the Systems of Innovation theory by explicitly incorporating the individual into our consideration. On the other hand, we also address an important weakness in the received body of entrepreneurship research, which has tended to over-emphasize the individual and ignore or sidestep the study of contextual influences. Our definition draws attention to the important *interaction* between system and individual levels of analysis.

We will elaborate on implications of the Systems of Entrepreneurship theory for policy in Chapter 5. For now, our interest is more on implications for index design. Framing entrepreneurship as a system that includes mutually dependent elements of individual agency and structural institutional characteristics has important implications for the level of analysis. Our emphasis on the regulating influence of the institutional context implies that entrepreneurship is best studied at levels that transcend the individual decision to engage in entrepreneurial activity, for example, the decision to set up a new firm. At the same time, the distinct functional ranges of the institutional framework conditions that are part of the entrepreneurship system defy a precise aggregate and spatial delineation of the issue. Many rules and regulations concerning business operations may be set at the national level, for example, whereas the availability of social capital and the economic context of entrepreneurship are likely most relevant at the local level. We argue here that, given the conceptualization of entrepreneurship as a system, the regional level – that is the sub-national level – is an appropriate aggregate level in many situations. It provides a sufficient scale to capture the socio-economic and institutional context of systems of entrepreneurship. At the same time, it acknowledges existing literature that has argued that many of the characteristics of the entrepreneurial process are inherently local (*Feldman*, 2001; *Sternberg*, 2012).

The regional nature of the outcomes of entrepreneurship is probably best evidenced by the stylized fact that most firms are started in or very near to the place of residence or work (*Stam*, 2007). In addition, setting up shop in a familiar environment is a pertinent determinant of success (*Dahl – Sorenson*, 2009; 2012). *Figueiredo et al* (2002) show that the perceived home-region advantage is large enough to the extent that investors are willing to accept higher labor costs if that allows them to keep the firm in the area of residence. The rootedness of entrepreneurs can be partially attributed to spatial inertia per se or a strong preference for a certain residential environment. *Baltzopolous – Broström* (2011) suggest that if residential preferences are leading and if people fail to find a suitable job in the preferred region, they are likely to be pushed into self-employment. In addition, business owners are generally well-embedded in local networks which they can use to the benefit of their firm.

Several studies have underscored the importance of embeddedness in different networks for starting up successful firms. *Shane* (2000) argues that business networks and industry experience determine the recognition of entrepreneurial opportunities. *Dahl* and *Sorenson* (2009; 2012), *Westlund* and *Bolton* (2003) and *Westlund* (2006), among others, stress the support that comes from social networks made up by friends and family. Also, access to finance has a regional component. Again, social networks may be important in providing financial support, but also banks are more likely to invest in a firm if it is located nearby (*Kerr – Nanda*, 2009). In short, entrepreneurship is a regional process because the effect of determinants of entrepreneurship including access to resources for production, access to finance, and embeddedness in regional networks attenuate quickly with distance.

In addition to elements in the entrepreneurship decision itself, also the broader institutional context in which the decision takes place has important regional dimensions. *Henrekson* and *Johansson* (2011) stress the importance of the institutional framework and argue that regional differences in entry rates

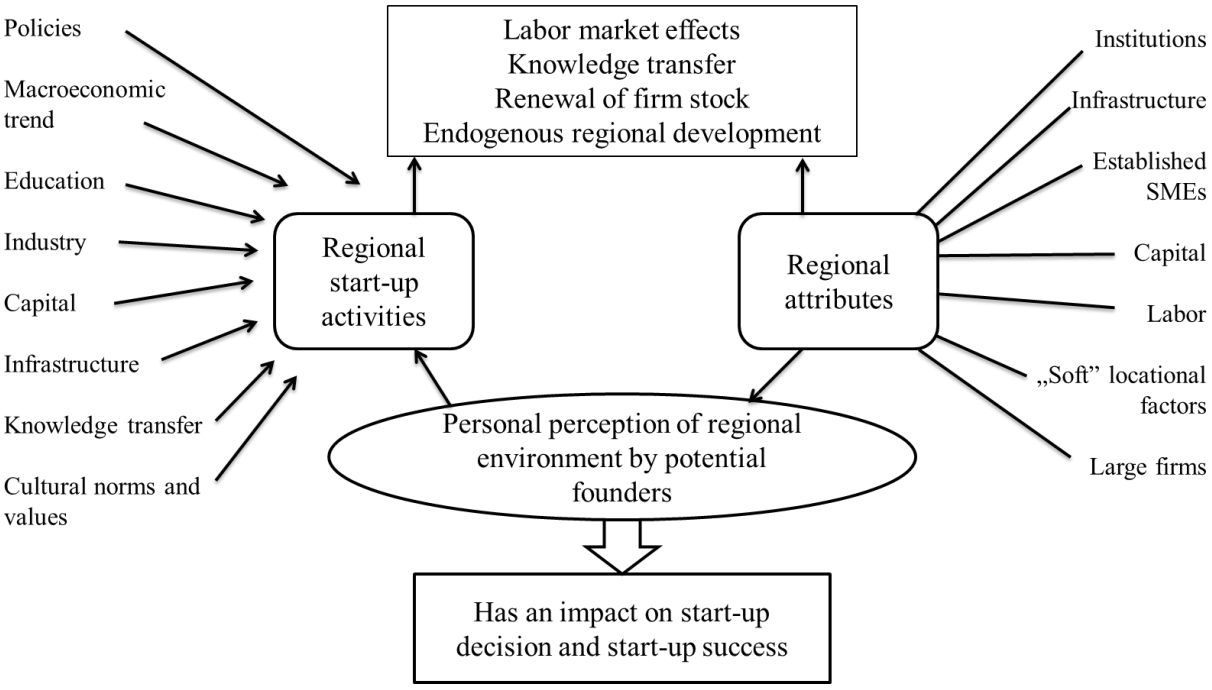
likely reflect the role of regulatory and institutional frameworks, all of which affect reallocation dynamics in various ways. For example, high barriers to entry, subsidies to incumbents, or policy measures that delay the exit of failing firms, may stifle competition and slow the reallocation process relative to an economy without barriers. Regional regulations, agreements between incumbent market players (suppliers or distributors), limited access to regional input resources, bankruptcy laws and labor market regulations also contribute to reducing the rate of entry of new firms. These barriers affect entry opportunities and hence have a strong influence on industrial renewal and entrepreneurship (*Aghion et al*., 2005; *Audretsch – Keilbach*, 2007, 2008). *Henrekson* and *Johansson* (2011) also stress that the regulatory framework alone is strongly differentiated with a number of actors involved at different judicial levels.

Thus, both national and regional regulatory frameworks matter for entrepreneurship. National regulatory frameworks are a clear element in the system of entrepreneurship through, for example, general taxes, the level of corruption, labor laws and regulations, bankruptcy legislation, and the openness of the economy (*Acs et al*, 2013b). However, national regulations are complemented by the subnational regulatory framework (see also *Sternberg*, 2012). In particular, countries where states have considerable judicial power, including Germany, Spain and the USA, focusing on national- or federal-level institutions alone may give an incomplete account of the true situation.

In addition to the regulatory framework, the less tangible part of the institutional framework has important regional elements. Through self-reinforcing demonstration and learning effects, regions may create an informal institutional framework that is conducive to entrepreneurship, an "entrepreneurial climate" (*Andersson – Koster*, 2011; *Andersson et al*, 2011). This does not only explain regional differences in entrepreneurship, but it also partially explains why regional patterns in entrepreneurship are persistent over time (*Andersson – Koster*, 2011; *Fritsch – Mueller*, 2007; *Fritsch – Wyrwich*, 2012).

The literature has shown that regional specificities, related to firms' accessibility to financing and innovation needs, together with the quality and quantity of human capital, or the proximity to scientific and technological infrastructures, are all among the most important characteristics that shape regional entrepreneurial and innovative climates (*Audretsch – Feldman*, 1996; *Boschma – Lambooy* 1999; *Andersson et al*, 2005; *Okamuro – Kobayashi*, 2006). Although the studies reviewed adopt different conceptualizations of entrepreneurship than the systems approach advocated above, the results clearly point towards a research strategy adopting the regional level. Both elements of the system of entrepreneurship, the individual decision making process and the relevant institutional context framework, carry information that is pertinent to the subnational level.

Figure 1. Causes and effects of regional entrepreneurship



Source: Sternberg (2009, 245)

2.4 Drivers of Regional Systems of Entrepreneurship

Finally, we review existing literature on the determinants of entrepreneurship in regions. These determinants feed into the different aspects of the *Regional Entrepreneurship Development Index*. In contrast to existing studies, the index explicitly tries to incorporate the recursive relationships between the different elements contributing to entrepreneurship. This sets it apart from other studies that, while acknowledging the complex nature of entrepreneurship, generally tend to use uni-dimensional measures of regional entrepreneurship, as discussed above. Arguably, studies addressing the *entrepreneurial culture or climate* most closely link to the conception of entrepreneurship as a process that takes place within a certain context. Even in these cases, the proxies used are generally relatively simple.

In survey-based studies, the acceptability of entrepreneurship is often assessed by asking whether an entrepreneur is familiar with other entrepreneurs (see, for example, *Estrin et al.*, 2009). At the regional level, the self-employment level or the share of small businesses has been used as a proxy for the entrepreneurial climate (*Armington – Acs*, 2002; *Lee et al*, 2004). Average firm size can also be an indicator of the extent to which employers have been prepared for entrepreneurship. In small firms, employees generally have to take on more tasks, a situation which can be seen as preparing them for entrepreneurship (*Lazear*, 2005). *Andersson* and *Koster* (2011) propose an indirect measurement of entrepreneurial culture based on interpreting regional residuals in a regression of regional start-ups. They found that regions with high levels of entrepreneurship also have an increased propensity to retain that level of entrepreneurship than regions with lower rates. This suggests that start-up activities may be reinforcing through the establishment of an entrepreneurial climate. This is in line with *Canever et al* (2010) who see the start-up rate in itself as an indicator of entrepreneurial climate.

Existing studies, such as these, help to inform the construction of the index as they pinpoint different relevant elements that explain regional entrepreneurial activity, as well as its outcomes. Given the goal of the index to also address the quality aspect of entrepreneurship, and with it development issues, we specifically include determinants of high-quality entrepreneurship. We here review the existing literature in five broad interrelated categories that describe pertinent elements in the entrepreneurship process: 1) Spatial externalities, 2) Clustering, networking, social capital, 3) Education, human capital and creativity, 4) Knowledge spillovers, universities and innovation 5) The state.

2.4.1 Spatial externalities

A. Agglomeration economies

Several pieces of work have found that urban areas host more entrepreneurship activities than non-urban regions in the same country (see *Sternberg*, 2004; *Acs et al.*, 2008). Two important aspects of urban areas relate to this category of environmental resource; the demand for and supply of entrepreneurship (*Keeble – Walker*, 1994, *Reynolds* 1994, *Verheul et al.*, 2002).

The literature on economic development suggests that a dense, urbanized context reflects the advantages of agglomeration, presumably including the benefits of access to customers and resources (*Delmar – Davidsson*, 2000). Spatial proximity of knowledge owners and potential users therefore appears to be critical for the transmission of tacit knowledge (*Polanyi*, 1966). Urban areas attract younger, better educated adults, thereby increasing the pool of potential entrepreneurs. People living in urban areas are more likely to be aspiring entrepreneurs, nascent entrepreneurs and business founders compared to individuals living in rural areas (*Rotefoss – Kolvereid*, 2005; *Bosma et al.*, 2008). In the case of Finnish regions, *Kangasharju* (2000) found that the presence of small firms and economic specialization, as well as urbanization and agglomeration have a consistent positive effect on firm formation.

Most of the theoretical arguments in favor of agglomeration (in an economic sense) also hold true for economic growth in many regional types (see *McCann – van Oort*, 2009; or argument in favor of connectivity see *McCann – Acs*, 2011; *Rodríguez-Pose*, 2012).

B. Population growth, size of the region and market potential

The regional demand for entrepreneurship is often linked to *population growth* and *population density* (*Bartik* 1989; *Audretsch – Fritsch*, 1994; *Keeble – Walker*, 1994; *Reynolds* 1994; *Reynolds et al.*, 1994, 1999; *Delmar – Davidsson*, 2000). As *Keeble* and *Walker* (1994) and *Reynolds* (1994) point out, *population growth and high population density* undoubtedly affect *the number of entrepreneurs.* The literature has also shown that SMEs favor countries within a low geographical distance with a *large market potential* (*Ojala – Tyrväinen*, 2007). Large markets allow firms to develop and benefit from economies of scale and could give incentives to entrepreneurship and innovation (*Yasuhiro et al.*, 2012; *European Commission*, 2010).

The literature on economic growth and regional development has also shown that both entrepreneurial activity and agglomeration have a positive and statistically significant effect on technological change, having indirectly an effect on regional development. In addition, the spillover impact in knowledge production is positively related to the *size and density of the region* due to the richer network linkages and the wider selection of producer services in larger areas (*Varga*, 2000; *Acs – Varga*, 2005).

All this results in more entrepreneurship activities (also in relative terms), the larger is the population of the urban area. The very recent "knowledge spillover theory of entrepreneurship" (*Acs et al.*, 2009, *Audretsch et al.*, 2006, *Audretsch – Keilbach*, 2007) builds on these findings. A high level of regional research and development (R&D) activity increases regional opportunities to start new knowledge-based businesses, and such a high level of R&D intensity is supposed to increase the creation of new technological knowledge and, through localized knowledge spillovers, the level of opportunities for start-ups in knowledge-based industries. Consequently, ideas and knowledge flow faster while the provision of ancillary services and inputs is also greater in large cities.

Entrepreneurial activity, as a result, has been found to be greater in densely populated regions (*Sternberg*, 2004). For Germany, *Wagner* and *Sternberg* (2004) found that the propensity to become self-employed is higher for persons who live in *more densely populated* and *faster growing regions* with higher rates of new firm formation. The authors also found that in densely populated regions higher prices of land and risk aversion can have a negative effect on new firm formation.

C. Industrial specialization

One aspect of industry specialization that is important for regional economic growth is the type of entrepreneurial activity. While there are many different type of start-up firm one type of specialization is especially important. That is while many firms are similar a subset of these is about scale and wealth creation. This subset of high impact firms is responsible for most of the job creation, innovation and growth.

Other types of agglomeration patterns are also associated with entrepreneurship. In the case of Finnish regions, economic specialization was shown to have a positive effect on regional firm formation (*Kangasharju – Pekkala*, 2004). The degree of industrial specialization provides the opportunity for industries to explore localization economies also in the case of Greek regions (*Fotopoulos – Spence*, 1999). In the case of Italian regions, the production structure and mainly local productive specialization appear to be one of the most important determinants for explaining firm formation and regional differentiation. The high specialization of the industrial environment, associated with an over-representation of small businesses, is positively associated with high new firm formation rates (*Garofoli*, 1994).

Although specialization in specific industries may positively impact on firm formation, the findings contrast with the more general ideas from agglomeration theory as discussed in the above, and the spill-over theory of entrepreneurship. Both advocate that a diverse set of actors will stimulate the discovery and development of new entrepreneurial opportunities. *Audretsch* and *Keilbach* (2008) confirm this empirically for Germany.

2.4.2 Clustering, networking, social capital

A. Clustering

The literature has also explored the positive impact of other types of industrial concentration, for example, the effect of *clusters*, defined as geographically proximate groups of interconnected firms and associated institutions in related industries, on new firm formation (for the case of German regions see *Rocha – Sternberg*, 2005). Industrial clusters can enhance new firm births as well as the productivity of existing firms. Linkages among firms and related institutions, which are the key

characteristics of the cluster phenomenon, can serve as an important determinant of new firm formation.

The network aspect of clusters helps nascent entrepreneurs to find resources and information easier and faster than in an isolated environment (*Koo – Cho,* 2011). *Sternberg* and *Litzenberger* (2004) also found that the existence of one or several industrial cluster(s) has a positive impact on the number of start-ups and attitudes. For the US, *Koo* and *Cho* (2011) found that clusters based on knowledge sharing (i.e., knowledge-labor cluster) significantly affect new firm formation, whereas clusters based on market transactions (i.e., value-chain cluster) do not seem to play a role. *Delgado et al.* 2010, also for the US, found that after controlling for convergence in start-up activity at the region-industry level, industries located in regions with strong clusters (i.e. a large presence of other related industries) experience higher growth in new business formation and start-up employment. Strong clusters are associated with the formation of new establishments of existing firms, thus influencing the location decision of multi-establishment firms and contributed greatly to start-up firm survival.

B. Networking (role models)

Entrepreneurs may become *role models* and encourage other individuals to consider business ownership. Evidence suggests that areas with a high proportion of small firms may provide role models for potential entrepreneurs (*Fritsch*, 1992; *Reynold*, 1994, *Garofoli*, 1994; *Hart – Gudgin*, 1994; *Love*, 1995; *Malecki*, 1997; *Spilling*, 1996). *Davidsson et al.* (1994) claim that the availability of role models and people with relevant work experience is the single most important determinant of regional variation in new formation rates. Their study, conducted in Sweden, reveals that regions with a high proportion of small firms have significantly higher new firm formation rates. Apart from SME presence, networks in general influence the decision to become an entrepreneur as networks and peer groups may provide *role models.* Therefore, a region with high levels of entrepreneurship may further encourage new entrepreneurial initiatives because it is easier to access information or resources from other entrepreneurs (*Bosma et al.*, 2012). The self-reinforcing effect of role models may also go some way in explaining the persistence in the regional distribution of start-up rates (*Andersson – Koster*, 2011; *Fritsch – Mueller*, 2007; *Fritsch –Wyrwich*, 2012).

C. Social capital

There are different conceptions of social capital, which each relate to entrepreneurship (*Westlund – Bolton*, 2003). First, social capital can be seen as the network through which valuable resources for the start-up of a new firm can be attained. This view is in line with Bordieu's conception of social capital (*Bourdieu – Waquant*, 1992). Secondly, value can be derived from the social network itself through the shared values, information in the social group. This mimics a conception of social capital that puts more emphasis on the social network itself – rather than the resources for production derived from it - as the defining element (see, for example, *Coleman* 1990). Without going into a detailed discussion on definitions and conceptions of social capital, this simple dichotomy helps structure the empirical examples that allude to social capital.

We have already mentioned a number of studies that stress how important resources for firm formation are derived from the social network. This includes access to finance (*Kerr –Nanda*, 2009), access to ideas and the recognition of opportunities (*Shane – Venkataraman*, 2000) and access to labor in the form of friends and family helping out in the business (Dahl and Sorenson, 2009). In this view,

the benefits from social capital may in principle be available to all members of the social network, but once allocated they are rival goods and only accrue to the entrepreneur (or firm) accessing them.

This is in contrast with the other type of social capital in which values, ideas and acceptance *vis-a-vis* entrepreneurship are shared in the social group. The effects are embedded in the group and become a public good for the members of the group. *Schutjens – Völker* (2010) stress this type of social capital as they see it as a culture of interaction among people. Social capital promotes regional learning both within a region and beyond, as it reinforces the openness to the ideas of others. The literature on role models can also be reframed in this conception of social capital. The role models, if relevant in a social group, can have an effect on the whole social network. Likewise, the occupational structure of regions may indicate the human capital endowments of the people and as a result their propensity of starting a firm. It can also be seen as a crude measure of the existence of shared values and beliefs that may or may not stimulate entrepreneurship (see, for example, *Hart – Gudgin*, 1994).

From the results reviewed here, it is apparent that social capital is seen as an important part of the entrepreneurial decision that also explains an important part of the idea why entrepreneurship is an inherent local phenomenon (*Fornahl*, 2003). Still, it is seems difficult to empirically pinpoint the effect of social capital. If it seen as a means of accessing resources, the availability of the resources can just as well be seen as the explanatory factor; if it seen as a value-laden network affecting entrepreneurship, it is difficult to measure directly.

2.4.3 Education, human capital and creativity

A. Education and vocations

Education has been related in the literature to knowledge, skills, problem-solving ability, discipline, motivation and self-confidence (*Cooper et al.*, 1994). There seems to be agreement that attaining a high level of education positively influences the probability of becoming involved in business start-up processes (*Cooper et al.*, 1994; *Bates*, 1995; *Delmar and Davidsson*, 2000). In addition, schooling has an important impact on successful entrepreneurship. *Van der Sluis et al.* (2008) review over 100 studies on the issue and they find a marginal return of 6.1% to an additional year of schooling. For wage income, they find an even larger marginal effect, suggesting that other factors are relatively important in explaining income from self-employment. *Iversen et al*. (2010) reinforce this observation in their study of returns to self-employment in the Danish labor market. They find a similar overall marginal effect of 6,5%, but also show that the effect is highly influenced by those that have enjoyed very long episodes of schooling. The marginal effect only increases significantly for those with at least 17 years of schooling. The level of education, however, is not the only determinant of self-employment (success). Also the type of study influences the incidence of self-employment (see, for example, *Falk – Leoni*, 2009). This may have to do with the content of the study and to what extent the content prepares the graduate for self-employment, but it is also importantly influenced by the labor market arrangements that are common in the industries the graduates are likely to be active in. In the Netherlands, for example, General Practitioners are generally organized in a specific legal arrangement that involves self-employment.

Similarly, *Glaeser* and *Kerr* (2009) find that abundant workers in relevant occupations strongly predict regional entry. For the case of Greek regions, the supply of skilled manufacturing labor was found to attract moving firms and stimulate new firm formation (*Fotopoulos – Spence*, 1999). Human resources in science and technology have a strong impact on the number of new start-ups and new jobs. They are

typically the workers who come up with new ideas and put them into practice, which leads to more new and more innovative and productive firms and higher creation of jobs (*Kern – Runge*, 2009). Entrepreneurs with high level of education are more likely to have a role model, and the likelihood that these entrepreneurs view their role models as crucially important is significantly higher (*Bosma et al.*, 2012).

Universities can be an important anchor tenants for regional clusters (*Hausman*, 2012; *Chatterji et al*, 2013). Certain studies have shown that long-run employment and wages increased quickly in industries more closely related to local universities' pre-existing strengths in innovation. This effect was realized through the entrance of new firms and, especially, the expansion of multi-unit firms into the area. The power of local universities to engender economic growth is also studied by *Moretti* (2004) and *Glaeser* and *Saiz* (2003).

B. Creative class, talent

According to the "economic geography of talent" hypothesis put forward by *Florida* (2002a, b) highly qualified people tend to live in close spatial concentration. Such regions are characterized by low barriers to entry for well-educated, young workers who are attracted in particular by cultural diversity and openness toward the new and the "different". Up until then a small number of empirical studies on the spatial mobility and entrepreneurial activities of the member of Florida's "creative class" (*Florida* 2002b, *Boschma – Fritsch*, 2009) show that they are highly mobile in a spatial sense, very discriminating when choosing locations and that they represent a high level of entrepreneurial potential. Given the fact that creative people are more inclined to economic independence, it seems plausible that they have a higher propensity to start a business comparing to non-creative people. Consequently, regions with a higher proportion of creative people (that is, mainly, urban areas) should also be characterized by higher start-up rates than rural areas (*Sternberg*, 2012). For the case of Italian regions, *Piergiovanni et al.* (2009) observed that the regional employment growth is influenced by the prevailing patterns of sectoral specialization and by the rate of growth of the share of firms in creative industries (artists' and writers' creation, fashion design, advertising, architectural and engineering activities and industrial design, software, etc.). Given the preference for attractive urban regions, the positive effect of agglomeration may therefore partially be a sorting effect of entrepreneurial talent congregating in certain areas.

2.4.4 Knowledge Spillovers, Universities and Innovation

A. Knowledge Spillovers

As long as the knowledge necessary for technological change is codified (i.e., it can be studied in written forms either in professional journals and books or in patent documentations), access to it is not essentially constrained by spatial distance; among other means, libraries or the Internet can facilitate the flow of that knowledge to the interested user, no matter where the user is located. However, where knowledge is not codified, because it is private, or not yet completely developed, or is so practical that it can only be transmitted while being applied, the flow of it can only be facilitated by personal interactions. Thus, for the transmission of such tacit knowledge spatial proximity of knowledge owners and entrepreneurs appears to be critical (*Polanyi*, 1967).

Adam Jaffe (1989) was the first to identify the extent to which university research spills over into the generation of commercial activity. His statistical results provided evidence that corporate patent

activity responds positively to commercial spillovers firm university research. Building on Jaffe's work, *Feldman* (1994) expanded the knowledge production function to innovative activity and incorporated aspects of the regional knowledge infrastructure. She found that innovative activity is conditioned by the knowledge infrastructure and responds favorably to spillovers from university research at the state level, strengthening Jaffe's findings.

Varga (1998) built further on this solid foundation. His main concern was whether university-generated economic growth observed in certain regions and from selected industries can be achieved by other regions. He extends the Jaffe-Feldman approach by focusing on a more precise measure of local geographic spillovers. Varga approaches the issue of knowledge spillovers from an explicit spatial econometric perspective and for the first time implements the classic knowledge production function for 125 Metropolitan Statistical Areas, yielding more precise insights into the range of spatial externalities between innovation and research and development.

The *Jaffe – Feldman – Varga* research into R&D spillovers takes us a long way towards understanding the role of R&D spillovers in knowledge-based economic development. A host of recent empirical studies have confirmed that knowledge spillovers are geographically bounded (*Acs et al.*, 1992, 1994; *Jaffe et al*., 1993; *Audretsch – Feldman*, 1996; *Anselin et al*, 1997; *Keller* 2002).

B. Innovation

The literature of *innovation systems,* even if highly influenced by the work by Schumpeter seems not to have a clearly defined role for entrepreneurship. *Radosevic* (2007) ascribed this absence to the predominantly institutional emphasis of the *innovation system literature,* which has made it difficult to accommodate the individual-centric perspective of the entrepreneurship literature (*Shane*, 2003). For instance, in the institutional tradition of the National Systems of Innovation literature, institutions engender, homogenize, and reinforce individual action: it is a country's institutions that create and disseminate new knowledge and channel it to efficient uses. In this perspective, individual action is either not considered or is supposed to happen automatically, subject to the homogenizing influences of the institutions. This routine-reinforcing perspective of the systems of innovation literature has proven difficult to reconcile with the individual-centric, routines-breaking emphasis of the entrepreneurship literature (*Radosevic*, 2007; *Schmid*, 2004).

The literature highlights three main problems typical of regional innovations systems that need to be addressed: (1) *fragmentation,* (2) *absence of key resources,* and (3) *negative lock-in* (*Tödtling –Trippl,* 2005).

Fragmentation can be a problem in regions where all the necessary components of a successful innovation system already exist. This means that strong actors are present in all three subsystems and that there is an institutional framework well suited to these actors. The problem of fragmentation occurs when the authors are not aware of each other and/or when they do not act in harmony with each other. One reason may be that there is an *institutional and/or functional mismatch.* An example of institutional mismatch can be the absence of an overall collective action. Functional mismatch, where the functions that the innovation system supports do not result in mutually reinforcing synergies, is experienced in the case of a lack of coordination.

The absence of key resources that are necessary for a proper functioning of an innovation system, such as the regional presence of human capital, represents a grand challenge in many regions. In this situation the region faces the challenge of attracting key resources either by influencing the regional

supply or by stimulating the regional actors to meet the resource needs through contracts with actors outside the region. This may also be the case for entrepreneurship.

Finally, *negative lock-in* represents the most difficult problem for regions today. Negative lock-in may occur when regional specialization has emerged in a sector that in the medium or long term does not have good growth potential, but which may still be an important part of the region's industrial identity. In this context, it is not necessarily just lock-in in obsolete technology that is in question, but also lock-in in skills and market terms. The main challenges for the development initiative in such a situation is to influence those actors who represent or support the specialization that is risky or problematic in the long term to be open to new inspiration or to change direction. The prerequisites for avoiding this kind of negative lock-in are probably better in regions with a diversified economy within related industries, as this provides opportunities for new combinations of existing knowledge and thus renewal in terms both of technology and of market orientation.

Additionally, *Henning et al* (2010) describe a final issue that is complementary to all the previous ones (4) *inconsistencies between the regional economic structure and the priorities of the regional policy.* A lack of correspondence between the policy measures implemented by the actors in the innovation system's support structure and, on the other hand, the regional economic structure, can result in an inefficient support structure and an unexploited regional innovation capacity.

C. Protection of property rights

Based on broad historical studies such as *North* (1981) and *Rosenberg* and *Birdzell* (1986) or *Rodrik et al.* (2004) and *Acemoglu* and *Johnson* (2005), it is now widely recognized that protection of property rights is of fundamental importance for economic growth. *Aidis et al*. (2010) find the property right system to play a pivotal role in determining entrepreneurial entry, in particular in low and middle income countries while *Johnson et al.* (2002) also provide evidence that weak property rights discourage entrepreneurs from reinvesting profits. Depending on the level of protection of property rights different types of entrepreneurship will be favored. For example, strong private property rights will help productive entrepreneurship to thrive as the entrepreneurial rents are expected to be retained. In contrast weaker property rights will favor the establishment of unproductive entrepreneurial activities or other productive activities such as private security services, created to solve the lack of security in the environment. *Henrekson* (2007) also points that in recent years the excessive protection of property rights is likely to impede productive entrepreneurship.

D. Finance

Small and newly established firms are more dependent on equity financing than large, well-established firms. Individual wealth positions have been considered as an important determinant in explaining the propensity of individuals to become entrepreneurs and to innovate in the case of SMEs (*Parker*, 2004). However, in the case of pure traditional measures of entrepreneurship, the literature seems not to be conclusive in determining the effect of saving rates on entrepreneurship. *Young* (1992) compares the cases of Singapore and Hong Kong and concludes that having GDP rates very similar but double the saving rates in Singapore, the Hong Kong economy appears to be more entrepreneurial. In the case of the mature welfare states in Northern Europe the entrepreneurial activity as conventionally measured seems to be low. Welfare state provisions such as unemployment or sick-leave benefits, income-dependent pensions and subsidizing health and care services remove a number of savings motives for

the individual and this could be the reason why entrepreneurs do not have at their disposal the required savings to start a business.

Henrekson (2007) also points that the composition, and not just the volume, of saving is of importance for entrepreneurship. For this reason, any social arrangement that channels savings and asset control to large institutional investors is likely to limit the supply of financial capital to potential entrepreneurs. These issues also point to the question of *taxation.* The literature argues that taxation is another institutional barrier that affects entrepreneurial activities. However, the analysis of how taxation may affect entrepreneurship in the aggregate data analysis is complex and sometimes cannot be explicitly captured.

While it is hard to deny the importance of banks in the provision of traditional type of debt especially in the European Union, over the last two decades some alternative forms of mainly equity financing has been emerging. Entrepreneurial finance refers to the alternative sources of capital (*Denis*, 2004; *Winton – Yerramilli*, 2008). For startups and entrepreneurial firms venture capital is particularly important (*Berger – Udell*, 1998; *Gompers et al.*, 2005; *Kanniainen – Keuschnigg*, 2004). Beside money, venture capitalist and business angels provide various assistance and help to the generally inexperienced young business owners (*Gompers*, 1995, *Helman – Puri*, 2002). Most start-ups have no other choice but to approach their relatives, friends or other acquaintances if the founders own savings are not enough for launching the business (*Mason*, 2007). GEM data based analyses highlight that the amount of informal investment exceeds that of the formal venture capital by 8-20 times. At the same time the average amount invested in one business by venture capitalists can be hundreds times higher than that of the informal venture source of family members, friends and alike (*Bygrave – Hunt*, 2004; *Bygrave – Quill*, 2007). Overall, the adequate supply of both formal and informal venture capital is vital for providing the necessary fuel for high growth potential businesses in their critical phases of the life cycle.

Both formal and informal investment, in particular angel finance, tends to concentrate to more prosperous agglomerated areas (*Florida – Smith*, 1993; *Jones-Evans – Thompson*, 2009; *Martin et al.* 2002, *Mason – Harrison*, 2003). Spatial proximity is particularly important in certain high tech, biotechnology or internet based sectors and clusters (*Powell et al.*, 2002; *Zook*, 2008).

2.4.5 The Role of the State

A. Size of government

A large state sector is usually synonymous with generous levels of welfare provision, for example unemployment benefits, pensions and child welfare for women in work. These benefits must be paid for, and this is usually done by high levels of personal taxation, often within a progressive tax regime in which high earners, such as successful entrepreneurs, pay higher marginal rates. This will reduce the expected returns to entrepreneurial activity. Moreover, when the welfare system for those in employment is generous, the opportunity cost of entrepreneurship is against other forms of employment or non-participation in the labor force is raised. Taken together, these factors would suggest that a larger state sector will reduce entrepreneurial activity (*Aidis et al.*, 2010). *Henrekson* (2005) found that a strong welfare state dampens entrepreneurial activity by taking away incentives for starting a firm. The range of rules and regulations in place sometimes give opposing incentives for firms and the effect of the institutional framework on firm dynamics is therefore essentially a net effect for which a limited number of variables form a poor proxy (*Henrekson – Johansson*, 2011).

B. Regulations

The *regulative* institutions are those controlling systems that are legally sanctioned, such as laws and regulations. *Normative* institutions, however, are not necessarily linked to any direct sanction system, but are maintained by (often unconscious) moral considerations and are thus indirect sanction systems (anyone who does not adhere to normative institutions loses his legitimacy and is marginalized in the long run). Examples of normative institutions are perceptions of what is accepted as good business practice in different contexts. Views on this may differ between industries, nations or regions. The *cognitive* institutions are shaped by culture and daily routines/practices and are thus more or less taken for granted by individuals. They are adhered to, therefore, without further reflection (*Moodysson*, 2007).

One example of this is the way in which problem-solving is conducted. In somewhat simplified terms, one can say that regulative institutions are largely but not entirely formal (particularly with regard to laws and regulations), while normative and cognitive institutions are to a significantly greater extent informal (norms and values). The above classifications do, however, overlap to a certain extent. As such, the three institutional types should not be regarded as distinctly separate categories, but rather as interdependent, inseparable dimensions that together form the institutional framework that affects the harmony of the innovation system by governing actors' behavior towards each other and the outside world. (*Henning et al.*, 2010)

The literature has shown that the effect on entrepreneurship activity on regional development is driven by the institutional context in which entrepreneurial activity takes place. Since *Baumol* (1990, 1993), a literature has emerged suggesting that disparities in entrepreneurial activity between countries (*or regions*) can be explained by the quality of their supporting institutions. Institutional theory has argued that company behavior, including entrepreneurial choices, will be context specific (*Meyer – Peng*, 2005), and a literature has emerged to show that entrepreneurial activity is sensitive to the quality of institutions (*Batjargal*, 2003; *Henrekson*, 2007; *Sobel*, 2008) as well as to the level of economic and social development.

The institutional context can be either conducive or detrimental to the entrepreneurship. It is reasonable to think that higher levels of corruption or weaker intellectual property rights will have a negative impact on entrepreneurship. A favorable business environment, where entrepreneurial activities are supported by institutions and a trustable governance system, will infer a positive effect in the creation and impact of entrepreneurship (*North*, 1990, 1994; *Baumol*, 1993; *Davidsson – Henrekson*, 2002).[3]

The degree of regulation of labor markets and wage-setting can be expected to influence incentives for entrepreneurship, since it restricts the freedom of contracting and therefore curtails the possible combinations of factors of production. The literature has found important differences between countries in terms of labor market regulation.

[3] Although the impact of institutions on entrepreneurship can vary depending on the stage of entrepreneurship and aspects such as the stage of economic development of the country or region, in this section these two aspects will be omitted. We then are going to consider as a whole the institutions that have an influence in entrepreneurship creation and their impact non discriminating the stages of entrepreneurship.

Henrekson (2007) states that there are reasons to believe that strict employment security provisions, and other regulations that restrict contracting flexibility, are more harmful for smaller and more entrepreneurial employers. Another labor market arrangement that may impact on the incentives for entrepreneurship is wage-setting institutions. Institutional pressures for wage compression are likely to disadvantage smaller and more entrepreneurial businesses.

The cross-country comparative studies on the effect of labor market regulations on job counts can help to understand some entrepreneurship and firm evolutionary patterns. *Birch* and *Medoff* (1994) hypothesize that in the US the really good entrepreneurial firms become fast-growing gazelles and the self-employment is fairly low in US. Oppositely, in Italy, the high regulatory environment with high labor taxes make difficult and risky to grow businesses, such that they prefer to remain smaller (*Lazerson – Lorenzoni*, 1999).

C. Corruption

Corruption has been seen as being negative for firm entry by raising the costs and therefore reducing the returns to entrepreneurial activity (*Anokhin – Schulze*, 2009). *Desai* and *Acs* (2007) argue that a corrupt environment may have negative supply side effects on entrepreneurs, and especially on those with higher aspirations, leading them to satisfy their ambitions through rent seeking rather than the formation of new firms. The effects of a corrupt institutional environment seem to have higher negative effect on higher growth aspiration entrepreneurship. Its negative effect impact more highly on potential new firms than incumbents, because incumbents have developed a higher resilience in operating longer in corrupt environment which is highly uncertain (*Aidis et al*., 2008, 2010). *Estrin et al.* (2012) find that the coefficient on freedom from corruption appears to be highly significant in explaining employment aspirations by entrepreneurs.

3 DATA AND METHODOLOGY

3.1 Introduction

This section devotes its attention to the data description and to methodological issues of the Regional Entrepreneurship and Development Index REDI. Index-building is a complex task that faces several potential pitfalls, starting with the vague and various definitions of a concept like entrepreneurship. Following *Acs et al* (2013a) we favor a complex perception of entrepreneurship and believe that this complexity requires a composite index, as opposed to the single measures often used. The Systems of Entrepreneurship (SE) theory is based on the following core assumptions:

1. Economic growth is ultimately driven by a trial-and-error resource allocation process, under which entrepreneurs allocate resources towards productive uses;
2. This process is driven by individual-level decisions, but those decisions are conditioned by contextual factors;
3. Similarly, the outcomes of individual-level entrepreneurial decisions are conditioned by contextual factors;
4. Because of the multitude of interactions, country-level entrepreneurship is best thought of as a system, the components of which co-produce system performance

While in the previous chapter we have provided an exact description of entrepreneurship, in practical terms it is closer to a permeable frame than a closed box. Our approach to entrepreneurship measure involves five important aspects.

1. First, we view entrepreneurship as a concept of quality rather than quantity.
2. Second, we consider both institutional and individual factors vital in measuring entrepreneurship.
3. Third, measuring the pillars of entrepreneurship is based on a benchmark of the best five percent existing achievement for each particular pillar.
4. Fourth, the averages of each 14 pillar values are equated to provide the same marginal effect. This point is particularly important from the entrepreneurship policy point of view.
5. And fifth, we view the building blocks of entrepreneurship, the 14 pillars, not as independent but as integrated elements of a system. We believe that the performance of the overall system depends on the weakest pillar, and that a good performance in one pillar can substitute only partially for a badly performing element of the system. A practical application of this theory is the penalty for bottlenecks **(**PFB**)** methodology.

After this short introduction, we present the description of the applied data. The REDI has a six-layer structure from sub-indicators, indicators, variables, pillars, sub-indexes. Here, we focus on the individual and the institutional indicators and variables. Individual-level variables are based on indicators from the GEM Adult Population Survey dataset except two innovation indicators that are from the European Union data collection. For this report we used the 2007-2011 pooled GEM data.

There are two types of institutional variables, country level and regional ones. Our original idea was to construct the institutional variables from fourteen country wide and fourteen regional indicators. The later would have reflected to spillovers effective mainly in smaller than county level geographic areas. However, in many cases we faced the lack of available data. Finally we ended up having eight country-wide and thirteen regional indicators. Institutional variables are more complex, some of them contain many sub-indicators. The sub-indicators are the basic building units of the institutional indicators and variables. The sub-chapter provides a detailed description of the 76 sub-indicators, and of the 40 variables we used to calculate the REDI scores for the mix of 125 NUTS1 and NUTS2 regions of 24 European Union countries.

In the following, we define and describe the structure of the Regional Entrepreneurship and Development Index (REDI). We propose six level index-building: (1) sub-indicators (2) indicators (3) variables, (4) pillars, (5) sub-indices, and, finally, (6) the super-index. The three sub-indices of attitudes, abilities, and aspiration constitute the entrepreneurship super-index, which we call REDI. All three sub-indices contain four or five pillars, which can be interpreted as quasi-independent building blocks of this entrepreneurship index. Each of our 14 pillars is the result of the multiplication of an individual variable and an associated institutional variable. In this case, institutional variables can be viewed as particular (regional-level) weights of the individual variables.

The fourth part of this chapter summarizes the most important steps of our index creation. An important novelty of our index-building is the way the pillars are combined (aggregated) into sub-indices. Most indices simply use the (weighted) average of the pillars; others apply a dimension-reduction methodology, such as factor analysis. We provide a different approach that takes into account the fact that the pillars are only partially substitutable for each other. Relying on the Theory of the Weakest Link (TWL) and the Theory of Constraints (TOC), we developed this new methodology, which we call the Penalty for Bottlenecks (PFB). We believe that the basic claim of these theories—that the performance of the system is determined by its weakest performing part and the pillars can only be partially substitutable with one another—are true in the case of entrepreneurship. The PFB relates the pillar values to the lowest pillar value. The penalty depends on the magnitude of the differences; for greater deviation, the penalty is greater. We applied an exponential penalty function. The PFB provides valuable policy suggestions for enhancing entrepreneurship by improving the weakest pillar in the system.

In the last section we introduce a new indicator, the Average Bottleneck Efficiency (ABE) measure. This efficiency indicator measures how much a country's fourteen pillars are balanced.

3.2 Data description

As mentioned previously, our entrepreneurship index incorporates both individual-level and institutional/environmental variables. Here we provide a full description of the data, the data collection method and the calculation of the variables from the indicators and sub-indicators. All individual-level variables except two are from the GEM survey. The institutional variables are obtained from various sources. For the details, we refer to the Appendices.

3.2.1 REDI individual data description

In this part we review the individual data. The full list and description of the applied GEM individual variables and indicators can be seen in Appendix A. For more information on the GEM methodology

we refer to *Reynolds et al* (2005). *Bosma* (2013) provides an update on the methodology and lists and discusses the academic articles that are (partly) based on GEM data.

As previously mentioned, individual-level variables are based on the GEM Adult Population Survey dataset. For this report we used the 2007-2011 pooled GEM data. For Estonia, 2012 was used since this country only joined the GEM project in 2012. For 24 countries in the European Union, including Croatia, it was possible to create the regional representation of the GEM dataset except Bulgaria, Cyprus, Luxembourg, and Malta. In the case of 10 countries, GEM data were regionalized at NUTS1 level (Austria, Belgium, Greece, France, Germany, Italy, Netherlands, Poland, Romania, and United Kingdom). For four additional countries the country level classification was equal to the NUTS1 level classification. These are the Czech Republic, Latvia, Lithuania and Estonia. For the remaining 10 countries, GEM data were calculated at NUTS-2 level (Croatia, Denmark, Finland, Hungary, Ireland, Portugal, Spain, Slovenia, Slovakia, and Sweden). In the case of Portugal, only those five NUTS-2 level data were available which belong to the *Continente* NUTS1 region. For Spain, the two small African continent NUTS1 regions, Ceuta and Melilla were also excluded. Thus, we have calculated the REDI for 24 countries which altogether contain a mix of 125 NUTS1 and NUTS2 regions.

It should be noted that some countries participated in GEM all years between 2007-2011, while others participated just a few years (or even just one in the case of the Czech Republic). In order to achieve satisfactory sample sizes for some of the regions in the classification listed above, we have included 2012 data for Austria, Estonia, Poland, the Slovak Republic and Sweden (see *Table 1* for an overview). For most of the regions, a satisfactory sample size was achieved. For 97 out of the 125 regions, the sample size exceeded 1,000 individuals. For four regions the GEM variables are based on sample sizes lower than 300 cases and should therefore be taken with care. These include Bremen (Germany), Algarve (Portugal), Saarland (Germany) and Alentejo (Portugal). Other regions with relatively limited coverage include Poludniowo-Zachodni (Poland), Mecklenburg-Vorpommern (Germany), Thüringen (Germany) and Bratislavsky Kraj (Slovakian Republic), all with sample sizes between 400-500.

In this respect it should also be noted that NUTS classifications are not always equally comparable in terms of region/population sizes; in fact for some countries a mix between NUTS1/NUTS2 or NUTS2/NUTS3 may be beneficial, dependent on the purpose of the analysis. For instance, the NUTS1 region of Bremen is limited to the core urban area and is much smaller in scope than for example the large NUTS1 region of Bavaria, which includes Munich. For the REDI indicators the abovementioned classification was adopted consistently.

In order to retrieve regional indicators from the individual level data, individual cases have been aggregated bearing in mind discrepancies in regional age & gender patterns between the GEM Adult Population Survey samples and those emerging from official national statistics and published by Eurostat. Hence, an individual weighting variable corrects for the under- or overrepresentation of a particular age/gender group in each of the 125 regions. The age groups considered are 18-24 years, 25-34 years, 35-44 years, 45-54 years and 55-64 years.

Table 1. GEM Adult Population Survey Details by Country

Country	Sample size 18-64 years	Basic Class.	Years included	Nr. of regions
Austria	6,544	Nuts1	2007 & 2012	3
Belgium	11,431	Nuts1	2007-2011	3
Croatia	8.516	Nuts2	2007-2011	3
Czech Republic	2,005	Nuts1	2011	1
Denmark	9,975	Nuts2	2007-2011	5
Estonia	1,721	Nuts2	2012	1
Finland	10,034	Nuts2	2007-2011	5
France	7,994	Nuts1	2007-2011	8
Germany	20,595	Nuts1	2008-2011	16
Greece	9,962	Nuts1	2007-2011	4
Hungary	9,417	Nuts2	2007-2011	7
Ireland	5,899	Nuts2	2007; 2010-2011	2
Italy	10,934	Nuts1	2007-2010	5
Latvia	10,015	Nuts2	2007-2011	1
Lithuania	2,003	Nuts2	2011	1
Netherlands	12.484	Nuts1	2007-2011	4
Poland	4,003	Nuts1	2011 & 2012	6
Portugal	6,036	Nuts2	2007; 2010-2011	3
Romania	8,453	Nuts1	2007-2011	4
Slovak Republic	2,000	Nuts2	2012	4
Slovenia	14,090	Nuts2	2007-2011	2
Spain	131,533	Nuts2	2007-2011	17
Sweden	7,862	Nuts2	2007; 2010-2012	8
United Kingdom	72,296	Nuts1	2007-2011	12
Total sample	**387,802**			**125**

In most cases - eleven out fourteen – the individual indicators were used directly as variables. In the remaining three cases we multiplied two indicators to calculate the variables. The *New Product* and the *New Technology* variables combine together a GEM based and another regional level innovation variable derived from the Poli-KIT database (*Capello – Lenzi*, 2013). The *Prod Innovation* and the *Tech Innovation* indicators serve to correct for the potential bias in the GEM's self-assessed questionnaire. The *Informal investment* variable is a result of the multiplication of the mean amount of informal investment (*Informal Investment Mean*) and the prevalence of informal investment (*Business Angel*), both of them are coming from the GEM survey. Therefore, *Informal investment* combines together tow aspect of informal finance providing a more accurate measure about the availability of startup capital of a region. For details, see Appendix A. The standard errors of the GEM Adult Population Survey base individual variables for each 125 regions are in Appendix B.

3.2.2 REDI institutional data description

Since the GEM dataset lacks the necessary institutional/environmental variables, we complete it for the index with other widely used relevant data derived from different sources. These are the followings:

- EUROSTAT Regional Database
- United Nations, Department of Economic and Social Affairs, Population Division
- EU Regional Competitiveness Index 2010
- World Bank – World Development Index,

- Legatum Prosperity Index,
- World Economic Forum,
- EU QoG Corruption Index,
- Heritage Foundation database,
- ESPON database,
- Cluster Observatory database,
- DGRegion Individual Datataset (not-published),
- Groh et al (2012) Global Venture Capital and Private Equity Country Attractiveness Index,
- OECD-PISA database.

A potential criticism of our method – as with any other index – might be the apparently arbitrary selection of institutional variables and the neglect of other important factors. In all cases, we aimed to collect and test alternative institutional factors before making our selection. Our choice was constrained by the limited availability of data in many regions. The selection criteria for a particular institutional/environmental variable were:

1. The potential to link logically to the particular entrepreneurship variable
2. The clear interpretation and explanatory power of the selected variable; for example, we have had interpretation problems with the taxation variables[4]
3. Avoiding the appearance of the same factor more than once in the different institutional variables[5]
4. The pillar created with the particular variable should positively correlate to the REDI.

To eliminate potential duplication, instead of using existing complex institutional variables offered by different research agendas, we created our own complex indexes using relevant simple indicators or sub-indicators.

- Basically we apply a single indicator only in one case that is *GERD* (Gross Domestic Expenditure in Research & Development as a percentage of GDP) used to measure technological development.
- In seven cases – *Quality of Education*, *Social Capital*, *Open Society*, *Business Environment*, *Absorption Capacity*, *Business Strategy*, *and Financial Institutions* – the application of a complex measure (using both country level and regional level indicators) proved to be more useful than using one single indicator. Most of these indicators are complex creatures by

[4] A former version of our index (*Acs – Szerb*, 2009) was criticized because we did not incorporate the taxation effect (*A European Paradise*, p. 25). While it is true that high taxation can be harmful for entrepreneurship, ceteris paribus, it should not be forgotten that high-taxation countries can provide better public services and an environment favorable to business startups. While Scandinavian countries have high taxation, they also lead the ranks in government effectiveness and regulatory quality, as reported by the World Bank Aggregate Governance Indicator dataset (http://info.worldbank.org/governance/wgi/index.asp).

[5] There is only one duplication in the data set we could not avoid: The corruption appears in the Corruption in the Social capital institutional variable and also in the EU QoG INDEX.

themselves. For example the *Business Environment* variable consists of the *Business Freedom* country level and the *EU QoG INDEX* regional level indicators. The *Business Freedom* is the most composite indicator including ten sub-indicators. The *EU QoG INDEX* reflecting to the quality of the government in the particular region contains four sub-indicators.

- In five cases - *Market Agglomeration, Higher Education & Training*, *Innovation sub-index, Clusters and Accessibility* – we use only regional level institutional indicators. In the case of the *Business disclosure* we could find only a country level institutional indicator as a measure of the overall risk in a particular country.
- In three cases, instead of using whole existing complex index, we applied only sub-indices that were more relevant to entrepreneurship: for example Business Freedom is a component of the Index of Economic Freedom, Social Capital Sub-Index is a subset of the Legatum Prosperity Index, and the Depth of capital market is a sub-index of the Venture Capital and Private Equity Index.

In this version, we apply the most recent institutional variable indicators available on June 30. 2013. The full description of the institutional variables, indicators and sub-indicators their sources, the year of the survey, and the calculation method for each institutional variable can be found in Appendix C.

As a general rule of regional level institutional variable calculation, if data were not available at NUTS1 level, we calculated the population weighted mean of the available NUTS2 regions. In cases, when both NUTS1 and NUTS2 regions were not available, NUTS0 (country level) were used as substitutes. NUTS0 data were used in Germany, France and Finland, because the lack of Technological Absorption data at NUTS1/NUTS2. We also endeavored to substitute other missing NUTS1 or NUTS2 level data (for detailed description see Appendix D).

For handling the extreme distribution of the institutional indicators we follow *Annoni* and *Kozovska* (2010) method. They built on the Box-Cox transformation in the cases the absolute value of skewness – a measure of the asymmetry of distribution – exceeds the absolute value 1. *We apply this Box-Cox transformation method to improve the distribution of those indicators that are out of the [-1,1] range of skewness* (*Annioni – Kozovska*, 2010, pp. 52-53)

The skewness, the degree of the asymmetry of distribution is calculated as the following:

$$\kappa = \frac{n}{(n-1)(n-2)} \sum_{i=1}^{n} \frac{(x_i - \bar{x})^3}{s^3} \qquad (1)$$

κ is the skewness,
n is the number observed values for the indicator,
x is the arithmetic mean
s is the standard deviation.

The Box-Cox transformations are a set of power transformations for skewed data, and depend on parameter λ.

$$\Phi_\lambda(x) = \frac{x^\lambda - 1}{\lambda} \qquad if\ \lambda \neq 0 \qquad (2)$$

$$\Phi_\lambda(x) = log(x) \quad if\ \lambda = 0$$

Following *Annioni* and *Kozovska* (2010) we set

$\lambda = 2$ if $\kappa \leq -1$ (left or negative skewness)
$\lambda = -0.05$ if $\kappa \geq +1$ (right or positive skewness)

3.3 The structure of the Regional Entrepreneurship and Development Index

Based on the definition of entrepreneurship we propose a six level index-building: (1) sub-indicator (2) indicators (3) variables, (4) pillars, (5) sub-indices, and, finally, (6) the super-index. The three sub-indexes of attitudes, abilities, and aspirations constitute the entrepreneurship super-index, which we call the Regional Entrepreneurship and Development Index (REDI). The sub-indexes compose the pillars. Pillars are the most important layers in the index structure because they provide the basis of the Penalty for Bottleneck (PFB) analysis and entrepreneurship policy. Each of the fourteen pillars consists of an institutional and an individual variable. The 40 indicators are the building blocks of the variables. Some institutional indicators are complex creatures by themselves adding up to 76 sub-indicators altogether. (For more details see Appendix E).

Figure 2 provides a more detailed picture of the sub-indexes, the pillars and its variables.

Figure 2. The structure of the Regional Entrepreneurship and Development Index

REGIONAL ENTREPRENEURSHIP AND DEVELOPMENT INDEX														
Entrepreneurial Attitudes Sub-Index					**Entrepreneurial Abilities Sub-Index**				**Entrepreneurial Aspirations Sub-Index**					
Pillars														
Opportunity Perception	**Start-up Skills**	**Risk Acceptance**	**Networking**	**Cultural Support**	**Opportunity Startup**	**Technology Adoption**	**Human Capital**	**Competition**	**Product Innovation**	**Process Innovation**	**High Growth**	**Globalization**	**Financing**	
Variables														
Opportunity Recognition	***Skill Perception***	***Risk Acceptance***	***Know Entrepreneurs***	***Career Status***	***Opportunity Motivation***	***Technology Level***	***Educational Level***	***Competitors***	***New Product***	***New Tech***	***Gazelle***	***Export***	***Informal Investment***	
Market Agglomeration	**Quality of Education**	**Business Risk**	**Social Capital**	**Open society**	**Business Environment**	**Absorption Capacity**	**Education and Training**	**Business Strategy**	**Technology transfer**	**Development**	**Clustering**	**Connectivity**	**Financial Institutions**	

Note: The REDI is a super-index made up of three sub-indices, 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).

While the abilities and aspiration sub-indices (outlined below) capture actual entrepreneurship abilities and aspiration as they relate to nascent and startup business activities, the entrepreneurial attitude (ATT) sub-index aims to identify the attitudes of a region's population as they relate to entrepreneurship. It consists of five pillars.

- *Opportunity Perception* is essential to recognizing and exploring novel business opportunities. It combines the individual variable of the opportunity recognition of the population with the Market agglomeration institutional variable. Market agglomeration reflects to the size of the market in a particular region including the growth of the population, the level of urbanization and the accessibility of the region.

- It is also critical to have proper startup skills to be able to exploit these opportunities. *Startup Skills* depend on the populations' self-esteem about its ability to start successfully a business (individual variable) and on the quality of education institutional variable. The Quality of education has two components. A country level indicator serves to measure the value of secondary education by the PISA test results. It is combined with a variable reflecting to the presence of the creative class in a region.

- Fear of failure can have a negative effect to start even a high potential business. The magnitude of risk acceptance of the population is the individual variable part of *Risk Perception*. On the institutional side the business disclosure rate of the country is used as a proxy of general business risk. Here we lack a proper regional variable.

- Personal networks are also vital for successful startups. The individual variable, knowing an entrepreneur personally (Know entrepreneur) is mixed together with the country level social capital and a regional level technological readiness variable to get the *Networking* pillar. While social capital proxies the human part of potential networking, the technological readiness reflects to the availability of the internet in the regions.

- *Cultural Support*, the acceptance, the encouragement and the support of successful entrepreneurs are important ingredients of attitudes. The individual variable Carrier status contains the view of the population about the carrier possibilities and the social status and respect of entrepreneurs. Open society is the institutional variable of *Cultural Support* containing a country level (Personal freedom) and a regional level indicator (Corruption). Personal freedom measures countries' performance in individual freedom and social tolerance. The persistence of corruption could easily undermine believes that clear rules and individual capabilities determine the reward structure of a region.

The entrepreneurial abilities (ABT) sub-index is principally concerned with measuring some important characteristics of the entrepreneur and the startup with high growth potential.

- An important aspect of high growth potential is the drive for startups. *Opportunity Startup* mixes together the opportunity motivation of the population (individual variable) with the favorability of the business environment (institutional variable). Business environment has a

country wide aspect as the freedom to start and operate business (Business freedom), and a regional aspect, the quality of local government (EU QoG Index).

- The sectorial composition of startups could also be a sign of potential high growth. The *Technology Adoption* pillar highlights the role of technology and creative sectors. We use the percentage of the young and nascent businesses that belong to a technology-intensive or creativity sectors (Technology level) as individual variable. The institutional variable (Absorption capacity) measures the technological readiness of the firms in a country and the regional level of employment in knowledge intensive and high technology firms.

- Most owners/managers of high growth potential businesses are educated persons. Moreover, it is also important to find such employees who have received some training to have an updated knowledge. The *Human Capital* pillar has two ingredients: the share of early phase entrepreneurs who have over secondary level of education (Educational level) is merged together with the involvement of the region's population in training and life-long learning (Education and training).

- Those businesses that face a low level of competition could grow faster than businesses with many competitors. The individual variable of *Competition* is the number of competitors, benchmarking those ventures that have not too many competitors. The institutional variable is Business strategy measuring the country's nature of competitive advantage and the regional level sophistication of the businesses. Unique products, processes and the number of employees working in sophisticated sectors serve as benchmarks.

The entrepreneurial aspiration (ASP) sub-index refers to the distinctive, qualitative, strategy-related nature of entrepreneurial activity. Entrepreneurial businesses are different from regularly managed businesses, thus it is particularly important to be able to identify the most relevant institutional and other quality-related interaction variables.

- *Product Innovation* reflects not only to the newness of the product (individual component) but also on the ability of the businesses in the region to create such products. Ultimately, the regional level institutional variable (Technology transfer) reflects to the regions' potential to patent and to create scientific publications.

- *Technology Innovation* has also two components. The individual variable (New technology) measures the technology innovation potential of the businesses. The institutional variable (Technology development) measures the financial aspect of innovation as the percentage of Research and Development in the regional gross domestic product (GERD).

- The *High Growth* pillar includes the percentage of gazelles as businesses with high growth ambitions (Gazelle) and a clustering institutional variable. Clustering takes into account that businesses are supported by other cluster members contributing to counterbalance missing individual resources and to get further support for high growth.

- A frequently noticed characteristic of high growth potential businesses is their capability to internationalize. The *Globalization* pillar combines together the export potential, as measured by the percentage of the businesses that have foreign customers, and the connectivity of the region. Connectivity reflects to the density of railways, highways and the frequency of air flight in a region.

- The financing possibilities of the businesses are frequently viewed as the most important aspect of exploiting high growth potential. The individual variable of the *Financing* pillar is a measure of informal financing possibilities provided by friends, relatives or business angels. The country level institutional variable the Depth of capital market is a complex variable by itself measuring the access to different capital and depth markets. Here we have a regional institutional variable about the concentration of financial services.

3.4 The creation of the Regional Entrepreneurship and Development Index

Index construction is a difficult task with many potential possibilities of calculation. Previously we have provided a description of the individual and institutional indicators and sub-indicators. We calculated the variables from the indicators. Most of the times we averaged the proper indicator values to get the particular variable. Many times – ten out of the fourteen individual variables – indicators were used as variables (See Appendices A and B for each case). An important novelty of the REDI index building approach is that we consider the institutional variables as interaction variables, not as independent factors.

The interaction variable approach is used in regression analysis, where two independent variables are multiplied by each other to demonstrate their combined effect on the dependent variable (*Acs –Varga*, 2005). We calculated all pillars from the variables using the interaction variable method; that is, by multiplying the individual variable with the proper country level and regional institutional variable. Institutional variables can also be viewed as country specific weights of the GEM based individual variables.

In this section we describe the way of calculation of the REDI scores for each of the 125 European Union regions following the suggestions of the OECD's *Handbook on constructing composite indicators* (*Giovannini et al*., 2008).

3.4.1 Treating the outliers: Capping

All index building is based on a benchmarking principle. The selection of the proper benchmarking considerably influences the index points and also the rank of the countries. However, the existence of outliers could lead to set up inappropriate benchmarks. Hence, we need to handle extreme value outliers. There are several outlier adjustment methods exist. For example *Tarabusi* and *Palazzi* (2004) suggested the metric homogeneity improvement as taking the decimal logarithm of the data to decreases the differences between the extreme values and the other data points. Another method is categorization. While categorization solves the outlier problem it does not seem to be proper tool because decreases the relative differences amongst the countries significantly.

Capping is also frequently used to handle outliers. The question relates to the value of the cap. The Environmental Sustainability Index uses the 97.5 percentile adjustment. In addition they make an additional 2.5 percentile adjustment in the bottom (*Giovannini et al*., 2008). *In our case we selected the 95 percentile score to adjust all of the fourteen pillars. It means that any observed pillar values higher than the 95 percentile is lowered to the 95 percentile.* It also means that at least six different regions have reached the maximum value in all of the 14 pillars. Hence, the best value is not a result of an extraordinarily effort of one or a few regions but a reachable benchmark for other regions too.

Table 2. The value of skewness of the original, the capped pillars, and the capped and average equalized pillars

Pillar	Skewness of the original pillars	Skewness of the capped pillars	Skewness of the capped and average equalized pillars
Opportunity perception	1.19	1.10	0.72
Startup skills	1.25	0.58	0.43
Risk perception	0.20	0.19	0.31
Networking	0.87	0.82	0.53
Cultural support	-0.17	-0.28	-0.23
Opportunity startup	-0.10	-0.21	0.06
Technology Adoption	0.54	0.15	0.12
Human Capital	1.03	0.33	0.37
Competition	0.73	0.27	0.35
Product innovation	-0.07	-0.33	0.12
Process innovation	0.71	0.30	0.54
High growth	1.14	0.34	0.14
Globalization	0.24	0.16	0.37
Financing	2.11	0.79	0.15

According to *Table 2*, the skewness of the original data pillars exceed the value 1 in five cases: Opportunity Perception, Startup Skills, Human Capital, and High Growth. After applying the capping, the skewness decreased in all cases. It seems to be that the distribution is problematic only in one pillar that is Opportunity Perception. In addition, we made another adjustment before aggregating the pillars that was the equalization of the average pillar values. We describe this technique in the following part of the report, but present the skewness values in *Table 2* All pillar skewness values are within the critical [-1,1] range.

3.4.2 Normalizing the pillars

Like other composite index components, our pillars are in different magnitudes. In order to be in exactly the same range, the normalization of the pillars is necessary. There are several available normalization methods. The most commonly used z-score, a mean of 0 and variance of 1 cannot be applied because our newly developed PFB method requires all pillars to be in the same range. A popular version is the Min-Max normalization technique, which arranges the data within an identical [0,1] range (*Acs – Szerb*, 2011). This approach has the disadvantage of increasing the differences, even if real deviations are minimal. This is the reason why we have turned to the distance normalization technique that preserves the distance (relative differences) amongst the regions.

$$x_{i,j} = \frac{z_{i,j}}{\max z_{i,j}} \qquad (3)$$

for all j= 1,..m, m=14 is the number of pillars
where $x_{i,j}$ is the normalized score value for region i and pillar j
$z_{i,j}$ is the original pillar value for region i and pillar j
$\max_i z_{i,j}$ is the maximum value for pillar j

Applying the distance methodology the pillar values are all in the range [0,1], however the lowest pillar value is not necessary equal to 0. In this case all regions' efforts are evaluated in relation to the benchmarking region but the worst region is not set to zero per se.

3.4.3 Harmonization of the pillars: Equalize pillar averages

The different averages of the normalized values of the 14 pillars imply that reaching the same performance requires different effort and consequently resources. Higher average values - e.g. *Opportunity startup* – could mean that it is easier to reach better scores as compared to lower average value – e.g. *Financing*. Since we want to apply REDI for public policy purposes, the additional resources for the same marginal improvement of the pillar values should be the same for all of the 14 pillars, on the average. So improving by 0.1 unit *Opportunity startup* should require the same additional resource as compared to all the other 13 pillars. As a consequence, we need a transformation to equate the average values of the 14 pillars.

Practically we have calculated the average values of the 14 pillars after the *capping* adjustment and the normalization and made the following average adjustment:

Let's x_i to be the normalized score for region *i* for a particular pillar j.

The arithmetic average of pillar j for number *n* regions is:

$$\bar{x}_j = \frac{\sum_{i=1}^{n} x_{i,j}}{n} \qquad for\ all\ j \qquad (4)$$

We want to transform the $x_{i,j}$ values such that the potential values to be in the [0,1] range.

$$y_{i,j} = x_{i,j}^{k} \qquad (5)$$

where k is the "strength of adjustment", the k^{th} moment of X_j is exactly the needed average, $\bar{y}_j$. We have to find the root of the following equation for k:

$$\sum_{i=1}^{n} x_{i,j}^{k} - n\bar{y}_j = 0 \qquad (6)$$

It is easy to see based on previous conditions and derivatives that the function is decreasing and convex which means it can be quickly solved using the well-known Newton – Raphson method with an initial guess of 0. After obtaining *k*, the computations are straightforward. Note that if

$$\bar{x}_j < \bar{y}_j \quad k < 1$$
$$\bar{x}_j = \bar{y}_j \quad k = 1$$
$$\bar{x}_j > \bar{y}_j \quad k > 1$$

that is k be thought of as the strength (and direction) of adjustment.

This technique have resulted the decrease of the over the average value pillars and the increase of the below the average pillars while keeping the maximum value at 1. *Table 3* provides information about the average pillar values before and after the adjustment.

Table 3. Average pillar values before and after the average equalization

Pillar	Pillar averages	Equalized Pillar Averages
Opportunity perception	0.38	0.51
Startup skills	0.48	0.51
Risk perception	0.55	0.51
Networking	0.43	0.51
Cultural support	0.52	0.51
Opportunity startup	0.57	0.51
Technology adoption	0.50	0.51
Human capital	0.53	0.51
Competition	0.55	0.51
Product innovation	0.63	0.51
Process innovation	0.59	0.51
High growth	0.44	0.51
Globalization	0.61	0.51
Financing	0.38	0.51
Average	**0.51**	**0.51**

While the average of the fourteen pillars is 0.51, it ranges from 0.38 (*Opportunity Perception* and *Financing*) to 0.63 (*Process Innovation*). It implies that the increase of the REDI scores by, let us say, 10 requires the raise of *Financing* by approximately 1.66 times more as compared to raise the *Process Innovation*. After applying the average equalization adjustment technique the percentage increase of these two pillars are the same implying a one-to-one substitution of the pillars on the average. A further consequence of the adjustment that below average value pillars need *smaller increase* of the original pillar value to reach the same increase in the REDI points as compared to over the average pillars. For example, only 0.75 (0.38/0,51) times of the average equalized value of *Financing* needs to increase the REDI point by 10, on the average. At the same times, about 1.24 (0,63/0,51) times of the average equalized value of *Process Innovation* is required for the same 10 point increase.

3.4.4 The penalty for bottleneck methodology

We have defined entrepreneurship as the dynamic interaction of entrepreneurial attitudes, abilities, and aspiration across different levels of development. One issue this definition raises is how to bring system perspective dynamism into the model. Configuration theory provides a useful way of thinking about this issue (*Miller*, 1987, 1996). Configurations are defined as "represent[ing] a number of specific and separate attributes which are meaningful collectively rather than individually. Configurations are finite in number and represent a unique, tightly integrated, and therefore relatively long-lived set of dynamics." (*Dess et al.*, 1993, pp. 775-776.)

Two closely related theories, the Theory of Weakest Link (TWL) and the Theory of Constraints (TOC), provide us another way to view the interrelationship of the elements. These theories argue that the performance of the system depends on the element that has the lowest value in the structure. According to the TOC, improvement can only be achieved by removing the weakest link, which constrains the performance of the whole system (*Goldratt*, 1994). The TWL claims that there is no perfect substitution among the elements of the system, only a partial one *Tol* and *Yohe* (2006), *Yohe*

and *Tol* (2001). Whereas both principles are mainly applied in the production process and operation management, a few are applied in the humanities.[6] According to the popular Six Sigma management theory, the production process can be improved by removing the causes of mistakes (weakest link) and reducing variation in the system (*Nave*, 2002, *Stamatis*, 2004). The notion of constraints is also present in the institutional literature, implying that economic development or growth depends on improving the binding institutional barriers *North* (1990), *Rodrik* (2008).

The weakest link postulate in entrepreneurship is also present. According to Lazear, entrepreneurs perform many tasks and therefore must be generalists—"jacks-of-all-trades." (*Lazear*, 2004). Lazear claims that the performance of a venture depends on the entrepreneur's weakest skills, therefore, developing a business can be achieved by improving the entrepreneur's worst skill. We argue that the generalist perspective can be applied not only to entrepreneurial traits but to other aspects of business and entrepreneurship.

A practical application of the TWL and TOC theories is the penalty for bottleneck methodology. A bottleneck is defined as the worst performing link or a binding constraint in the system. With respect to entrepreneurship, bottleneck means a shortage or the lowest level of a particular entrepreneurial pillar, relative to other pillars. This notion of a bottleneck is important for policy purposes. Our model suggests that pillars interact; if they are out of balance, entrepreneurship is inhibited. The pillar values should be adjusted in a way that takes into account this notion of balance. After normalizing the scores of all the pillars, and equalizing the averages of the pillars, the value of each pillar of a region is penalized by linking it to the score of the pillar with the weakest performance in that region. This simulates the notion of a bottleneck; if the weakest pillar were improved, the whole REDI would show a significant improvement. Moreover, the penalty should be higher if differences are higher. From the perspective of either the configuration or the weakest link, it implies that stable and efficient configurations are those that are balanced (have about the same level) in all pillars.

Following *Tarabusi* and *Palazzi* (2004) and *Szerb et al.* (2011) we use the following penalty function:[7]

$$h_{(i),j} = min\, y_{(i),j} + (1 - e^{-(y_{(i)j} - miny_{(i),j})}) \qquad (7)$$

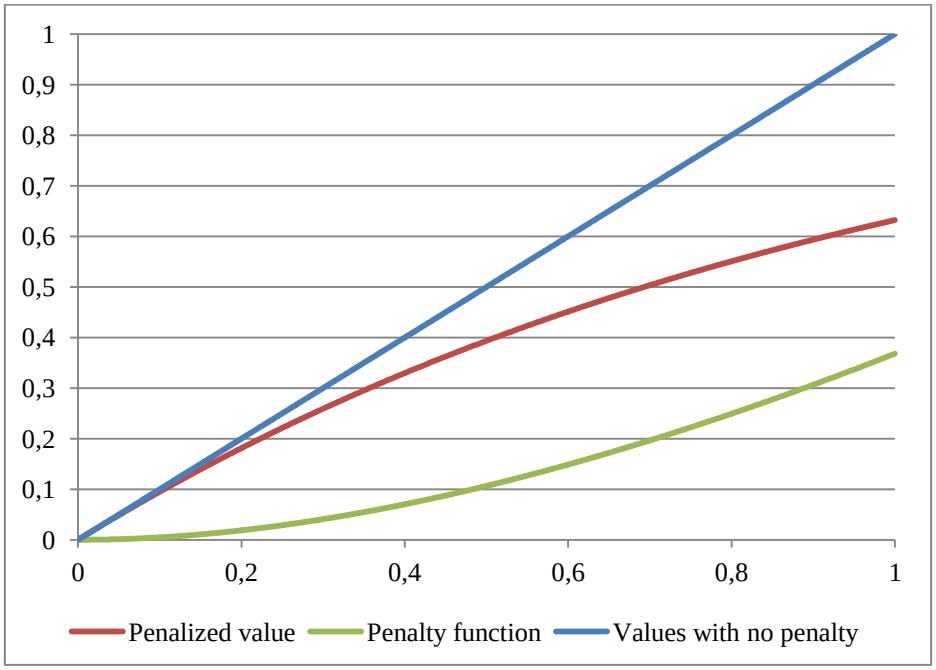
where $h_{i,j}$ is the modified, post-penalty value of pillar j in region i
$y_{i,j}$ is the normalized value of index component j in region i
y_{min} is the lowest value of $y_{i,j}$ for region i.
i = 1, 2,……n = the number of regions
j= 1, 2,…. ..m= the number of pillars

A note that there is no objective criterion exists about the selection of the size or the calibration of the penalty. An intermediate solution seems to be useful for our purposes. It is shown in *Figure 3*.

[6] In a public choice paper, *Harrison – Hirshleifer* (1989) present a model where the individual social composition function is constructed by taking into account the weakest link. The financial system can also be described by the weakest link postulate (*Rajan – Bird*, 2001).

[7] For a more detailed description about the selection method and the properties of the penalty function see Appendix E.

Figure 3. The penalty function, the penalized values and the pillar values with no penalty (y_{min} =0)



In this case the maximum penalty is 0.368. This maximum penalty that is around a third loss of the original value looks reasonable. Larger penalty values rearrange the ranking of the regions considerably by closing the REDI values to the minimum value pillar of that region. It is much more important to include the concept of penalization in the index building than the size of the penalty itself.

We suggest that this dynamic index construction is particularly useful for enhancing entrepreneurship in a particular region. Although one could argue that entrepreneurship is a horizontal policy concept with relevance across a number of traditional policy domains (e.g., trade policy, regulatory policy, fiscal policy), the application of the dynamic index construction would allow measurement of the effectiveness of different policy steps toward entrepreneurship. This method could rearrange the ranking of the countries for a particular feature. The level of the rearrangement would depend on the relative position of a region in terms of how its bottlenecks compare to the bottlenecks of the others. If every country has similar differences in terms of the features, then the ranking does not change much; if one country is much less balanced than the others, then a lower rank for that particular country can be expected. The policy message is that a weak performance on a particular feature, such as a bottleneck, should be handled first because it has the most negative effect on all the other features.

There are two potential drawbacks to the PFB method. One is the arbitrary selection of the magnitude of the penalty. There is no research that can determine how big the penalty should be, which is why we applied a conservative estimate. Comparing the correlation between the GDP per capita and the REDI, calculated as the simple average of the indicators (r = 0.89) and the PFB methodology (r = 0.89), provides about the same correlation coefficient, with no statistically significant differences. The other problem is that we cannot fully exclude the possibility that a particularly good feature can have a positive effect on the weaker performing features. While this could happen, most of the entrepreneurship policy experts hold that policy should focus on improving the weakest link in the system. Overall, then, we claim that the PFB methodology is theoretically better than the arithmetic

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

3.4.5 Aggregation

The pillars are the basic building blocks of the sub-indices: The entrepreneurial attitudes (ATT), the entrepreneurial abilities (ABT), and the entrepreneurial aspirations (ASP). The value of a sub-index for any region is the arithmetic average of its PFB-adjusted pillars for that sub-index multiplied by a 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 region in a particular sub-index.

$$ATT_i = 100 \sum_{j=1}^{5} h_j \quad (8a)$$

$$ABT_i = 100 \sum_{j=6}^{10} h_j \quad (8b)$$

$$ASP_i = 100 \sum_{j=11}^{14} h_j \quad (8c)$$

where $h_{i,j}$ is the modified, post-penalty value of pillar j in region i
i = 1, 2,……n = the number of regions
j= 1, 2,…..14= the number of pillars

The super-index, the Regional Entrepreneurship and Development Index, is simply the arithmetic average of the three sub-indices:

$$REDI_i = \frac{1}{3}(ATT_i + ABT_i + ASP_i) \quad (9)$$

where i = 1, 2,……n = the number of regions

3.4.6 The Average Bottleneck Efficiency (ABE) measure

For measuring the overall level of optimality, we developed the Average Bottleneck Efficiency (ABE) method. ABE is defined as how close a region's pillars to a region's best performing pillar score, on average. ABE is expressed in terms of percentages. Higher ABE values imply more balanced performance and therefore more efficient use of the available resources while lower ABE values mean substantial imbalances over the fourteen pillars of the REDI. An equal alternative indicator of efficiency is to calculate the Average Bottleneck Gap (ABG). ABG basically shows the percentage of the wasted resources because of the unbalance of the pillars. ABG also prevails how much additional resource, on average, is necessary to raise all thirteen pillar values to their maximum pillar value. ABG is just the opposite to ABE, higher ABG values mean less balanced and low ABG values mean more balanced performance of the fourteen pillars

Equations 10a and 10b technically describe the general form of the calculation:

$$ABG_I = \frac{100 * \sum(max_{i,j} - y_{(i),j})}{(j-1) * maxx_{i,j}} \quad (10a)$$

$$ABE_i = 100 - ABG_i \quad (10b)$$

for all j, the number of pillars

where ABG_i is the Average Bottleneck Gap for region i
where ABE_i is the Average Bottleneck Efficiency for region i

4 RESULTS AND ANALYSIS

4.1 Introduction

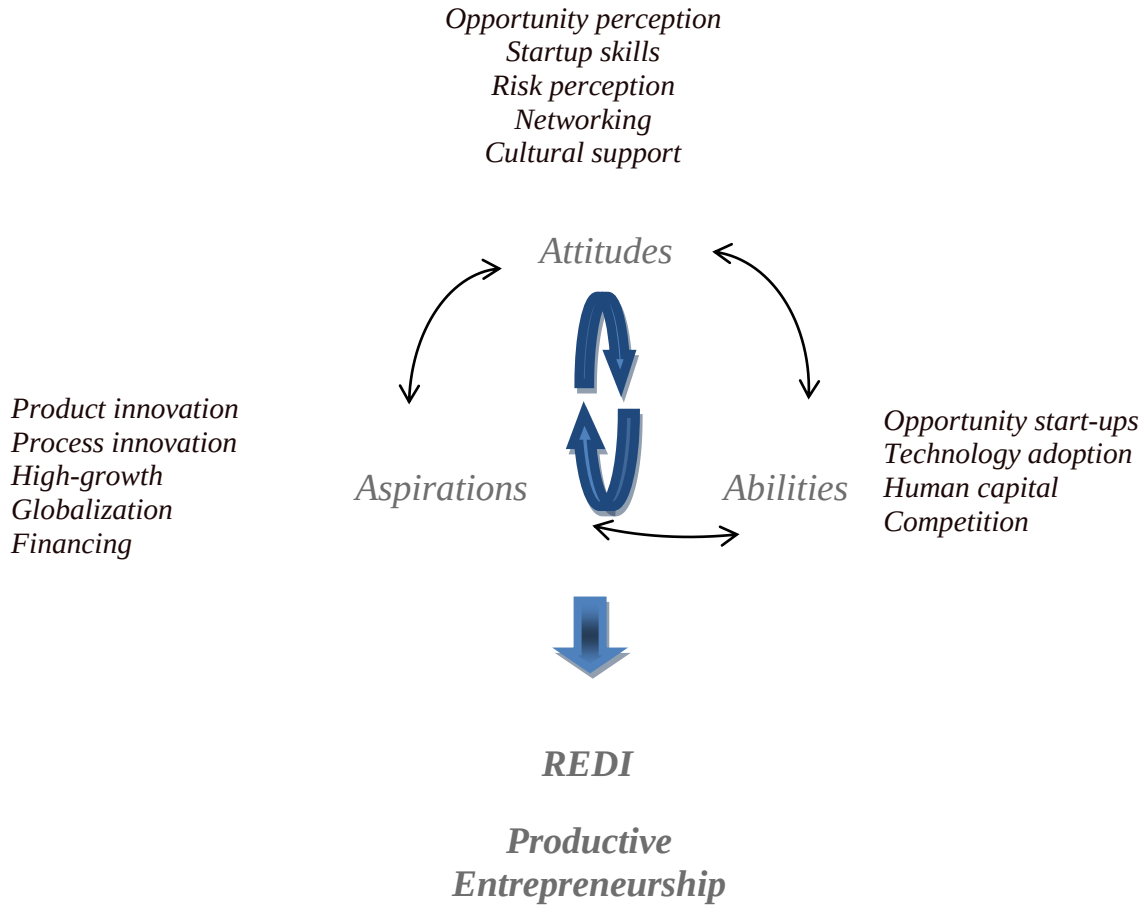
This part of the report is devoted to the interpretation and the analysis of the Regional Entrepreneurship and Development Index (REDI). As a multi-faceted index, REDI recognizes that regional level entrepreneurship is a complex phenomenon that cannot be satisfactorily captured by single-item aggregates, and it cannot be captured by focusing exclusively on attitudes, abilities, or aspirations. Nor can it be captured by considering the framework conditions alone. What is needed, therefore, is an approach that combines all of the above. REDI does this by using a total of 14 individual measures of entrepreneurial attitudes, abilities, and aspirations and by weighting them with descriptors of regional-level framework conditions.

REDI also captures system dynamics and so doing goes beyond traditional, linear-additive index approaches. Traditional indices are summative – or as we like to call them, 'cake' indices: They simply add different component values together, and as long as the sum of components is greater than some threshold value, all is considered well. This is similar to if one were advised to compensate for missing sugar by adding more flour when baking a cake. Although the total weight of ingredients is the same, everyone recognizes that it is difficult to bake a good cake without sugar.

By applying the Penalty for Bottleneck approach, the REDI index methodology captures the notion that systems, by definition, comprise multiple components; and that these components co-produce system performance. These are defining characteristics of any system and ones that simple summative indices fail to capture. In a simple summative index, each system component contributes directly and independently to system performance. In the context of entrepreneurship, this would mean that, for example, a regional measure of education would directly and independent of other system components contribute to 'regional entrepreneurship'. In reality, we know that, say, education cannot contribute much to a region's entrepreneurial performance, if individuals fail to act. On the other hand, in the absence of education, the economic potential of entrepreneurial entries would be severely constrained. Even in the presence of both education and entries into entrepreneurship, regional-level entrepreneurial performance would be constrained if, e.g., growth aspirations are missing or if there are no financial resources available to feed the growth of new ventures. A simple summative index would fail to recognize such interactions – thereby ignoring crucial aspects of system-level performance.

The system perspective is pictured in *Figure 4* where the 14 pillars of the components representing the three aspects of regional entrepreneurship, attitudes, abilities and aspirations, interact with each other resulting a Regional Entrepreneurship and Development Index. Unlike most single item entrepreneurship proxies like self-employment or business density, the REDI measures productive entrepreneurship that is major source of productivity growth and long term development.

Figure 4. Dynamic of Regional Systems of Entrepreneurship



In this chapter, after a short description of the European Union's regional classification system (NUTS), we report the rank and the REDI points of the investigated 125 European Union regions. The entrepreneurial efficiency ABE scores are also presented for all the regions. We have conducted various robustness methods to validate our results and investigate the underlying structure of the data. The main text contains the most important results while the details can be found in the appendices G-I. For example, we categorized the 125 regions into five clusters according to their REDI scores and show the outcome in a map. The robustness tests for the five cluster categorization are in Appendix H.

Section 4.4 includes a deeper analysis of the entrepreneurial performance of the regions in the sub-index and the pillar levels. Colored numbers from green to red represent the strong and the weak points of each of the 125 regions. Three figures serve to demonstrate the applicability of the REDI pillar level analysis by comparing different types of regions: One is for three leading regions, the other is for a leading a medium raking a lagging region, and finally for three German regions. Subchapter 4.5 is about the further examination of the pillar structure with various statistical tests. The correlation coefficients also reinforce the internal consistency of the REDI structure.

A novel approach of the REDI methodology is the combination of the individual and institutional components. Practically it means the multiplication of the two types of variables. Part 4.6 presents three other possible ways of the REDI score calculation: One that includes only the individual variables, the other that contains only the institutional variables and the third that incorporate the individual and institutional variables independently. The individual variables based REDI version is

analyzed in details and compared to the original REDI version in the main text. The other two versions are described in Appendix I.

A common robustness test is to examine the consequences of discarding a pillar and calculating the new index scores. We provide this type of analysis in 4.7 subchapter by demonstrating the effect on the change of ranking when we discard each of the pillars one by one. The compensability effects of the pillars are further examined with the help of the Ordered Weighted Averaging approach. We have identified 17 regions that were effected the most by the removal of the pillars. Appendix J contains the effect and the analysis of replacing two institutional variables with other ones. While the REDI scores and ranks seem to be sensitive for certain changes of the pillars and variables, the magnitude of the changes are within an acceptable range reinforcing the proper selection of the variables and the methodology.

In the final subchapter (4.8) the REDI is compared to other regional level indices including the Regional Competitiveness index, the regional Innovation Scoreboard, the Quality of Government Index, and the Regional Corruption Index. The close relationship and the high positive correlation between the REDI and these regional indices is not a surprise since REDI contains several institutional indicators derived from these indices. Albeit from different perspective, but all of these indices intend to explain regional development.

4.2 NUTS – Nomenclature of Territorial Units for Statistics

The *Nomenclature of Territorial Units for Statistics* (hereinafter referred to as *NUTS*) was developed at the beginning of the 1970s by the Statistical Office of the European Communities (Eurostat) in close collaboration with the national statistical institutes of the EU Member States.

The NUTS system can be regarded as a *geocode standard* for dividing up the whole territory of the European Union. Currently it is defined only for the 27 Member States of EU. However, Eurostat has proposed a similar hierarchical classification for countries belong to the European Economic Area (EEA), Switzerland and the new candidate countries as well.

The main objective of the NUTS system is to ensure a uniform statistical classification of the territorial units of the EU Member States in order to collect, compile and disseminate comparable, harmonized regional statistics primarily for conducting socio-economic analyses. A decisive role of the NUTS system is to minimize the impact of fortuitous changes in the national administrative structures of different EU countries. However, the NUTS classification has been changed several times starting from 1981 to reflect the administrative changes of the Member States. All Member States' spatial statistics has been delivered to the European Commission should use the NUTS classification.

Furthermore, the hierarchical system of the NUTS nomenclature was developed for framing EU regional policies and it has a direct role of appraising eligibility for financial support from the EU Structural Fund.

Two criteria are used in subdividing the territory of the Member States into spatial units:

"*normative regions* are the expression of political will; their limits are fixed according to the tasks allocated to the territorial communities, according to the sizes of population necessary to carry out these tasks efficiently and economically, and according to historical, cultural and other factors;

analytical (or functional) regions are defined according to analytical requirements; they group together zones using geographical criteria (e.g. altitude or type of soil) or using socio-economic criteria (e.g. homogeneity, complementarities, or polarity of regional economies)." [*Regions in the EU* 2011, p. 5]

The NUTS classification is based on the institutional (normative) division of the territory of the EU Member States.

According to the NUTS nomenclature each Member State is divided into NUTS level 1 territorial units, each of which is subdivided into NUTS level 2 territorial units. While NUTS 2 spatial units are made up from NUTS level 3 spatial units. The NUTS classification determines the following minimum and maximum limits for population size of the regional units. The thresholds refer to average population size, which based on the number of those persons who have their usual place of residence in this area (*Table 4*).

Administrative units of the EU Member States, which offer legal and institutional framework for a given geographical areas, indicate the first criterion used for the definition of NUTS territorial units.

Table 4. The characteristics of three NUTS level regions

Level	Characteristics	Minimum population	Maximum population
NUTS 1	Major socio-economic regions.	3 million	7 million
NUTS 2	Basic regions for the application of regional policies.	800 000	3 million
NUTS 3	Small regions for specific diagnoses.	150 000	800 000

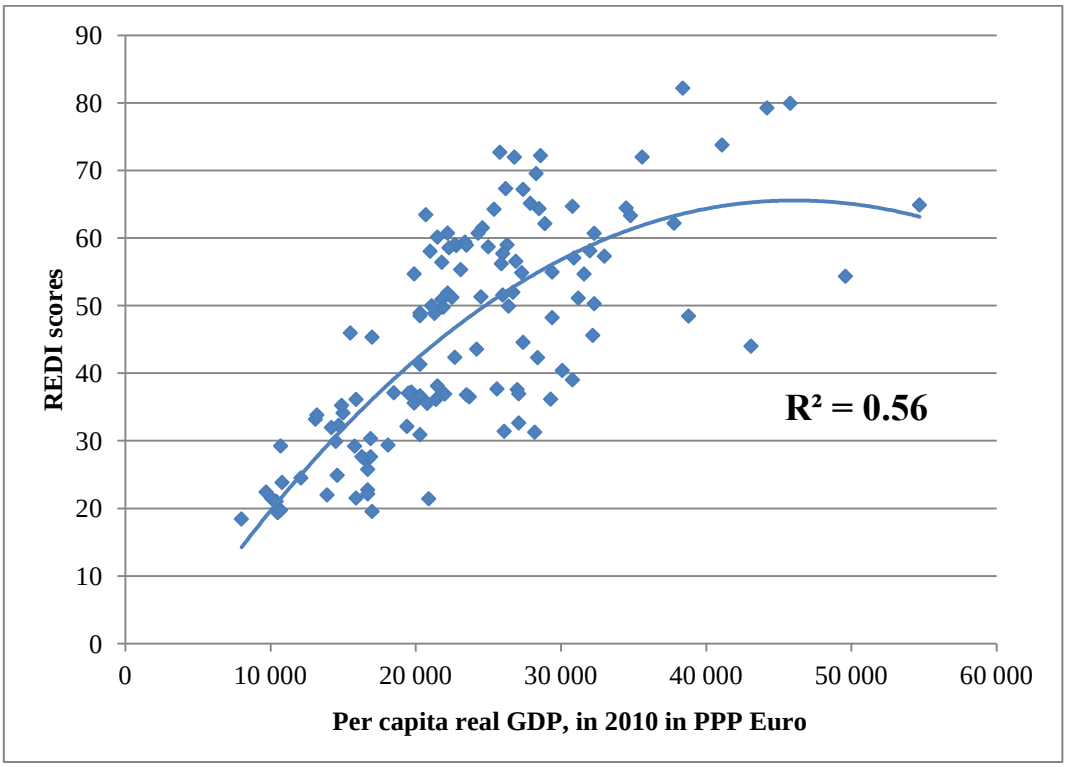
Source: Regions in the EU 2011

From 2000 the Commission Regulation (EC) No 1059/2003 ensures legal status for the NUTS. This was entered into force in July 2003. The regulation can guarantee stability of the classification for at least three years. The current NUTS classification is valid from 1 January 2012 until 31 December 2014. It contains 97 regions at NUTS 1, 270 regions at NUTS 2 and 1294 regions at NUTS 3 level.

4.3 The REDI and ABE scores and rankings

According to the REDI methodology described in section Part 3, we have calculated the REDI scores for each of the 24 countries' 125 regions. Since REDI claims to measure the role of entrepreneurship in economic development, it is worth examining the connection between the REDI scores and economic development, measured by the per capita GDP (*Figure 5*).

Figure 5. The connection between REDI scores and economic development



Notes: Third degree of polynomial adjustment. Number of observations=125

According to *Figure 5*, there is a close connection between entrepreneurship, measured by REDI and regional development, measured by the per capita GDP. The REDI scores can vary from zero to the hypothetically maximum of 100. In our case, REDI scores range from the 18.4 to 82.2 showing that even the best European region is almost 18 points from the potential maximum level. The third degree polynomial adjustment explains 56 percent of the variations between entrepreneurship and economic development. The associated Pearson's correlation coefficient is 0.70, showing moderately strong connection between the REDI and the per capita GDP. Viewing *Figure 5*, REDI scores increase sharply at the lower level of development until about €25 000 per capita GDP; then it is increasing at a decreasing rate and leveling at around €40 000 per capita GDP. Richer and developed country's regions, mainly in North-Western Europe – Belgium, Denmark, France, Germany, Ireland, the Netherlands, Sweden, UK – are generally ahead of the lower developed South European regions of Greece, Italy, Portugal and Spain. In fact, Greek regions are in the bottom of ranking reflecting not only macroeconomic instability but well below average entrepreneurship. Central and Eastern member states regions show a mixed picture: More developed regions like Zahodna Slovenija Estonia, Vzhodna Slovenija, and Bratislavsky kraj are in the middle of ranking. Polish, Slovakian, Croatian, Hungarian and Romanian regions can be found at the bottom of ranking.

Figure 6 shows the map of the REDI scores in five categories, from the best to the worst, for the mix of 125 NUTS-1 and NUTS-2 regions. Moreover, *Table 5* contains the REDI scores, the rank, and the ABE scores for the 125 regions from the most entrepreneurial to the least entrepreneurial.

Figure 6. The map of REDI scores in five cluster categories in 125 European Union regions, 2013

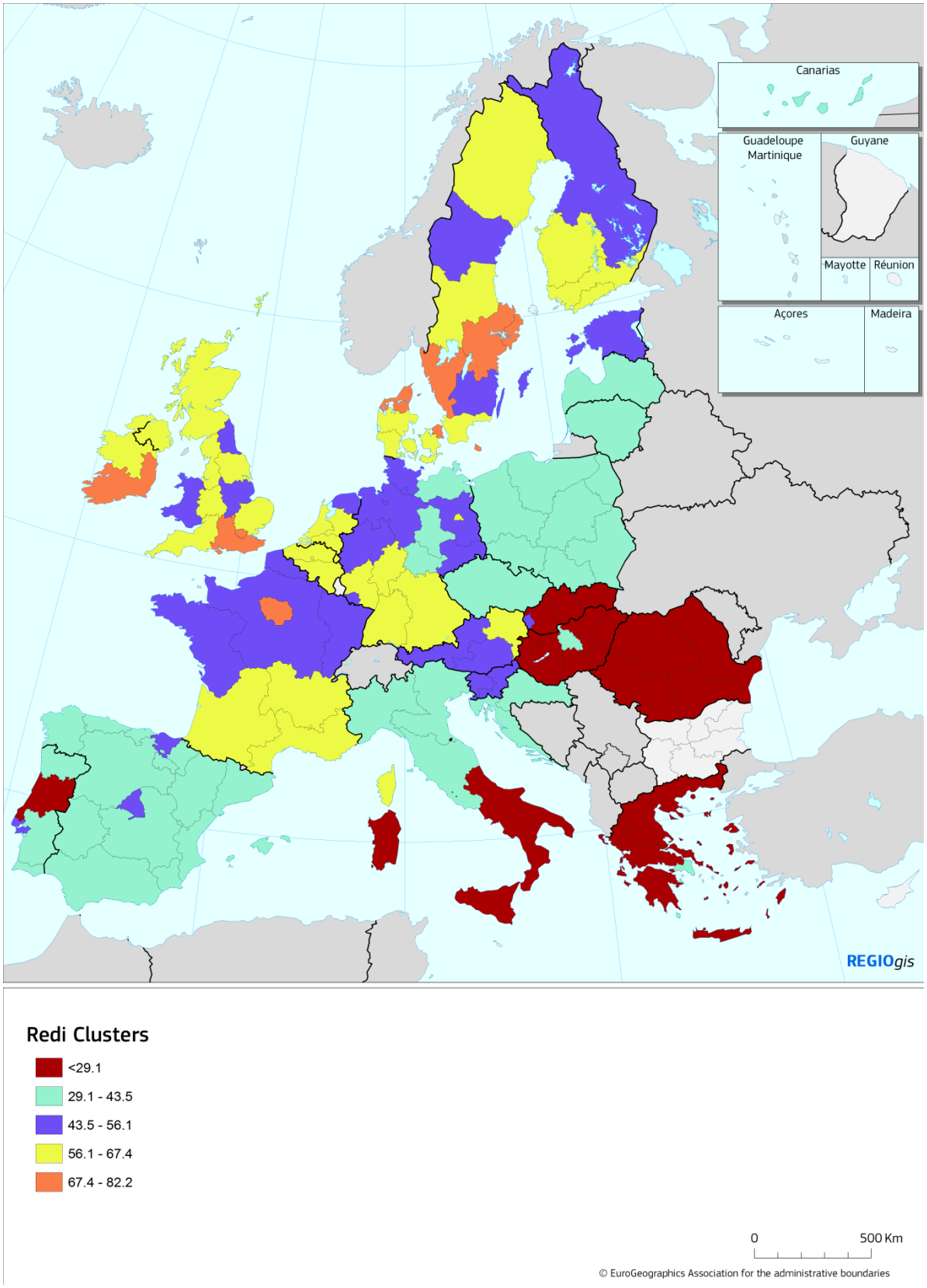


Table 5. The REDI ranking, REDI scores, and the ABE scores of the 125 European Union regions

Rank	Code	Region	REDI	ABE	Rank	Code	Region	REDI	ABE	Rank	Code	Region	REDI	ABE
1	DK01	Hovedstaden	82.2	90.2	42	UKF	East Midlands (UK)	55.3	64.8	83	ES41	Castilla y León	36.8	66.4
2	UKI	London	79.9	85.3	43	DEA	Nordrhein-Westfalen	55.0	69.8	84	ES62	Región de Murcia	36.7	64.0
3	FR1	Île de France	79.2	84.5	44	DEC	Saarland	54.9	69.4	85	ES13	Cantabria	36.5	55.0
4	SE11	Stockholm	73.8	84.4	45-46	UKL	Wales	54.7	64.2	86-88	ITH	Nord-Est	36.1	65.2
5	SE12	Östra Mellansverige	72.7	78.3	45-46	ES30	Comunidad de Madrid	54.7	64.8	86-88	PL5	Region Poludniowo-Zachodni	36.1	54.7
6	SE23	Vastsverige	72.2	78.3	47	DE6	Hamburg	54.3	69.6	86-88	PL1	Region Centralny	36.1	53.4
7-8	IE02	Southern and Eastern	72.0	78.1	48	AT2	Südösterreich	52.0	61.5	89	DE8	Mecklenburg-Vorpommern	35.6	61.9
7-8	DK05	Nordjylland	72.0	83.1	49	FR5	Ouest (FR)	51.8	70.4	90	ES70	Canarias (ES)	35.5	62.6
9	UKJ	South East (UK)	69.5	76.9	50	DE9	Niedersachsen	51.6	70.3	91	LT	Lithuania	35.2	47.9
10	SE22	Sydsverige	67.3	78.2	51	SI02	Zahodna Slovenija	51.3	68.6	92	PL2	Region Poludniowy	34.1	59.6
11	DE3	Berlin	67.2	77.3	52	FI1D	Pohjois- ja Ita-Suomi	51.2	66.7	93	LV	Latvia	33.8	51.3
12	DK03	Syddanmark	65.1	76.4	53	NL1	Noord-Nederland	51.1	62.0	94	PL6	Region Pólnocny	33.2	64.2
13	BE1	Région de Bruxelles-Capitale	64.9	77.2	54	FR2	Bassin Parisien	50.9	67.0	95	ES24	Aragón	32.6	55.9
14	SE33	Övre Norrland	64.7	75.4	55	AT3	Westösterreich	50.3	61.7	96	PL4	Region Pólnocno-Zachodni	32.3	62.1
15	NL3	West-Nederland	64.4	79.3	56	DED	Sachsen	50.0	72.1	97	ES42	Castilla-la Mancha	32.1	58.3
16	DK04	Midtjylland	64.3	78.8	57	SE21	Smaland med öarna	49.9	62.3	98	HR03	Jadranska Hrvatska (Adriatic Croatia)	32.0	53.0
17	FR7	Centre-Est (FR)	64.2	74.6	58	FR4	Est (FR)	49.7	70.3	99	HU10	Közép-Magyarország	31.4	50.2
18	IE01	Border. Midland and Western	63.4	74.1	59	UKC	North East (UK)	48.9	64.4	100	EL3	Attiki	31.3	63.7
19	DE7	Hessen	63.3	73.1	60	FR3	Nord - Pas-de-Calais	48.8	64.7	101	PT15	Algarve	30.9	46.6
20	FI1B	Helsinki-Uusimaa	62.2	75.3	61	DE4	Brandenburg	48.5	68.4	102	ES43	Extremadura	30.3	56.2
21	BE2	Vlaams Gewest	62.1	76.2	62	DE5	Bremen	48.4	67.5	103	HR04	Kontinentalna Hrvatska (Continental Croatia)	29.9	51.1
22	UKH	East of England	61.5	71.4	63	SE32	Mellersta Norrland	48.2	68.5	104	PT18	Alentejo	29.4	46.4
23-25	DK02	Sjalland	60.7	79.5	64	EE	Estonia	45.9	64.5	105-106	PL3	Region Wschodni	29.2	46.8
23-25	UKK	South West (UK)	60.7	68.7	65	ES21	País Vasco	45.6	57.3	105-106	PT11	Norte	29.2	55.3
23-25	AT1	Ostösterreich	60.7	70.4	66	SI01	Vzhodna Slovenija	45.3	78.9	107-108	PT16	Centro (PT)	27.6	45.5
26	BE3	Région wallonne	60.1	69.9	67	PT17	Lisboa	44.6	69.4	107-108	ITG	Isole	27.6	57.5
27	FR8	Méditerranée	59.4	67.0	68	SK01	Bratislavsky kraj	44.0	64.3	109	ITF	Sud	27.3	55.6

Rank	Code	Region	REDI	ABE
28-29	UKD	North West (UK)	59.0	69.4
28-29	UKM	Scotland	59.0	69.2
30-31	FI1C	Etelä-Suomi	58.9	73.0
30-31	FR6	Sud-Ouest (FR)	58.9	69.4
32	FI19	Länsi-Suomi	58.7	74.9
33	UKG	West Midlands (UK)	58.6	67.3
34	DE1	Baden-Württemberg	58.1	77.4
35	UKN	Northern Ireland (UK)	58.0	70.5
36	SE31	Norra Mellansverige	57.7	69.0
37	DE2	Bayern	57.3	75.8
38	NL4	Zuid-Nederland	57.0	70.8
39	NL2	Oost-Nederland	56.5	72.0
40	UKE	Yorkshire and The Humber	56.4	65.9
41	DEB	Rheinland-Pfalz	56.2	70.1

Rank	Code	Region	REDI	ABE
69	DEF	Schleswig-Holstein	43.6	63.0
70-72	ES12	Principado de Asturias	42.3	63.2
70-72	ES51	Cataluna	42.3	70.4
70-72	DEE	Sachsen-Anhalt	41.3	61.7
73	ITC	Nord-Ovest	40.4	72.0
74	ES22	Comunidad Foral de Navarra	39.0	49.5
75	ES52	Comunidad Valenciana	38.1	67.1
76	ES53	Illes Balears	37.7	56.6
77	ES23	La Rioja	37.6	56.0
78	DEG	Thüringen	37.2	61.5
79	ES61	Andalucía	37.1	68.0
80	CZ	Czech Republic	37.0	49.1
81-82	ITI	Centro (IT)	36.9	57.5
81-82	ES11	Galicia	36.9	61.8

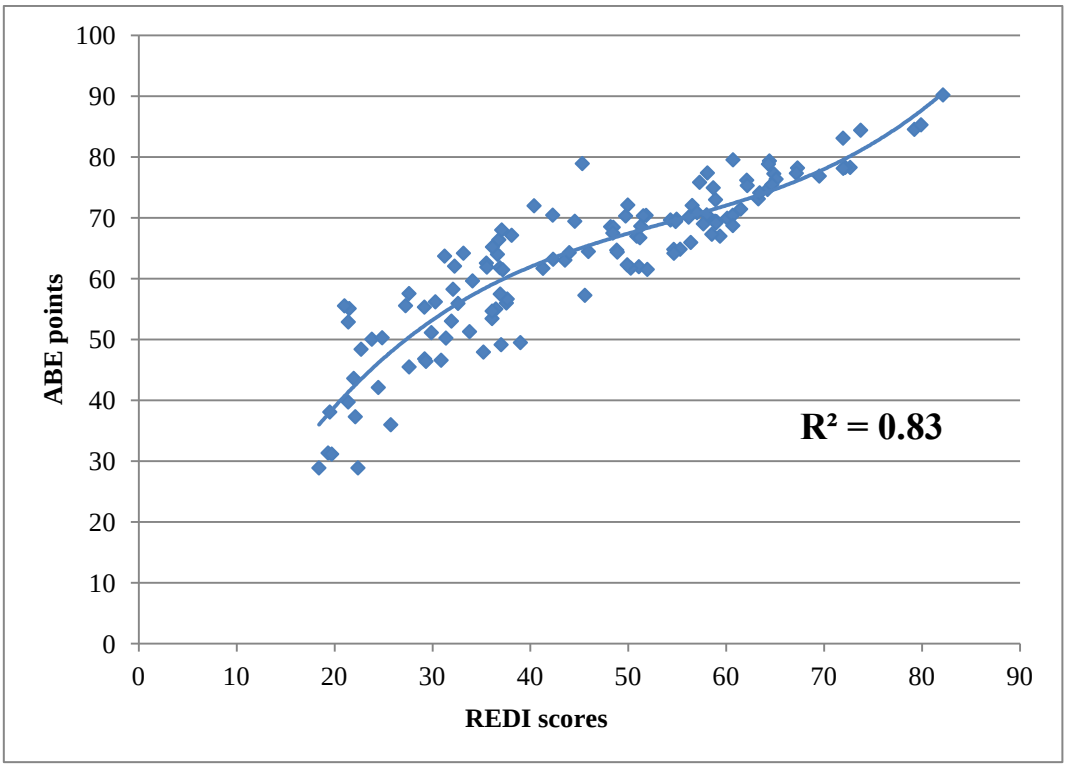
Rank	Code	Region	REDI	ABE
110	SK02	Západné Slovensko	25.8	36.0
111	SK03	Stredné Slovensko	24.9	50.3
112	SK04	Vychodné Slovensko	24.5	42.1
113	HU23	Dél-Dunántúl	23.8	50.0
114	EL1	Voreia Ellada	22.7	48.4
115	HU31	Észak-Magyarország	22.4	28.9
116	RO3	Macroregiunea trei	22.1	37.3
117	HU21	Közép-Dunántúl	22.0	43.6
118	HU22	Nyugat-Dunántúl	21.5	55.1
119-120	HU32	Észak-Alföld	21.4	52.9
119-120	EL4	Nisia Aigaiou. Kriti	21.4	39.7
121	HU33	Dél-Alföld	21.0	55.5
122	RO4	Macroregiunea patru	19.7	31.2
123	EL2	Kentriki Ellada	19.5	38.1
124-125	RO1	Macroregiunea unu	19.4	31.3
124-125	RO2	Macroregiunea doi	18.4	28.9

Table 5 shows the rank and the REDI points of the 125 regions from the lowest to the highest. As expected, the variations in entrepreneurship over the 125 regions are substantial, over four-fold between the 1st Hovedstaden and the 125th Romanian Macroregiunea doi. It means that Hovedstaden has reached 82.2 points out of the maximum reachable 100 points. At the same time, Macroregiunea doi has achieved only 18.4 points. In the first ten regions, four Swedish, two Danish, two United Kingdom, one French, and one Irish region can be found. According to our calculation, the Danish Hovedstaden, with Copenhagen in the center, is found to be the most entrepreneurial region in the European Union. The EUs two mostly agglomerated regions, London and Íle de France rank 2nd and 3rd, respectively. Larger, more developed city regions with higher per capita GDP generally rank ahead of lower developed regions in the same countries. Most of the times capital cities, that are generally the largest and the most developed, lead the country rank. There are two exceptions: The best Dutch region is West Netherland with Amsterdam, and the Milan centered Nord-Ovest region is leading in Italy. Two Polish regions, Region Poludniowo-Zachodni and Region Centraly including Warsaw have exactly the same REDI points, 36.1.

We conducted a K-means cluster analysis taking into account only the REDI score values. For our purposes the five group version proved to be the best. According to the ANOVA test, the differences between any two of the REDI groups are smaller than within the groups, at p=0.001 level. A more detailed robustness analysis about the selection of the five clusters can be found in Appendix H. *Figure 6* shows the cluster membership of all the 125 regions. Nine regions from 82.2 to 69.5 REDI points belong to the best cohort. These are mainly Nordic country regions. 32 regions, from the 10th to the 41st place, constitute the second group of regions. Their REDI scores range from 67.3 to 56.2. Besides the remaining of the Nordic country regions, United Kingdom, Belgian, Dutch and some French as well as the best German regions can be found here. The following 28 regions the UK East Midlands (55.3 REDI points, 42nd place) to the German Schleswig-Holstein (43.6 REDI points, 69th place) form the third group. Most Austrian, German and French regions form this cluster together with the best Central- and South European regions. The most populous is the fourth group with 37 regions ranging from the 70-72nd place to the 105-106th place. Their REDI scores are much lower, 42.3-29.2 REDI scores. Mainly former East German, Spanish, Italian, Polish and Croatian regions make up this cluster. The last group of regions is mainly from Greece, Hungary, Portugal Slovakia and Romani together with two Italian regions. They occupy the 107-125th places with 27.6-18.4 REDI scores..

The Average Bottleneck Efficiency (ABE) measure reflects to the use of available resources. High ABE score mean that a particular region uses its available resource efficiently. It also implies that the fourteen pillars of the REDI are very close to each other without significant bottleneck. Because of the use of the PFB methodology it is not possible to reach good scores with unbalanced performance. On the contrary, it is possible to have low REDI points and high ABE scores, at least in theory. It could indicate that a region use efficiently its limited entrepreneurial resources. However, practically the REDI and the ABE scores correlate closely (*Figure 7*).

Figure 7. The connection between the REDI and the ABE scores



Notes: Third degree of polynomial adjustment. Number of observations=125

The third degree polynomial curve explains 83% of the total variation between REDI and ABE. *Figure 7* also prevails that the ABE score variations are higher in the lower and relatively low at the higher levels. Hovedstaden, the leading Danish region has the highest ABE scores of 90.2% implying that less than 10 percent of its available entrepreneurial resources are wasted more or less. The first ten regions' ABE scores exceed the 78% with the exception of the UK South-East region that has a little bit less ABE score (76.9%). In the middle of ranking, the 66th Slovenian Vzhodna Slovenija has only a moderate 45.3 REDI point but possesses a relatively high 78.9 ABE score. It seems that UK regions, except the second ranked London have the tendency to have lower ABE scores than implied by their REDI points. At the bottom of ranking we can find ABE scores around 30%. The Romanian Macroregiunea doi is not only the last in the ranking but has the lowest ABE score of 28.9% together with the 115th ranked Hungarian Észak-Magyarország. At the same time another Hungarian region, the 121st Dél-Alföld's ABE score is 55.5; much higher that we would have expected according to its 21.4 REDI point.

4.4 The analysis of the three sub-indices and the fourteen pillars

While the REDI points are suitable to compare the overall entrepreneurial performances of the regions they are not proper for policy application. The REDI needs to be decomposed to be able to get a more accurate picture about the entrepreneurial profile of the regions and the potential direction of entrepreneurship policy action. *Table 6* provides the scores and the ranking of the 125 regions in all three sub-indices.

Table 6. The Entrepreneurial Attitudes (ATT), Entrepreneurial Abilities (ABT) and Entrepreneurial Aspirations (ASP) values and ranks of the 125 regions

Regional Code	Region	ATT	ATT Rank	ABT	ABT Rank	ASP	ASP Rank	Regional Code	Region	ATT	ATT Rank	ABT	ABT Rank	ASP	ASP Rank
AT1	Ostösterreich	58.8	33	60.4	35	62.8	14	HR03	Jadranska Hrvatska (Adriatic Croatia)	24.1	107	27.4	96	44.4	68
AT2	Südösterreich	50.2	52	49	62	56.7	31	HR04	Kontinentalna Hrvatska (Continental Croatia)	23.1	108	26.6	97	40	76
AT3	Westösterreich	51.6	50	45.9	66	53.3	40	HU10	Közép-Magyarország	30.2	102	31.8	93	32.1	101
BE1	Région de Bruxelles-Capitale	61.1	30	63.6	27	69.9	8	HU21	Közép-Dunántúl	20.7	116	23.9	101	21.3	123
BE2	Vlaams Gewest	55.4	41	68.5	14	62.5	16	HU22	Nyugat-Dunántúl	21.4	113	25.4	98	17.7	125
BE3	Région wallonne	52.1	48	57.2	43	71.1	5	HU23	Dél-Dunántúl	22.2	109	24.2	100	25	117
CZ	Czech Republic	29.5	104	21.5	107	60.1	24	HU31	Észak-Magyarország	19.3	122	24.3	99	23.6	118
DE1	Baden-Württemberg	54	44	60.4	36	59.9	25	HU32	Észak-Alföld	20	119	23.4	104	20.9	124
DE2	Bayern	51.9	49	59.4	38	60.6	21	HU33	Dél-Alföld	20	120	20.1	109	23	120
DE3	Berlin	57.5	37	74.4	9	69.7	9	IE01	Border. Midland and Western	66.8	20	63.9	26	59.6	26
DE4	Brandenburg	41.3	69	55.9	48	48.3	50	IE02	Southern and Eastern	72.8	8	76.9	7	66.2	11
DE5	Bremen	46.7	58	52.2	55	46.4	62	ITC	Nord-Ovest	38.5	76	35.8	84	46.8	59
DE6	Hamburg	56.3	39	65.3	23	41.4	73	ITF	Sud	29.4	105	20.3	108	32.2	100
DE7	Hessen	53.5	45	66.4	19	69.9	7	ITG	Isole	29.5	103	22.2	106	31.1	104
DE8	Mecklenburg-Vorpommern	38.5	77	35.1	87	33.2	98	ITH	Nord-Est	37.5	83	34.7	88	36.3	87
DE9	Niedersachsen	46.1	60	52	57	56.6	32	ITI	Centro (IT)	37	88	31.9	92	42	72
DEA	Nordrhein-Westfalen	52.4	47	54.6	52	57.9	27	LT	Lithuania	35.6	91	33.5	90	36.6	86
DEB	Rheinland-Pfalz	49.6	53	55.3	49	63.7	13	LV	Latvia	34.3	95	31.5	94	35.6	90
DEC	Saarland	47.7	57	55.9	47	61	19	NL1	Noord-Nederland	55.7	40	50	59	47.6	54
DED	Sachsen	45.5	63	58.4	42	46.1	64	NL2	Oost-Nederland	60.4	31	54.8	51	54.3	36
DEE	Sachsen-Anhalt	39.7	73	42.1	73	42.2	71	NL3	West-Nederland	66.9	19	65.4	22	61	20
DEF	Schleswig-Holstein	42.9	67	48.8	63	38.9	79	NL4	Zuid-Nederland	61.1	29	57.1	44	52.9	41

Regional Code	Region	ATT	ATT Rank	ABT	ABT Rank	ASP	ASP Rank	Regional Code	Region	ATT	ATT Rank	ABT	ABT Rank	ASP	ASP Rank
DEG	Thüringen	38.2	81	42.1	74	31.3	103	PL1	Region Centralny	40.4	70	20	111	48	51
DK01	Hovedstaden	79.7	2	89.6	1	77.2	3	PL2	Region Poludniowy	38.5	75	16.4	114	47.4	55
DK02	Sjalland	63.4	23	64.8	24	53.9	39	PL3	Region Wschodni	36	90	13.7	121	38	81
DK03	Syddanmark	68.8	15	72.4	11	54.1	38	PL4	Region Pólnocno-Zachodni	38.3	79	12.4	123	46.2	63
DK04	Midtjylland	67.9	17	72.5	10	52.6	42	PL5	Region Poludniowo-Zachodni	39.7	71	18.7	112	50	48
DK05	Nordjylland	69.5	11	77.2	6	69.2	10	PL6	Region Pólnocny	39.7	72	12	124	47.9	52
EE	Estonia	50.5	51	43.5	72	43.8	69	PT11	Norte	31.1	101	23.6	102	32.9	99
EL1	Voreia Ellada	15	124	20	110	33.2	96	PT15	Algarve	34.2	96	29.7	95	28.8	113
EL2	Kentriki Ellada	12.4	125	16.4	115	29.8	110	PT16	Centro (PT)	26.4	106	23.2	105	33.3	95
EL3	Attiki	20.9	115	35.2	86	37.7	82	PT17	Lisboa	44.1	65	38	81	51.5	45
EL4	Nisia Aigaiou. Kriti	15.6	123	18.1	113	30.6	108	PT18	Alentejo	31.2	100	23.4	103	33.5	94
ES11	Galicia	37.1	85	43.6	71	29.9	109	RO1	Macroregiunea unu	21.7	112	14.9	119	21.4	122
ES12	Principado de Asturias	38.3	78	47.5	65	41.2	74	RO2	Macroregiunea doi	19.7	121	10.3	125	25.2	115
ES13	Cantabria	36.3	89	44.8	67	28.3	114	RO3	Macroregiunea trei	21.1	114	16.1	116	29.1	112
ES21	País Vasco	44.1	66	52.4	54	40.3	75	RO4	Macroregiunea patru	20.2	118	13.9	120	25.1	116
ES22	Comunidad Foral de Navarra	38.1	82	44.8	68	34.1	93	SE11	Stockholm	79.5	3	79	4	62.7	15
ES23	La Rioja	37.1	86	44.6	69	31	106	SE12	Östra Mellansverige	80	1	67.2	17	70.8	6
ES24	Aragón	35.6	92	38.9	79	23.4	119	SE21	Smaland med öarna	67.6	18	50.1	58	32.1	102
ES30	Comunidad de Madrid	48.2	56	58.4	41	57.4	29	SE22	Sydsverige	77.2	6	68.2	15	56.5	33
ES41	Castilla y León	34.5	94	40.3	77	35.6	91	SE23	Vastsverige	79.4	4	75.1	8	62	18
ES42	Castilla-la Mancha	32.9	99	34.2	89	29.2	111	SE31	Norra Mellansverige	69.4	12	57	45	46.7	61
ES43	Extremadura	33.2	98	35.8	85	22	121	SE32	Mellersta Norrland	58.7	35	54.9	50	31.1	105
ES51	Cataluna	44.6	64	44.3	70	38.1	80	SE33	Övre Norrland	74.6	7	59.2	40	60.3	22
ES52	Comunidad Valenciana	39.2	74	41.9	75	33.2	97	SI01	Vzhodna Slovenija	42.7	68	40.9	76	52.3	44

Regional Code	Region	ATT	ATT Rank	ABT	ABT Rank	ASP	ASP Rank	Regional Code	Region	ATT	ATT Rank	ABT	ABT Rank	ASP	ASP Rank
ES53	Illes Balears	37.2	84	38.4	80	37.4	83	SI02	Zahodna Slovenija	49.4	54	50	60	54.4	35
ES61	Andalucía	37	87	36.9	83	37.3	84	SK01	Bratislavsky kraj	33.9	97	33.1	91	64.9	12
ES62	Región de Murcia	34.8	93	39.9	78	35.3	92	SK02	Západné Slovensko	21.9	111	16	117	39.4	77
ES70	Canarias (ES)	38.3	80	37.6	82	30.7	107	SK03	Stredné Slovensko	22.1	110	15.6	118	36.9	85
FI19	Länsi-Suomi	68.3	16	60.5	34	47.2	56	SK04	Vychodné Slovensko	20.5	117	13.6	122	39.3	78
FI1B	Helsinki-Uusimaa	70.5	10	69.2	13	46.7	60	UKC	North East (UK)	54.7	42	56.3	46	35.8	89
FI1C	Etelä-Suomi	69	14	60.8	33	47	58	UKD	North West (UK)	62.3	25	65.9	21	49	49
FI1D	Pohjois- ja Ita-Suomi	65.7	21	52	56	35.9	88	UKE	Yorkshire and The Humber	61.7	27	62	31	45.4	65
FR1	Île de France	69.3	13	78.7	5	89.6	1	UKF	East Midlands (UK)	61.6	28	62.1	30	42.2	70
FR2	Bassin Parisien	45.7	62	52.7	53	54.2	37	UKG	West Midlands (UK)	62	26	66	20	47.6	53
FR3	Nord - Pas-de-Calais	46	61	49.8	61	50.7	46	UKH	East of England	63.4	24	64.1	25	57	30
FR4	Est (FR)	46.7	59	48.1	64	54.5	34	UKI	London	79	5	83	2	77.7	2
FR5	Ouest (FR)	48.9	55	59.4	39	47.2	57	UKJ	South East (UK)	70.7	9	80	3	57.9	28
FR6	Sud-Ouest (FR)	53.5	46	62.8	28	60.3	23	UKK	South West (UK)	63.6	22	68.1	16	50.4	47
FR7	Centre-Est (FR)	54.6	43	66.7	18	71.4	4	UKL	Wales	57.8	36	61.2	32	45	66
FR8	Méditerranée	56.6	38	59.5	37	62	17	UKM	Scotland	59.8	32	72.2	12	44.9	67
								UKN	Northern Ireland (UK)	58.8	34	62.7	29	52.6	43

Note: number of observations = 125

The examination of the three sub-indexes demonstrates the varieties of the regions entrepreneurial characteristics. There are only a few well balanced regions exists, e.g. London is one of these with 77.7 ASP, 79.0 ATT and 83.0 ABT values. Stockholm is at the fourth place in the REDI ranking. A closer look at its sub-indices prevails a high ATT score (79.5), a little bit lower ASP value (79.0) but its ASP score is relatively low "only" 62.7. Picking up a Spanish region, Galicia, has a relatively high ABT score (43.6), an acceptable ATT score (37.1) but a very low ASP score (29.9). Most Polish regions seem to have a relatively low performance in ASP. While Hungarian and Romanian regions are at the bottom of ranking, their three sub-indices are relatively well-balanced at the low level.

An analysis on the 14 pillar level provides a more detailed and a more precise picture about the entrepreneurial profile of a region. *Table 7* shows the non-penalized average equated pillar values for all the 125 regions. The colors help to identify the position of a region's particular pillar. For example, Noord-Nederland has a maximum value in *Cultural support* (green color) but weaker in *Competition* (0.52, amber color) and low in Risk perception (0.29, reddish color). Greener colors mean higher and better scores while reddish color imply poor performance that may call for policy intervention.

Table 7. The fourteen average equated pillar values of the 125 European Union regions

Regional Code	Regions	Opportunity perception	Strat-up skills	Risk Perception	Networking	Cultural support	Opportunity startup	Technology Absorption	Human Capital	Competition	Product innovation	Process innovation	High growth	Globalization	Financing
AT1	Ostösterreich	0.77	0.86	0.40	0.65	0.48	0.63	0.72	0.40	0.84	0.78	0.53	0.37	0.79	1.00
AT2	Südösterreich	0.41	0.73	0.41	0.57	0.52	0.58	0.68	0.32	0.49	0.58	0.52	0.39	0.64	1.00
AT3	Westösterreich	0.54	0.72	0.42	0.61	0.51	0.60	0.44	0.26	0.67	0.58	0.41	0.32	0.71	1.00
BE1	Région de Bruxelles-Capitale	0.76	0.86	0.90	0.50	0.37	0.34	1.00	1.00	0.58	0.97	0.50	1.00	0.97	0.60
BE2	Vlaams Gewest	0.46	0.64	0.86	0.44	0.47	0.82	0.61	0.73	0.77	0.42	0.73	0.49	0.89	0.81
BE3	Région wallonne	0.46	0.66	0.79	0.42	0.39	0.47	0.57	0.68	0.66	0.57	0.98	0.75	0.97	0.68
CZ	Czech Republic	0.52	0.38	0.15	0.29	0.23	0.20	0.28	0.16	0.24	0.62	1.00	0.86	0.97	0.43
DE1	Baden-Württemberg	0.55	0.64	0.39	0.55	0.66	0.73	0.66	0.46	0.71	0.74	0.41	0.62	0.59	0.81
DE2	Bayern	0.45	0.60	0.37	0.60	0.66	0.61	0.74	0.49	0.67	0.49	0.42	0.77	0.75	0.83
DE3	Berlin	0.78	0.73	0.39	0.57	0.56	0.66	0.90	0.79	1.00	0.89	0.40	0.82	0.87	0.90
DE4	Brandenburg	0.33	0.73	0.37	0.51	0.55	0.54	0.69	0.77	1.00	0.61	0.07	1.00	0.97	0.64
DE5	Bremen	0.56	0.57	0.39	0.74	0.58	0.50	0.53	0.99	0.65	1.00	0.37	0.09	0.97	0.66
DE6	Hamburg	0.94	0.81	0.42	0.67	0.52	0.80	1.00	0.52	1.00	0.69	0.27	0.19	0.50	0.67
DE7	Hessen	0.62	0.62	0.38	0.57	0.59	0.54	0.66	0.73	0.99	0.77	0.53	1.00	0.88	0.72
DE8	Mecklenburg-Vorpommern	0.25	0.41	0.37	0.48	0.62	0.51	0.55	0.16	0.32	0.21	0.24	0.15	0.60	0.66
DE9	Niedersachsen	0.35	0.49	0.36	0.57	0.59	0.58	0.56	0.42	0.60	0.57	0.39	0.80	0.59	0.66
DEA	Nordrhein-Westfalen	0.62	0.44	0.39	0.61	0.65	0.61	0.60	0.53	0.51	0.52	0.42	0.75	0.86	0.52
DEB	Rheinland-Pfalz	0.42	0.58	0.37	0.62	0.55	0.63	0.54	0.51	0.61	0.61	0.64	0.69	0.89	0.59
DEC	Saarland	0.58	0.36	0.39	0.55	0.55	0.60	0.78	0.43	0.55	0.88	0.49	0.66	0.76	0.50
DED	Sachsen	0.41	0.45	0.36	0.56	0.58	0.60	0.76	0.64	0.55	0.30	0.43	0.39	0.70	0.62
DEE	Sachsen-Anhalt	0.25	0.47	0.34	0.52	0.61	0.44	0.48	0.29	0.68	0.82	0.65	0.17	0.75	0.15
DEF	Schleswig-Holstein	0.33	0.55	0.38	0.54	0.67	0.69	0.47	0.40	0.80	0.12	0.47	0.35	0.89	0.48
DEG	Thüringen	0.26	0.42	0.40	0.57	0.59	0.53	0.65	0.42	0.41	0.46	0.10	0.08	0.49	0.76
DK01	Hovedstaden	0.98	0.70	0.62	1.00	1.00	0.98	1.00	1.00	1.00	1.00	0.98	1.00	0.51	0.68
DK02	Sjalland	0.90	0.48	0.64	0.96	1.00	0.95	0.62	0.98	0.69	0.88	0.88	0.81	0.19	0.52
DK03	Syddanmark	0.95	0.45	0.64	0.90	1.00	1.00	0.51	1.00	0.85	1.00	0.35	0.55	0.42	0.62
DK04	Midtjylland	1.00	0.46	0.62	1.00	1.00	1.00	0.68	1.00	0.83	1.00	0.28	0.76	0.31	0.64
DK05	Nordjylland	0.91	0.40	0.61	1.00	1.00	1.00	0.70	1.00	0.80	0.92	0.76	0.76	0.40	1.00
EE	Estonia	0.74	0.85	0.67	0.37	0.27	0.37	0.45	0.58	0.45	0.49	0.56	0.59	0.50	0.22
EL1	Voreia Ellada	0.28	0.29	0.04	0.19	0.02	0.08	0.28	0.33	0.21	0.45	0.50	0.20	0.29	0.56
EL2	Kentriki Ellada	0.22	0.20	0.04	0.15	0.04	0.13	0.22	0.22	0.13	0.47	0.45	0.10	0.17	0.59
EL3	Attiki	0.41	0.49	0.04	0.23	0.04	0.29	0.60	0.57	0.25	0.45	0.59	0.30	0.38	0.57
EL4	Nisia Aigaiou. Kriti	0.25	0.35	0.04	0.20	0.03	0.19	0.21	0.20	0.19	0.65	0.47	0.11	0.22	0.41
ES11	Galicia	0.30	0.36	0.33	0.34	0.66	0.56	0.43	0.65	0.28	0.42	0.42	0.20	0.20	0.31
ES12	Principado de Asturias	0.38	0.31	0.34	0.36	0.59	0.51	0.48	0.74	0.33	0.56	0.67	0.29	0.26	0.41
ES13	Cantabria	0.33	0.33	0.33	0.39	0.55	0.42	0.50	0.76	0.35	0.47	0.35	0.18	0.22	0.27
ES21	País Vasco	0.49	0.44	0.38	0.39	0.67	0.58	0.60	0.96	0.29	0.41	0.57	0.28	0.23	0.70
ES22	Comunidad Foral de Navarra	0.35	0.37	0.37	0.37	0.59	0.44	0.42	0.98	0.27	0.41	0.58	0.22	0.17	0.46

Regional Code	Regions	Opportunity perception	Strat-up skills	Risk Perception	Networking	Cultural support	Opportunity startup	Technology Absorption	Human Capital	Competition	Product innovation	Process innovation	High growth	Globalization	Financing
ES23	La Rioja	0.35	0.30	0.35	0.38	0.61	0.49	0.50	0.78	0.27	0.30	0.58	0.21	0.17	0.40
ES24	Aragón	0.38	0.38	0.34	0.37	0.59	0.50	0.42	0.72	0.25	0.07	0.34	0.29	0.19	0.40
ES30	Comunidad de Madrid	0.55	0.53	0.36	0.41	0.64	0.39	0.72	0.96	0.48	0.82	0.88	0.50	0.41	0.49
ES41	Castilla y León	0.28	0.32	0.32	0.35	0.53	0.36	0.43	0.60	0.33	0.45	0.59	0.20	0.25	0.40
ES42	Castilla-la Mancha	0.19	0.31	0.31	0.34	0.59	0.42	0.27	0.47	0.27	0.25	0.40	0.21	0.27	0.38
ES43	Extremadura	0.19	0.35	0.32	0.35	0.60	0.48	0.33	0.51	0.26	0.32	0.32	0.13	0.18	0.18
ES51	Cataluna	0.49	0.46	0.36	0.41	0.58	0.30	0.52	0.63	0.40	0.49	0.31	0.35	0.35	0.44
ES52	Comunidad Valenciana	0.42	0.38	0.34	0.37	0.56	0.41	0.45	0.62	0.32	0.50	0.45	0.21	0.24	0.34
ES53	Illes Balears	0.30	0.35	0.35	0.39	0.57	0.44	0.32	0.52	0.35	0.76	0.38	0.20	0.20	0.52
ES61	Andalucía	0.31	0.35	0.31	0.37	0.58	0.31	0.40	0.49	0.33	0.47	0.54	0.26	0.24	0.43
ES62	Región de Murcia	0.29	0.27	0.33	0.35	0.57	0.45	0.41	0.49	0.32	0.44	0.62	0.22	0.22	0.37
ES70	Canarias (ES)	0.36	0.33	0.35	0.37	0.61	0.46	0.31	0.47	0.33	0.36	0.37	0.22	0.26	0.36
FI19	Länsi-Suomi	1.00	1.00	0.60	0.97	0.70	0.92	0.80	0.84	0.36	0.79	0.81	0.57	0.22	0.30
FI1B	Helsinki-Uusimaa	0.85	1.00	0.59	0.97	0.77	0.85	1.00	0.89	0.53	0.79	0.72	0.29	0.32	0.40
FI1C	Etelä-Suomi	0.82	1.00	0.60	0.97	0.76	0.93	0.72	0.62	0.51	0.84	0.69	0.44	0.35	0.26
FI1D	Pohjois- ja Ita-Suomi	0.89	1.00	0.57	1.00	0.75	0.84	0.59	0.62	0.39	0.51	0.57	0.37	0.18	0.29
FR1	Île de France	0.76	0.66	0.89	0.61	0.60	0.59	1.00	0.84	0.86	1.00	0.98	1.00	0.86	0.95
FR2	Bassin Parisien	0.36	0.29	0.78	0.49	0.57	0.58	0.76	0.24	0.83	0.55	0.91	0.35	0.64	0.62
FR3	Nord - Pas-de-Calais	0.48	0.30	0.76	0.45	0.60	0.59	0.51	0.46	0.70	0.18	0.54	0.86	0.97	0.53
FR4	Est (FR)	0.31	0.33	0.80	0.49	0.56	0.42	0.59	0.29	0.76	0.56	0.73	0.58	0.45	0.61
FR5	Ouest (FR)	0.33	0.32	0.80	0.55	0.61	0.59	0.80	0.42	0.81	0.51	0.48	0.34	0.48	0.65
FR6	Sud-Ouest (FR)	0.35	0.41	0.86	0.61	0.63	0.61	0.89	0.62	0.61	0.85	0.98	0.53	0.42	0.54
FR7	Centre-Est (FR)	0.48	0.37	0.84	0.57	0.62	0.65	0.81	0.58	0.88	1.00	0.83	0.80	0.70	0.65
FR8	Méditerranée	0.48	0.46	0.88	0.57	0.53	0.44	0.72	0.43	0.93	0.74	0.98	0.55	0.54	0.47
HR03	Jadranska Hrvatska (Adriatic Croatia)	0.49	0.34	0.07	0.23	0.22	0.34	0.31	0.18	0.38	0.20	0.63	0.67	0.77	0.53
HR04	Kontinentalna Hrvatska (Continental Croatia)	0.50	0.31	0.06	0.19	0.22	0.30	0.29	0.19	0.40	0.19	0.71	0.73	0.62	0.26
HU10	Közép-Magyarország	0.54	0.79	0.15	0.29	0.07	0.14	0.52	0.54	0.28	0.22	0.26	0.71	0.29	0.38
HU21	Közép-Dunántúl	0.21	0.35	0.15	0.24	0.18	0.29	0.29	0.25	0.21	0.09	0.24	0.58	0.27	0.05
HU22	Nyugat-Dunántúl	0.30	0.31	0.14	0.24	0.18	0.31	0.37	0.29	0.17	0.04	0.15	0.27	0.43	0.10
HU23	Dél-Dunántúl	0.23	0.37	0.15	0.26	0.18	0.33	0.26	0.25	0.19	0.21	0.24	0.53	0.33	0.08
HU31	Észak-Magyarország	0.21	0.33	0.12	0.21	0.15	0.25	0.35	0.22	0.23	0.06	0.22	0.97	0.20	0.07
HU32	Észak-Alföld	0.14	0.43	0.13	0.20	0.16	0.25	0.33	0.21	0.20	0.13	0.31	0.34	0.25	0.09
HU33	Dél-Alföld	0.16	0.39	0.14	0.21	0.15	0.23	0.23	0.18	0.19	0.19	0.24	0.40	0.27	0.11
IE01	Border. Midland and Western	0.51	0.74	0.96	0.64	0.73	0.60	0.69	0.80	0.60	0.41	0.64	0.77	0.66	0.64
IE02	Southern and Eastern	0.56	0.87	0.94	0.72	0.72	0.61	0.69	0.99	1.00	0.74	0.69	0.73	0.51	0.72
ITC	Nord-Ovest	0.50	0.39	0.54	0.25	0.37	0.27	0.56	0.20	0.50	0.36	0.44	0.58	0.57	0.63
ITF	Sud	0.41	0.39	0.52	0.25	0.19	0.01	0.38	0.20	0.36	0.48	0.63	0.29	0.22	0.35

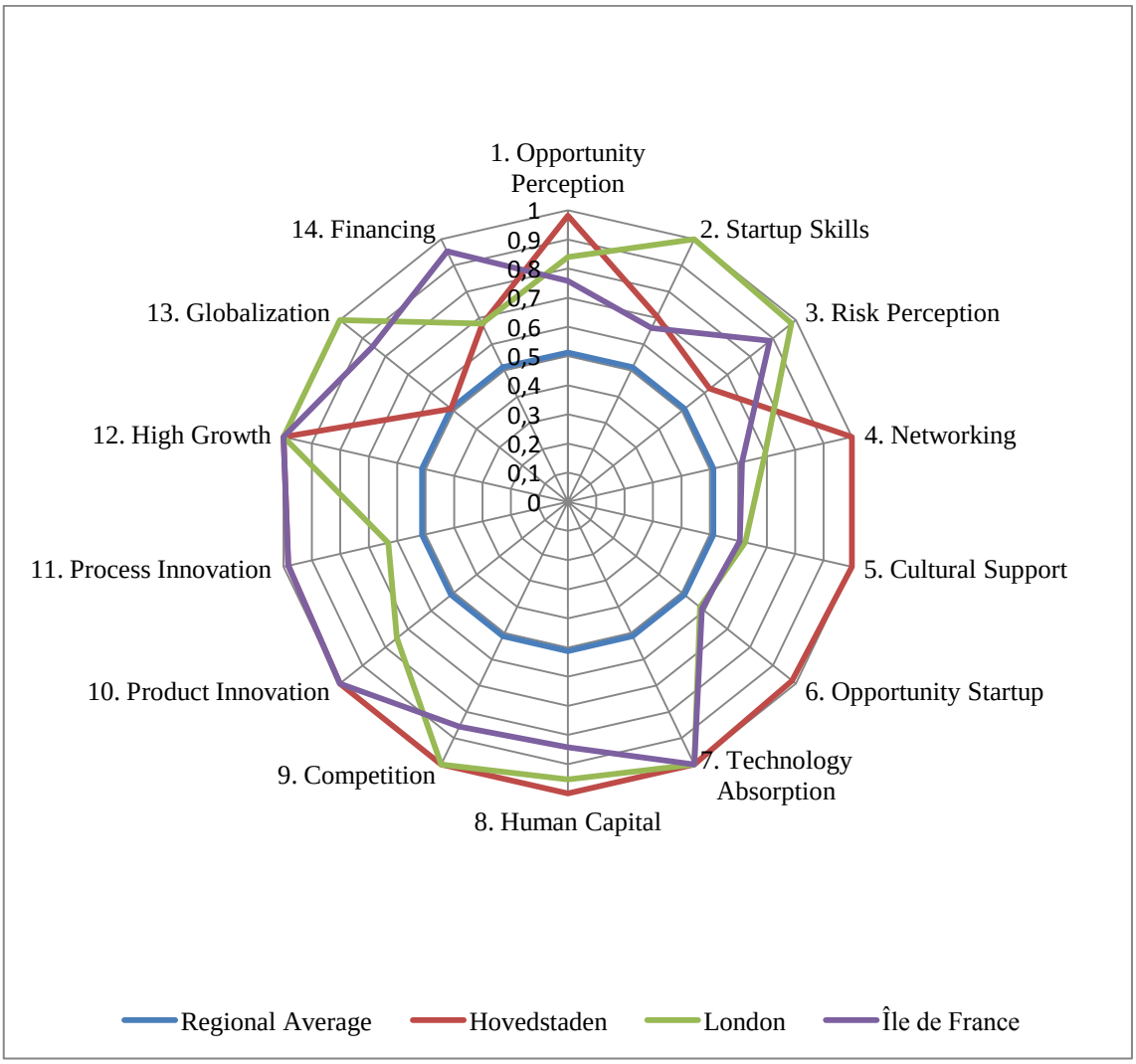
Regional Code	Regions	Opportunity perception	Strat-up skills	Risk Perception	Networking	Cultural support	Opportunity startup	Technology Absorption	Human Capital	Competition	Product innovation	Process innovation	High growth	Globalization	Financing
ITG	Isole	0.33	0.35	0.49	0.25	0.25	0.05	0.27	0.22	0.45	0.31	0.58	0.30	0.29	0.30
ITH	Nord-Est	0.42	0.35	0.55	0.29	0.40	0.33	0.43	0.27	0.44	0.50	0.47	0.17	0.24	0.63
ITI	Centro (IT)	0.42	0.40	0.55	0.27	0.33	0.19	0.41	0.24	0.51	0.42	0.75	0.31	0.37	0.47
LT	Lithuania	0.47	0.46	0.53	0.24	0.23	0.16	0.27	0.90	0.23	0.23	0.52	0.44	0.49	0.31
LV	Latvia	0.50	0.54	0.41	0.21	0.19	0.17	0.30	0.51	0.36	0.18	0.27	0.77	0.46	0.29
NL1	Noord-Nederland	0.39	0.71	0.29	0.80	1.00	0.96	0.45	0.30	0.52	0.78	0.28	0.42	0.48	0.61
NL2	Oost-Nederland	0.60	0.81	0.30	0.82	0.93	0.71	0.65	0.32	0.72	0.89	0.49	0.56	0.45	0.56
NL3	West-Nederland	0.88	1.00	0.29	0.88	1.00	0.79	0.76	0.55	0.90	0.83	0.42	0.67	0.65	0.89
NL4	Zuid-Nederland	0.66	0.82	0.29	0.80	0.97	0.66	0.65	0.47	0.72	0.65	0.38	0.49	0.74	0.61
PL1	Region Centralny	0.50	0.65	0.45	0.48	0.32	0.07	0.11	0.38	0.30	0.95	0.44	0.76	0.79	0.21
PL2	Region Poludniowy	0.53	0.58	0.42	0.47	0.28	0.06	0.19	0.22	0.21	0.74	0.17	0.76	0.75	0.68
PL3	Region Wschodni	0.43	0.41	0.40	0.46	0.34	0.09	0.10	0.18	0.20	0.46	0.36	0.80	0.43	0.21
PL4	Region Pólnocno-Zachodni	0.45	0.57	0.44	0.51	0.27	0.07	0.13	0.17	0.14	0.52	0.40	0.67	0.65	0.63
PL5	Region Poludniowo-Zachodni	0.50	0.49	0.44	0.50	0.30	0.12	0.17	0.26	0.20	0.86	0.31	0.67	0.66	0.55
PL6	Region Pólnocny	0.50	0.50	0.45	0.47	0.34	0.10	0.11	0.12	0.15	0.57	0.49	0.55	0.64	0.64
PT11	Norte	0.38	0.31	0.47	0.24	0.26	0.35	0.14	0.22	0.27	0.20	0.60	0.14	0.53	0.37
PT15	Algarve	0.37	0.33	0.45	0.27	0.47	0.53	0.28	0.17	0.33	0.11	0.35	0.27	0.81	0.14
PT16	Centro (PT)	0.12	0.32	0.45	0.23	0.30	0.42	0.10	0.26	0.22	0.23	0.73	0.21	0.67	0.14
PT17	Lisboa	0.58	0.56	0.55	0.31	0.37	0.43	0.23	0.53	0.40	0.38	0.67	0.53	0.74	0.54
PT18	Alentejo	0.31	0.29	0.48	0.26	0.47	0.56	0.04	0.23	0.26	0.11	0.78	0.35	0.85	0.10
RO1	Macroregiunea unu	0.34	0.04	0.75	0.08	0.14	0.08	0.13	0.23	0.20	0.03	0.36	0.23	0.45	0.16
RO2	Macroregiunea doi	0.33	0.03	0.80	0.06	0.05	0.01	0.09	0.15	0.18	0.15	0.34	0.22	0.49	0.26
RO3	Macroregiunea trei	0.43	0.04	0.77	0.09	0.03	0.01	0.19	0.36	0.18	0.09	0.55	0.57	0.48	0.13
RO4	Macroregiunea patru	0.31	0.03	0.79	0.07	0.08	0.02	0.17	0.24	0.17	0.03	0.30	0.65	0.49	0.09
SE11	Stockholm	1.00	1.00	0.73	1.00	0.77	1.00	0.95	1.00	0.63	0.91	0.48	0.42	0.59	1.00
SE12	Östra Mellansverige	0.99	0.64	0.77	1.00	0.82	1.00	0.63	0.59	0.56	1.00	0.56	0.77	0.57	0.77
SE21	Smaland med öarna	1.00	0.54	0.77	1.00	0.86	0.99	0.41	0.38	0.51	0.25	0.29	0.23	0.37	0.52
SE22	Sydsverige	1.00	0.72	0.88	1.00	0.81	0.97	0.59	0.80	0.63	0.58	0.38	0.73	0.56	0.71
SE23	Vastsverige	1.00	0.67	0.78	0.99	0.81	1.00	0.57	1.00	0.64	0.52	0.81	0.57	0.54	0.72
SE31	Norra Mellansverige	0.98	0.54	0.79	0.95	0.71	0.93	0.50	0.65	0.41	0.33	0.40	0.40	0.48	0.86
SE32	Mellersta Norrland	0.99	0.64	0.72	1.00	0.71	1.00	0.66	0.64	0.63	0.26	0.17	0.07	0.51	0.94
SE33	Övre Norrland	1.00	0.65	0.82	0.97	0.77	0.90	0.38	0.64	0.61	0.64	0.76	0.40	0.47	1.00
SI01	Vzhodna Slovenija	0.44	0.48	0.26	0.52	0.53	0.41	0.50	0.46	0.33	0.63	0.54	0.58	0.62	0.47
SI02	Zahodna Slovenija	0.53	0.88	0.27	0.54	0.50	0.39	0.67	0.68	0.42	0.69	0.77	0.53	0.65	0.37
SK01	Bratislavsky kraj	0.66	0.69	0.23	0.45	0.06	0.23	0.55	0.48	0.27	1.00	0.83	1.00	0.93	1.00
SK02	Západné Slovensko	0.20	0.30	0.20	0.46	0.06	0.16	0.29	0.12	0.11	0.10	0.44	0.44	0.60	0.96
SK03	Stredné Slovensko	0.18	0.32	0.21	0.45	0.06	0.16	0.21	0.15	0.13	0.09	0.41	0.59	0.59	0.57
SK04	Vychodné Slovensko	0.20	0.24	0.20	0.43	0.05	0.15	0.17	0.12	0.13	0.26	0.43	0.51	0.47	0.73

Regional Code	Regions	Opportunity perception	Strat-up skills	Risk Perception	Networking	Cultural support	Opportunity startup	Technology Absorption	Human Capital	Competition	Product innovation	Process innovation	High growth	Globalization	Financing
UKC	North East (UK)	0.60	0.48	0.95	0.54	0.64	0.75	0.55	0.52	0.83	0.52	0.32	0.61	0.19	0.28
UKD	North West (UK)	0.66	0.58	0.99	0.55	0.63	0.75	0.68	0.55	0.96	0.48	0.57	0.81	0.39	0.34
UKE	Yorkshire and The Humber	0.62	0.58	1.00	0.56	0.64	0.68	0.62	0.52	0.91	0.44	0.34	0.76	0.33	0.50
UKF	East Midlands (UK)	0.54	0.58	1.00	0.59	0.71	0.85	0.62	0.53	0.75	0.32	0.44	0.54	0.36	0.50
UKG	West Midlands (UK)	0.61	0.56	0.98	0.53	0.65	0.71	0.72	0.55	0.86	0.43	0.41	0.73	0.48	0.39
UKH	East of England	0.55	0.67	1.00	0.60	0.63	0.73	0.69	0.47	0.92	0.64	0.98	0.64	0.45	0.36
UKI	London	0.84	1.00	0.98	0.69	0.62	0.58	1.00	0.95	1.00	0.75	0.63	1.00	1.00	0.68
UKJ	South East (UK)	0.64	0.79	1.00	0.65	0.68	0.84	1.00	0.69	1.00	0.46	0.52	0.85	0.58	0.56
UKK	South West (UK)	0.48	0.63	1.00	0.64	0.68	0.82	0.62	0.59	0.94	0.52	0.50	0.64	0.39	0.53
UKL	Wales	0.45	0.52	1.00	0.56	0.65	0.70	0.58	0.61	0.78	0.45	0.37	0.78	0.44	0.32
UKM	Scotland	0.48	0.55	1.00	0.58	0.71	0.92	0.82	0.69	0.92	0.38	0.44	0.71	0.47	0.32
UKN	Northern Ireland (UK)	0.51	0.48	0.88	0.49	0.72	0.74	0.59	0.44	0.88	0.50	0.47	0.88	0.43	0.44

Note: The colors reflect to the value of the score from the best (green) toward the medium (amber) to the worst (red).

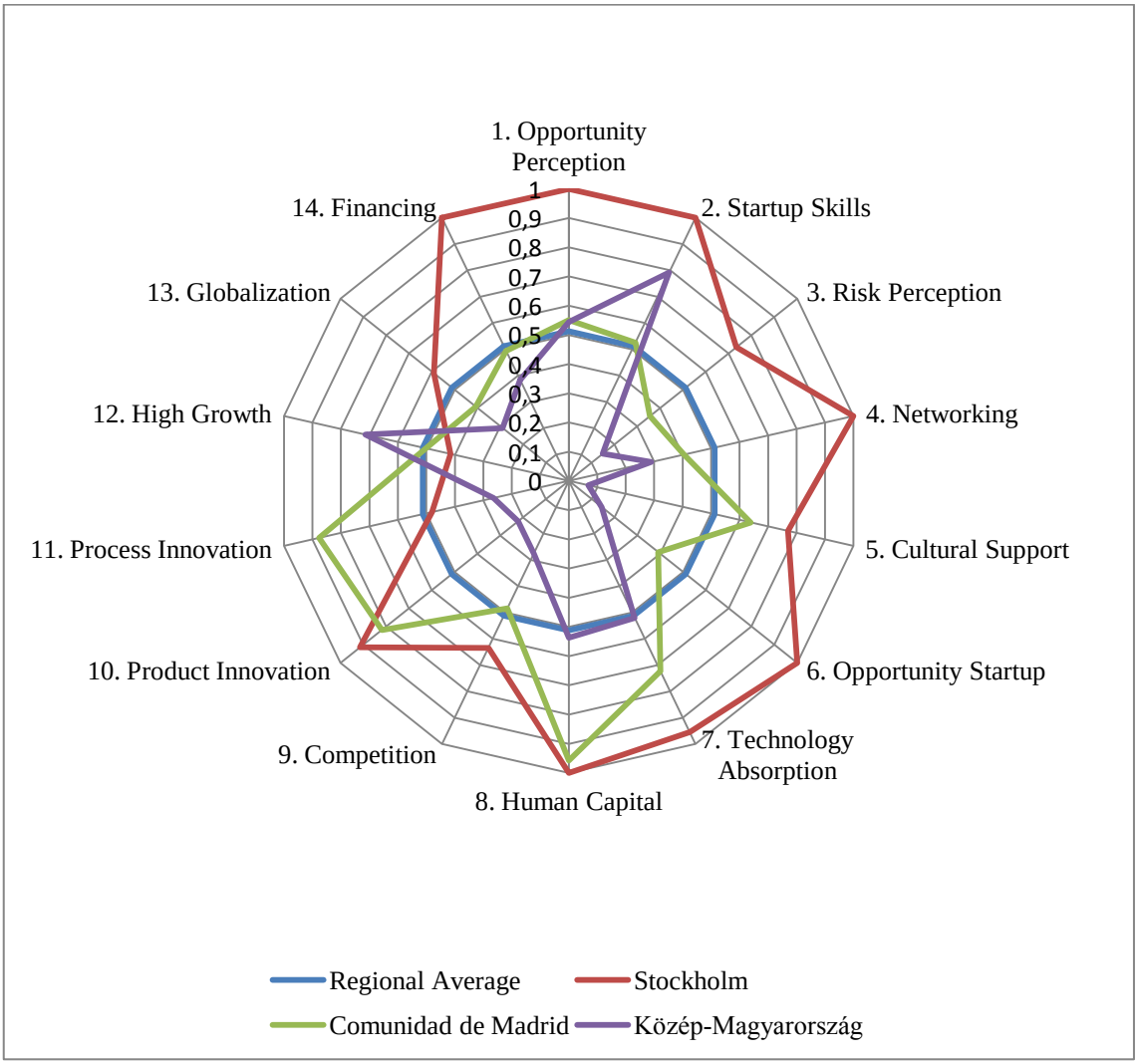
Showing the varieties of the potential investigations we present three types of spider diagrams: One that compares the leading regions (*Figure 8*) the other that relates the leading and the medium ranking and lagging regions (*Figure 9*) and one the pictures the same country regions (*Figure 10*).

Figure 8. The comparison of the entrepreneurial profile of the three leading regions



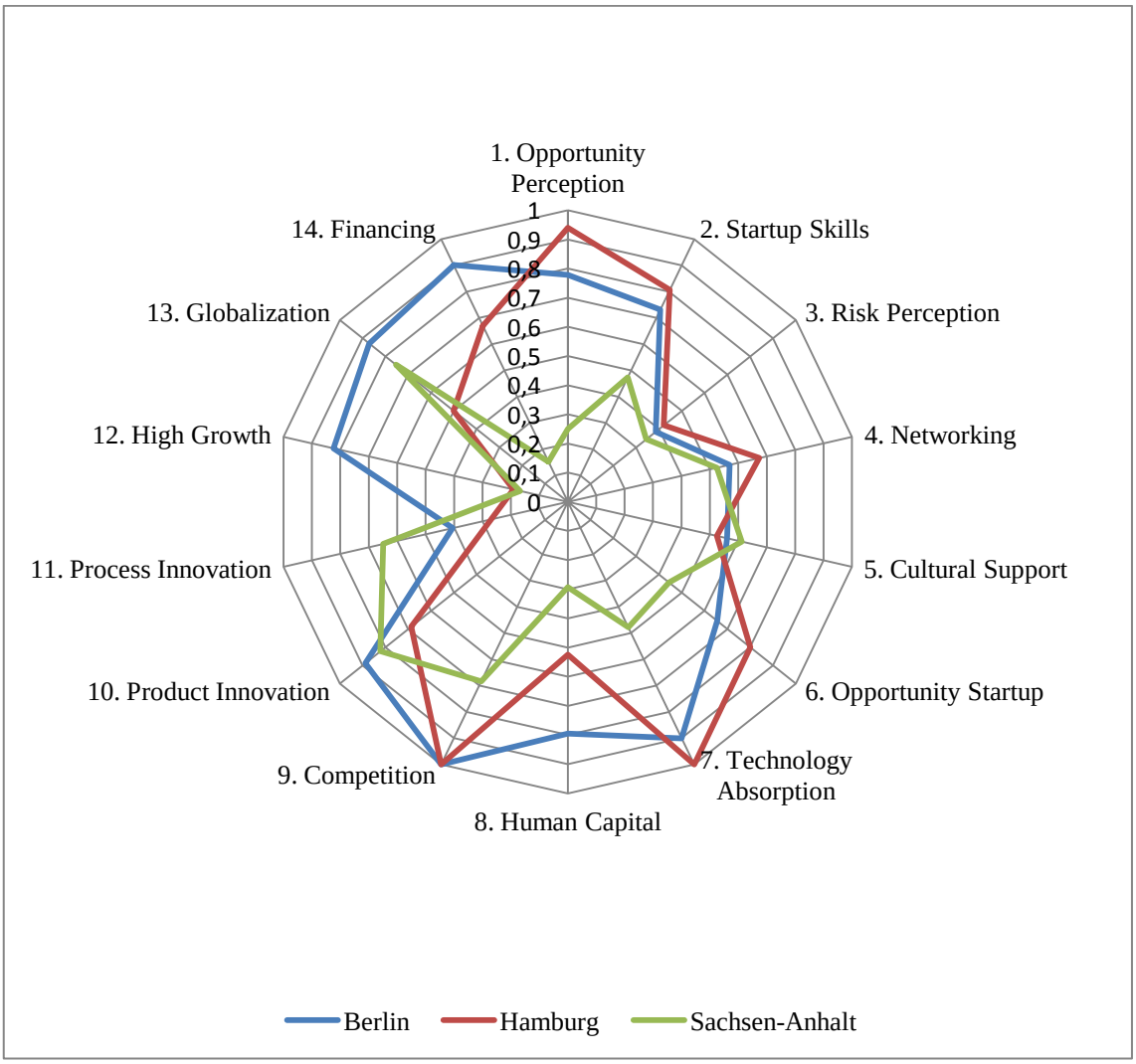
According to *Figure 8*, all the three leading regions are above the average pillar values in all cases. Only Hovedstaden's Globalization is equal to the 125 regions average value of this pillar. All three regions have some common features: All seems to be strong in Technology Absorption, Human Capital, Competition and High growth. However, differences are more notable. Hovedstaden is stronger than the other two regions in Opportunity Perception, Networking, Cultural Support, and Opportunity Startup, but weak in Risk Perception and Globalization. London's advantages are the Startup Skills, Risk Perception, and Globalization pillars. At the same time, London is weak in Cultural Support, Opportunity Startup, Product Innovation and process Innovation. Íle de France is strong in Financing, and, similar to London, weak in Cultural Support and Opportunity Startup.

Figure 9. The comparison of the entrepreneurial profile of a leading (Stockholm) a medium ranking (Communidad del Madrid) and a lagging (Közép-Magyarország) region



There are even more differences amongst the three regions in *Figure 9*. Stockholm is above the average in all but two pillars, Communidad del Madrid is around the average and Közép-Magyarország with Budapest is below the average in most pillars. All regions have some strengths and weaknesses. Stockholm is strong in the Attitudes and Abilities related pillars but weak in Process Innovation and High Growth. Madrid's strongest points are Human Capital Product Innovation and Process Innovation but it is below average in Risk Perception, Opportunity Startup, High Growth and Globalization. Közép-Magyarország's Stratup Skills is the pillar with highest value while other pillars of attitudes, Risk Perception, Networking and Cultural Support are extremely low. By surprise, High Growth is the highest in Közép-Magyarország amongst the three regions, while Globalization, Financing and the two innovation related pillars are also critically low.

Figure 10. The comparison of the entrepreneurial profile of three German regions



The comparison of the three German regions (*Figure 10*) prevails some notable similarities amongst Berlin, Hamburg and Sachsen-Anhalt. In the case of four pillars – three of the attitude related pillars – have about the same values. These are the Risk Perception, Networking, Cultural Support, and Product Innovation. The minimal differences are partially due to the application of the country level institutional variables (Risk Perception, Opportunity Startup). While Berlin, partially a former East German region, has couth up to the leading regions of Europe manly due to its very strong aspiration related pillars, another former East German region, Sachen-Anhalt's entrepreneurial performance is about the same as one of the leading former socialist country region Bratislavsky kraj, and other Italian and Spanish regions. Hamburg's REDI point is more than 10 points higher than Sachen-Anhalt's. While Hamburg has a similar or even better performance than Berlin in the attitude and the ability related pillars – except Human Capital, it lags behind Berlin in four of the five ability related pillars. High Growth is particularly weak both in Hamburg and Sachen-Anhalt.

4.5 The examination of the pillar structure of the REDI

As a part of the robustness check, we provide a basic analysis of the interrelationship between the different variables. Although the PFB methodology provides a practical solution for how to take this

interrelationship into account, it does not save us from examining the underlying structure of the pillar. It is particularly important to have a well-defined nested structure of whole index.

The arbitrary selection of the pillars would cause confusion, false interpretation, and, finally, a misleading policy interpretation. The OECD handbook of composite indicators suggests analyzing the dataset in two dimensions, pillars and observation units, in our case regions (*Giovannini et al*., 2008). We have already provided detailed analyses at the regional level; here we are presenting a pillar-level analysis by calculating the common (Pearson) correlation coefficients. We report correlations between the original pillars, shown in *Table 8*, and the correlations between the normalized indicators after applying the PFB methodology, shown in *Table 9*.

In general, significant and low to high correlations exist between the pillars in both cases. Most importantly all the pillars are positively correlate to one another with two exceptions: The correlations between *Process Innovation* and *Cultural Support* and *Process Innovation* and *Human Capital* is -0,01 and -0,02, respectively, are insignificant. The pillars *Process Innovation* and *Globalization* show the lowest correlation with the other pillars. However, the PFB, as can be expected, improved the correlation, implying a closer relationship between the entrepreneurial features. The two, previously negative insignificantly correlated, pillars have also become positive but weakly correlated pillars. The positive connection between the entrepreneurship pillars is vital for proper policy interpretation and suggestions. If the connection between the pillars were negative, it would have implied that one pillar can only be improved at the cost of the other pillar. In this case, the improvement of the weakest pillar value would not necessary improve the REDI value.

There are other ways to check out the consistency of the dataset and the potentially strong connection between the pillars. Both the Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity reinforce the fact that the 14 pillars of REDI are closely correlated, and it is worth looking for a single complex measure.[8] The most popular test of the internal consistency of the pillars is based on the Cronbach Coefficient Alpha (c-alpha). The c-alpha value for the 14 pillars is 0.91 with the original data, and 0.96 after applying the PFB methodology; both are well above the critical 0.7 threshold value. In sum, all of these tests support the internal consistency of the structure as described with the 14 selected pillars.

[8] The Kaiser – Meyer – Olkin measures for the original pillar values are 0.83 and 0.88 for the PFB adjusted pillars, well above the critical value of 0.50. The Bartlett test is significant at the 0.000 level, excluding the possibility that the pillars are not interrelated.

Table 8. The correlation matrix between the average adjusted pillar values

	Average adjusted pillars	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	REDI points	1.00	**0.74**	**0.69**	**0.60**	**0.80**	**0.78**	**0.80**	**0.84**	**0.69**	**0.84**	**0.68**	**0.39**	**0.48**	**0.32**	**0.57**
2	Opportunity perception		1.00	**0.66**	**0.44**	**0.80**	**0.58**	**0.67**	**0.55**	**0.58**	**0.51**	**0.55**	*0.20*	**0.35**	0.16	**0.45**
3	Startup skills			1.00	**0.24**	**0.67**	**0.47**	**0.53**	**0.62**	**0.47**	**0.51**	**0.55**	0.14	**0.34**	**0.27**	**0.40**
4	Risk perception				1.00	**0.40**	**0.42**	**0.47**	**0.43**	**0.37**	**0.61**	*0.18*	**0.27**	**0.32**	**0.11**	0.14
5	Networking					1.00	**0.81**	**0.84**	**0.61**	**0.55**	**0.57**	**0.60**	0.15	**0.24**	**0.12**	**0.53**
6	Cultural support						1.00	**0.87**	**0.61**	**0.61**	**0.65**	**0.50**	0.14	0.12	-0.01	**0.34**
7	Opportunity startup							1.00	**0.67**	**0.58**	**0.68**	**0.40**	0.15	0.15	0.03	**0.39**
8	Technology adoption								1.00	**0.63**	**0.77**	**0.56**	**0.28**	**0.33**	*0.19*	**0.46**
9	Human capital									1.00	**0.47**	**0.48**	**0.25**	*0.22*	-0.02	**0.29**
10	Competition										1.00	**0.50**	**0.23**	**0.43**	**0.31**	**0.42**
11	Product innovation											1.00	**0.36**	**0.33**	**0.24**	**0.48**
12	Process innovation												1.00	*0.19*	*0.17*	0.14
13	High growth													1.00	**0.45**	*0.18*
14	Globalization														1.00	**0.39**
15	Financing															1.00

Bold: Correlation is significant at the 0.01 level (2-tailed).

Italic: Correlation is significant at the 0.05 level (2-tailed).

Table 9. The correlation matrix between the pillar values after applying the PFB method

	Penalized pillars	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	REDI points	1.00	**0.83**	**0.79**	**0.70**	**0.88**	**0.83**	**0.85**	**0.88**	**0.78**	**0.89**	**0.77**	**0.54**	**0.62**	**0.49**	**0.70**
2	Opportunity perception		1,00	**0.73**	**0.57**	**0.82**	**0.66**	**0.70**	**0.64**	**0.68**	**0.64**	**0.65**	**0.36**	**0.51**	**0.33**	**0.58**
3	Startup skills			1.00	**0.42**	**0.75**	**0.59**	**0.63**	**0.70**	**0.60**	**0.64**	**0.64**	**0.32**	**0.49**	**0.43**	**0.53**
4	Risk perception				1.00	**0.54**	**0.57**	**0.58**	**0.56**	**0.52**	**0.70**	**0.36**	**0.43**	**0.47**	**0.28**	**0.34**
5	Networking					1.00	**0.85**	**0.86**	**0.71**	**0.64**	**0.70**	**0.70**	**0.34**	**0.42**	**0.31**	**0.65**
6	Cultural support						1.00	**0.90**	**0.71**	**0.69**	**0.74**	**0.61**	**0.34**	**0.32**	*0.18*	**0.50**
7	Opportunity startup							1.00	**0.75**	**0.67**	**0.76**	**0.53**	**0.33**	**0.34**	*0.22*	**0.53**
8	Technology adoption								1.00	**0.72**	**0.84**	**0.67**	**0.45**	**0.49**	**0.36**	**0.59**
9	Human capital									1.00	**0.60**	**0.58**	**0.42**	**0.39**	*0.16*	**0.45**
10	Competition										1.00	**0.62**	**0.42**	**0.58**	**0.47**	**0.57**
11	Product innovation											1.00	**0.50**	**0.45**	**0.35**	**0.61**
12	Process innovation												1.00	**0.35**	**0.29**	**0.33**
13	High growth													1.00	**0.54**	**0.34**
14	Globalization														1.00	**0.51**
15	Financing															1.00

Bold: Correlation is significant at the 0.01 level (2-tailed).

Italic: Correlation is significant at the 0.05 level (2-tailed).

4.6 Calculating the REDI with the different combination of individual and institutional variables: The issue of weighting

A common problem of index building is to find the proper weight. While we did not use classical weighting to calculate the REDI scores, the pillar values were calculated as multiplying the individual variable with the proper institutional variable. It is possible to interpret either the institutional or the individual variables as being the weights. A major advantage of this approach is the ability to assign the proper weight to a particular variable on a variable basis; therefore, country and regional differences can be incorporated in the index. Moreover, the arbitrary selection of the weight can also be eliminated. Now, the question is which variable is the weight and which one is the weighted? Entrepreneurship scholars probably select the institutional variables to be the weights, but institutional economists would choose the individual variables to weight the institutional ones.

Here, as a part of the robustness check, we have tested different combinations of the individual and the institutional variables. Practically it also means alternating the weighting structure. We have conducted three other types of calculation. We calculated the REDI scores of the 125 regions by using only the individual variables (Individual REDI); only the institutional variables (Institutional REDI); and independently the fourteen individual and the fourteen institutional variables (REDI 28). The Individual REDI is the version where we us the GEM Adult Population Survey individual data and the two innovation variables from the Poli-KIT database (*Capello – Lenzi*, 2013).

The Pearson correlation coefficients of the REDI points and the rank correlation coefficients (Spearman's rho) for the four versions are reported in *Table 10*.

Table 10. The Pearson's correlation coefficients and Spearman's rho values with different REDI versions

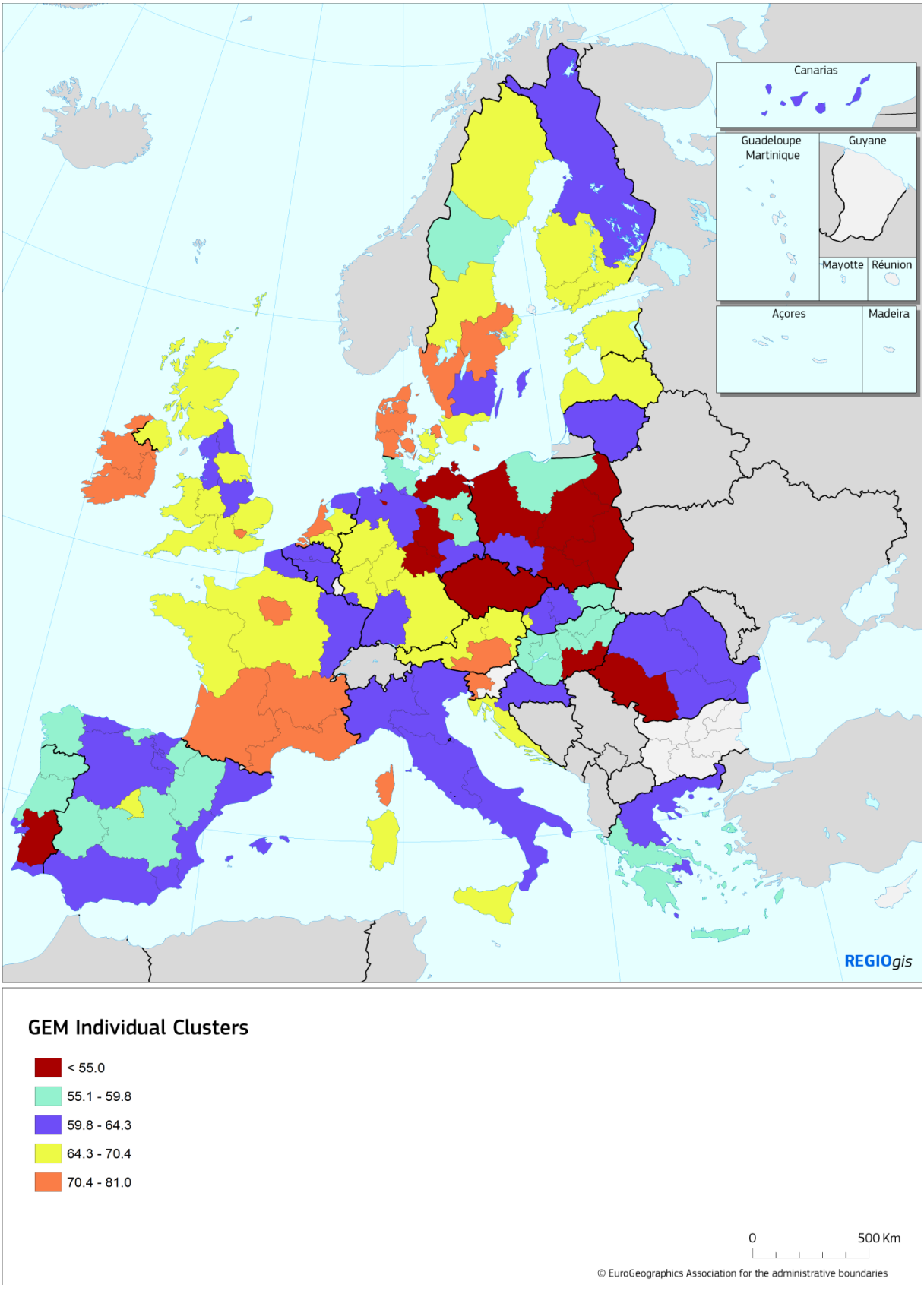
			1	2	3	4
1	REDI	Pearson's correlation	1	0.68	0.95	0.95
		Spearman's rho	1	0.72	0.94	0.96
2	Individual REDI	Pearson's correlation		1	0.47	0.56
		Spearman's rho		1	0.55	0.64
3	Institutional REDI	Pearson's correlation			1	0.98
		Spearman's rho				0.97
4	REDI 28	Pearson's correlation				1
		Spearman's rho				1

Number of observations: 125
Note: All correlation coefficients are significant at p= 0.01 level

According to *Table 9*, the four versions are highly correlated to one another both in the cases of the REDI point and the REDI ranks. The Individual REDI shows the lowest correlation with the other three versions. Any version using the institutional variables correlates highly with all the other versions.

The map of the 125 regions with the Individual REDI scores in five clusters is presented in *Figure 11*.

Figure 11. The map of the GEM Individual REDI scores in five categories in 125 European Union regions, 2013



If we compare the original and individual REDI scores we can see that the individual scores have significantly smaller range and interquartile range than in the original case (*Table 11*). The interquartile range is only 8 points and it means that mid 50% of the points are within this range.

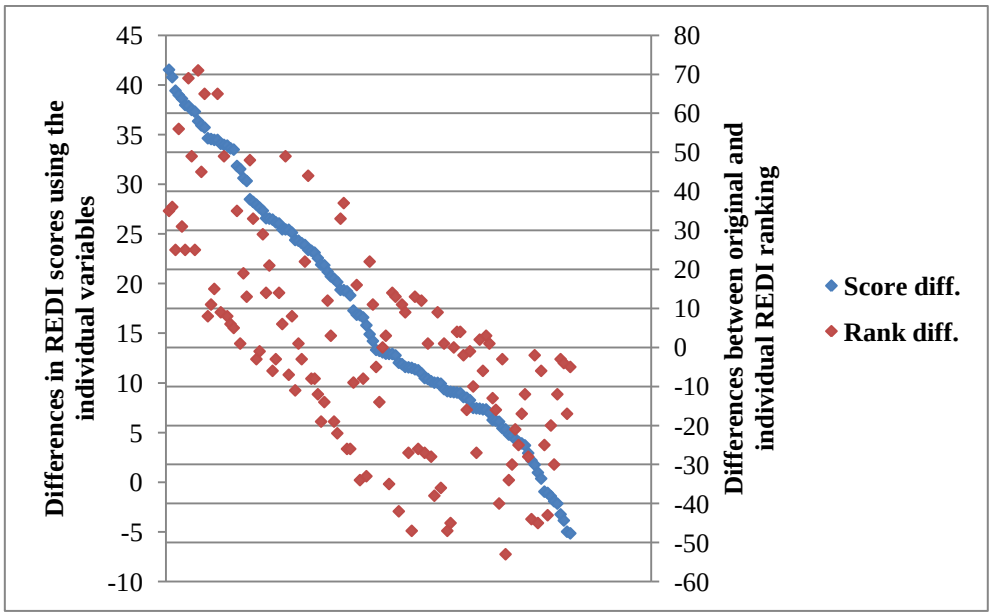
Table 11. The descriptive statistics of the original REDI and the Individual REDI scores

	REDI scores	Individual REDI scores
Average	46.03	63.42
Median	48.21	63.20
Minimum	18.42	46.37
Maximum	82.16	81.04
Range	63.74	34.67
Interquartile range	25.51	8.04

We can see that the Individual REDI score average value (63.42) is much higher than that of the original REDI scores. Taking into account the lower interquartile range it means that the individual variables prevail lower differences. Comparing the REDI ranking with the Individual REDI ranking the changes are substantial, range from +71 to -53. It means, that calculating only with the individual variables, Jadranska Hrvatska has stepped ahead from the 98th place to the 27th while the German Bremen has fallen from the 62nd to the 115th place. As it can be seen in *Figure 11*, the scores disperse in a relatively narrow range. The goodness of fit between the individual REDI scores and the GDP per capita is weak (R^2=0.23), so the individual REDI scores can hardly explain the regional dispersion of the GDP per capita.

Figure 11 pictures the comparison of the original REDI and the Individual REDI scores and ranking. The point differences are shown by the blue points and data points are on the primary (left) Y axis ("Differences in REDI scores with individual variables"). The red points and the secondary (right) Y axis show us the differences between the original and individual REDI rankings. All of these "difference figures" show the score differences values in descending order and we can also notice the ranking differences. It is straightforward from *Figure 12* that score changes are in much smaller in magnitude than the rank changes.

Figure 12. The differences in the REDI scores and ranking using the individual variables



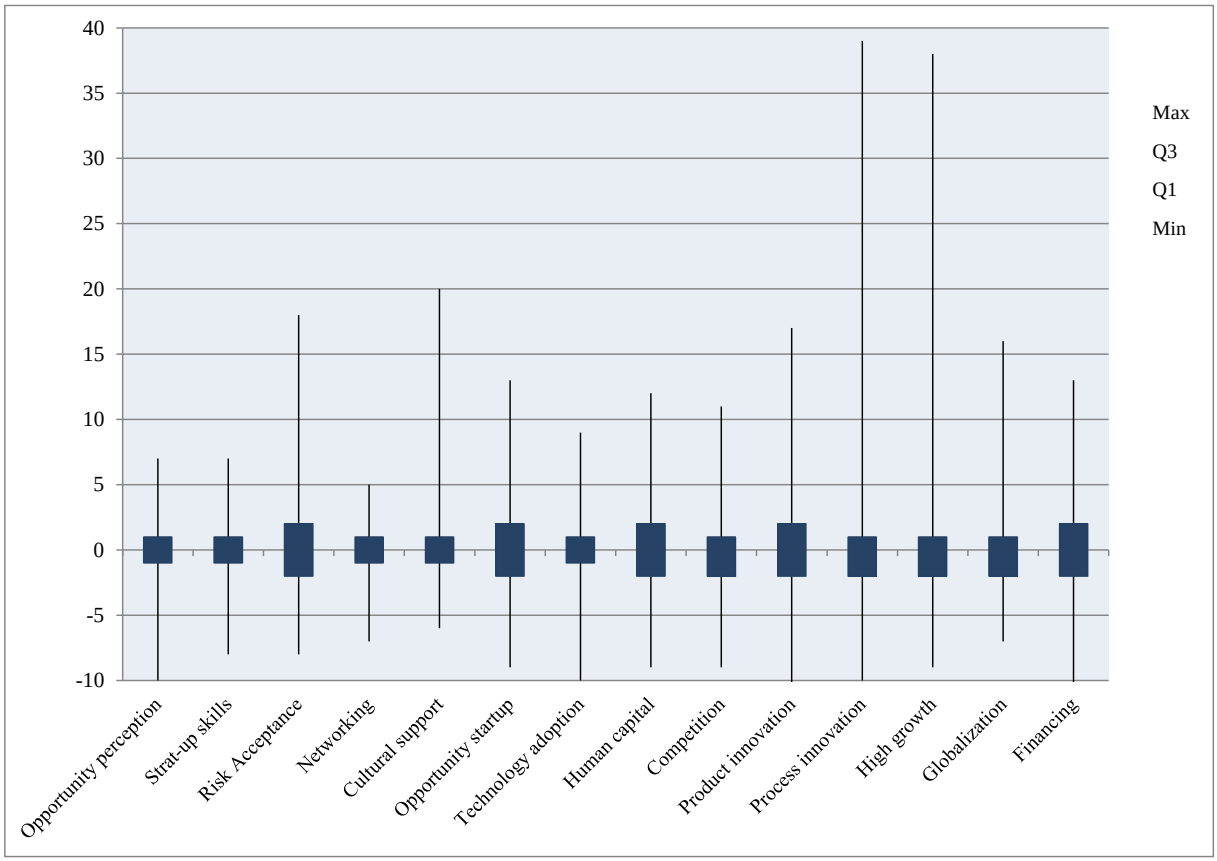
The same type of analysis for the Institutional REDI and the REDI 28 has also be done. In both cases the differences between the original REDI and these two cases are much lower than the case of the Individual REDI. For the detailed comparison and the new rankings and scores for all the four versions see Appendix I.

4.7 Robustness analysis: The effect of discarding a pillar

The aim of the robustness analysis is to examine the extent to which the final ranking depends on the set of choices made during the selection and transformation of the variables included in the sub-indices. The pillar variables are generally selected according to integrating experts' judgment, data availability and checks on statistical consistency. So it is the situation with the REDI, as it has been described in details in the earlier chapters of this paper. A typical robustness test is to drop out one pillar at a time and view the changes in the rank of the regions. It is an appropriate method to evaluate the balance among the pillars in the REDI. This is usually called an uncertainty analysis. We have calculated the REDI score values with the help of the penalty adjusted method, but we discarded one pillar at a time. So basically the model just slightly changed. We run fourteen simulations to see the effect of excluding each pillar one at the time.

The box-plot figure (*Figure 13*) displays the minimum, maximum values together with the lower and upper quartile (Q_1, Q_3) values (range and interquartile range) of the distribution of the difference between the modified rank, obtained discarding one pillar, and the reference rank, computed on the basis of the original REDI scores.

Figure 13. Distribution of the rank differences
(uncertainty analysis discarding one pillar at a time)



All the interquartile ranges are between the band -2 and +2, meaning that, for all the simulations, in 50% of the cases the maximum shift of the region rank is up to only 2 positions wide. This indicates a very balanced role of the pillars. The total ranges (maximum-minimum) are between -11 and +11 in case of 11 indicators. The three most influencing variables are the *Process innovation*, *High growth* and *Cultural support*. The highest differences are due to the extremely weak performance of these three pillars in three regions. *Cultural support* is 0.06 in Bratislavsky kraj (Slovakia), *Process innovation* is 0.07 only in Brandenburg (Germany), and *High growth* is 0.09 in Bremen (Germany). Excluding these extreme value pillars the three regions stepped ahead a lot in the ranking. Beyond these three extreme cases the minimum and maximum differences are within +18 and -11. If we take into account that altogether 125 regions are in the analysis, these shifts clearly show the balanced construction of the pillars and the overall REDI.

Looking at the Spearman rank correlation coefficients in *Table 12* we feel that the earlier statement is even more confirmed. In each case of the simulations the new ranks are in a very strong stochastic relationship (values are above 0.99) with the original ranking.

Table 12. Spearman rank correlation coefficient by the excluded pillars

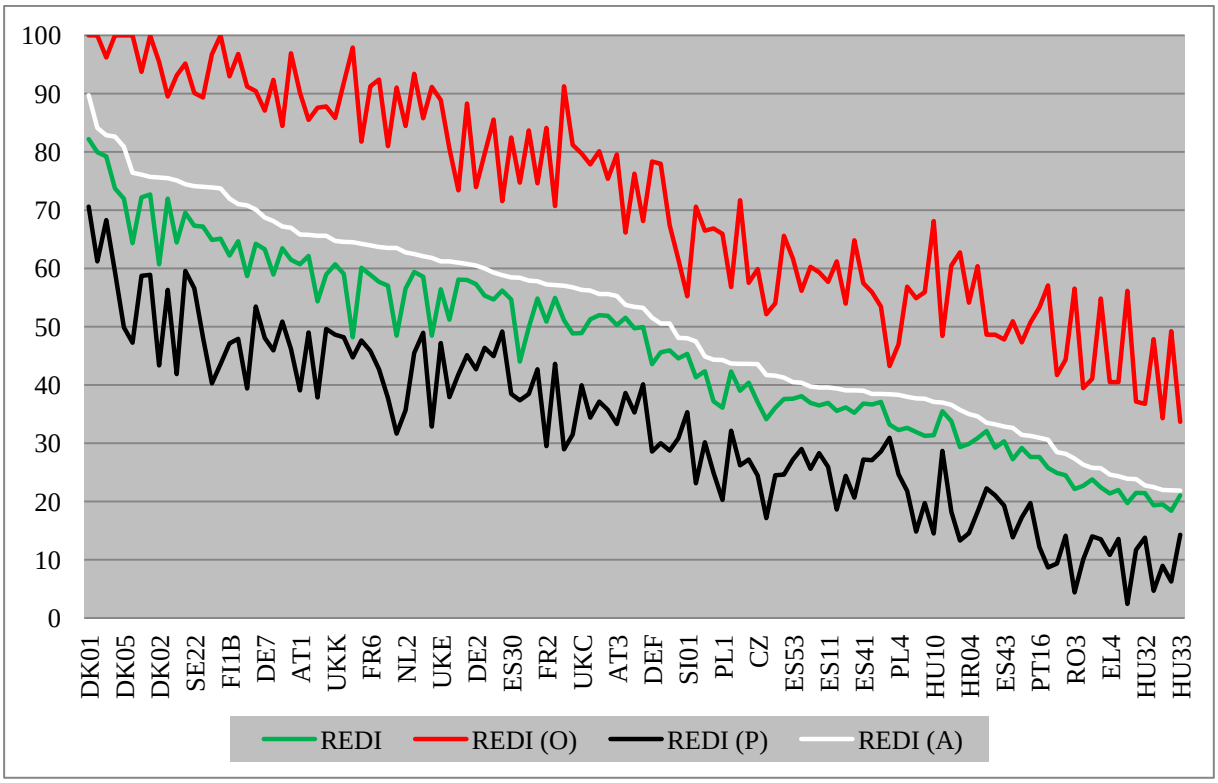
Excluded pillar	Spearman rank correlation coefficient
Opportunity perception	0.9981
Strat-up skills	0.9975
Risk Acceptance	0.9938
Networking	0.9989
Cultural support	0.9960
Opportunity startup	0.9941
Technology adoption	0.9970
Human capital	0.9952
Competition	0.9967
Product innovation	0.9935
Process innovation	0.9902
High growth	0.9901
Globalization	0.9957
Financing	0.9950

In connection with the analysis of the effect of excluding one pillar at a time the next question is the amount of compensability effects. Compensability is the "existence of trade-off, i.e. the possibility of offsetting a disadvantage on some criteria by a sufficiently large advantage on another criterion" (Munda, 2008 71. p.). We applied Ordered Weighted Averaging (OWA) approach to present one aspect of compensability in case of the REDI (*Yager*, 1996). This technique looks for different scenarios of weights to put together more variables into a single index. The variables are to be in descending order. From our point of view there are three special cases defined for the OWA operators (set of weights, where the sum of the weights is 1).

- Purely optimistic operator (O): the highest pillar value gets all of the weight (1). So basically the overall index takes into account just the highest value. This concept expresses an "or" multiple criteria condition, where the satisfaction of at least one criterion is enough to have a good position.
- Purely pessimistic operator (P): the lowest pillar gets the weight 1. So the overall index will include only the value of the lowest pillar. It can be understood as an "and" condition. No compensation is allowed, all criteria must be satisfied at the same time.
- From our point of view an operator, which calculates a simple arithmetic mean of the pillars (A) is interesting as well, to see, how far the penalty weighted results from the average situation are.

These three different scenarios are calculated at the level of the sub-indices based on the average equalized pillar values, and then the REDI score comes as a simple arithmetic mean of the sub-indices (the same way as in the original methodology). The results are displayed in *Figure 14* together with the original (penalty adjusted) REDI scores.

Figure 14. REDI scores calculated with different scenarios of the OWA operators



As an obvious result, the average and the original REDI scores move between the pessimistic and the optimistic lines. It is also clear, that the aim of the penalty adjusted was reached, as the original REDI scores are always below the average line. It means that compensability is restricted within the REDI indicator, and a balanced performance is rewarded. It is also important to look at the result at the level of the regions. What is the variability of the different scenarios within the regions? Regions with very low pessimistic REDI scores are also those with very high optimistic results.

Detailed data of the 17 most effected regions can be found in *Table 13*. Beside the average equalized data of the pillars the table includes the original REDI score and ranks, the scores based on the three scenarios (REDI(O) – optimistic, REDI(P) – pessimistic, REDI(A) – average), and the difference between the optimistic and pessimistic scores.) They are those regions that are influenced by the compensability effect the most. In addition, they are the most sensitive ones with respect to the change of the weighting scheme. It means those regions where the average distance (range) of the lowest and highest pillars within the sub-indices is the highest. In *Table 13* the orange cells indicate the highest values within the sub-index, and the green ones the lowest values. It does not necessarily mean to have very high and very low values at the same time; however at one end (minimum or maximum) the values are “extreme” within the sub-indices. These 17 regions are coming randomly from every part of the original REDI ranking (the ranks can be seen in the grey row of *Table 13*), which means, that the sensitivity to compensability is independent from the overall position of the regions.

Table 13. The 17 most effected regions by the changes of the weight

GEO code	NL1	DE4	DE5	BE1	DK03	FR2	RO4	HU10	SE32	DK04	RO3	DK02	FI19	NL3	AT1	UKH	DK05
GEO title	Noord-Nederland	Brandenburg	Bremen	Région de Bruxelles-Capitale	Syddanmark	Bassin Parisien	Macroregiunea patru	Közép-Magyarország	Mellersta Norrland	Midtjylland	Macroregiunea trei	Sjalland	Länsi-Suomi	West-Nederland	Ostösterreich	East of England	Nordjylland
Opportunity perception	0.39	0.33	0.56	0.76	0.95	0.36	0.31	0.54	0.99	1.00	0.43	0.90	1.00	0.88	0.77	0.55	0.91
Strat-up skills	0.71	0.73	0.57	0.86	0.45	0.29	0.03	0.79	0.64	0.46	0.04	0.48	1.00	1.00	0.86	0.67	0.40
Risk Acceptance	0.29	0.37	0.39	0.90	0.64	0.78	0.79	0.15	0.72	0.62	0.77	0.64	0.60	0.29	0.40	1.00	0.61
Networking	0.80	0.51	0.74	0.50	0.90	0.49	0.07	0.29	1.00	1.00	0.09	0.96	0.97	0.88	0.65	0.60	1.00
Cultural support	1.00	0.55	0.58	0.37	1.00	0.57	0.08	0.07	0.71	1.00	0.03	1.00	0.70	1.00	0.48	0.63	1.00
Opportunity startup	0.96	0.54	0.50	0.34	1.00	0.58	0.02	0.14	1.00	1.00	0.01	0.95	0.92	0.79	0.63	0.73	1.00
Technology adoption	0.45	0.69	0.53	1.00	0.51	0.76	0.17	0.52	0.66	0.68	0.19	0.62	0.80	0.76	0.72	0.69	0.70
Human capital	0.30	0.77	0.99	1.00	1.00	0.24	0.24	0.54	0.64	1.00	0.36	0.98	0.84	0.55	0.40	0.47	1.00
Competition	0.52	1.00	0.65	0.58	0.85	0.83	0.17	0.28	0.63	0.83	0.18	0.69	0.36	0.90	0.84	0.92	0.80
Product innovation	0.78	0.61	1.00	0.97	1.00	0.55	0.03	0.22	0.26	1.00	0.09	0.88	0.79	0.83	0.78	0.64	0.92
Process innovation	0.28	0.07	0.37	0.50	0.35	0.91	0.30	0.26	0.17	0.28	0.55	0.88	0.81	0.42	0.53	0.98	0.76
High growth	0.42	1.00	0.09	1.00	0.55	0.35	0.65	0.71	0.07	0.76	0.57	0.81	0.57	0.67	0.37	0.64	0.76
Globalization	0.48	0.97	0.97	0.97	0.42	0.64	0.49	0.29	0.51	0.31	0.48	0.19	0.22	0.65	0.79	0.45	0.40
Financing	0.61	0.64	0.66	0.60	0.62	0.62	0.09	0.38	0.94	0.64	0.13	0.52	0.30	0.89	1.00	0.36	1.00
REDI	51.1	48.5	48.4	64.9	65.1	50.9	19.7	31.4	48.2	64.3	22.1	60.7	58.7	64.4	60.7	61.5	72.0
REDI rank	53	61	62	13	12	54	122	99	63	16	116	23	32	15	25	22	8
REDI (O)	91.2	91.0	91.2	96.8	100.0	84.1	56.2	68.1	97.9	100.0	56.6	95.4	91.2	93.1	90.1	96.9	100.0
REDI (P)	29.0	31.6	32.9	40.3	43.5	29.5	2.5	14.5	44.7	47.2	4.4	43.4	39.4	41.8	39.1	46.1	49.9
REDI (A)	57.0	63.5	61.8	73.9	73.7	57.2	23.9	37.1	64.5	76.4	27.3	75.6	70.8	75.1	65.8	67.0	80.9
REDI(O)-REDI(P)	62.3	59.4	58.3	56.5	56.5	54.6	53.7	53.6	53.2	52.8	52.1	52.1	51.8	51.3	51.1	50.8	50.1

Uncertainty analysis together with the compensability effect analysis supports the robustness of the REDI indicator. The results justify, that the index provides a synthetic picture of the regional entrepreneurship within the European Union at the level of regions, while representing a balanced diversity of the different aspects (pillars).

We have also conducted other robustness checks examining the consequences of changing the variables. In all cases the changes of the scores and ranking was minimal. Out of these checks we show the effects of changing two institutional variables on the REDI scores and the ranking Appendix J.

4.8 The comparison of REDI to other regional indices

In this part of the report we compare the REDI scores and rankings to other available regional level indexes:

- Regional Competitiveness Index (RCI)
- Regional Innovation Scoreboard (RIS)
- Quality of Government Index (QoG)
- Regional Corruption Index

Note that three out of the four indices were used partially or fully in the REDI as measuring various institutional dimensions of regional level entrepreneurship. Therefore it can be expected that these indices should show a significant correlation and close relationship to REDI.

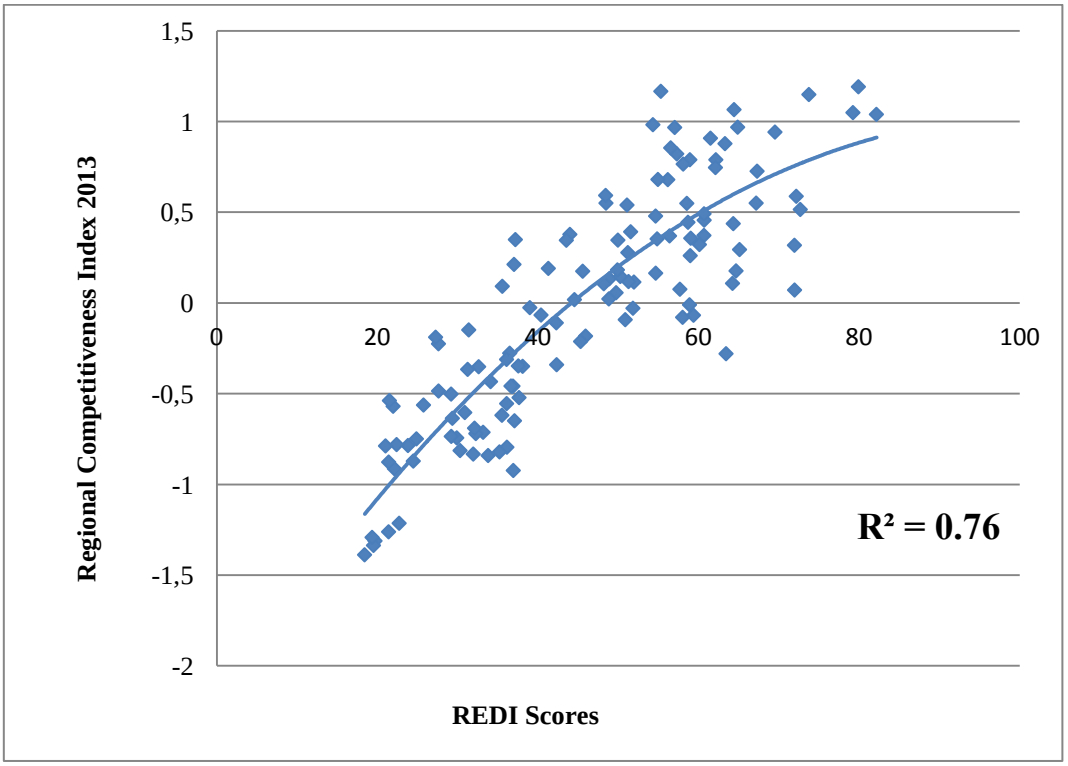
The EU Regional Competitiveness Index (RCI 2013) intended to measure and to examine the various levels of competitiveness at the regional level. "RCI 2013 reveals a strong regional dimension of competitiveness, which national level indicators cannot capture. The RCI shows the strengths and weaknesses of each of the EU NUTS2 regions. It can provide a guide to what each region should focus on, taking into account its specific situation and its overall level of development." (Source:http://ec.europa.eu/regional_policy/information/studies/index_en.cfm#3 2013.09.28.)

The RCI uses only institutional variables to measure regional competitiveness. The RCI contains 3 sub-indexes which build up 11 pillars: (I) Basic Sub-index: (1) Institutions (2) Macroeconomic Stability (3) Infrastructure (4) Health (5) Basic Education (II) Efficiency Sub-index: (1) Higher Education and Lifelong Learning (3) Labor Market Efficiency (4) Market Size (III) Innovation Sub-index: (1) Technological Readiness (2) Business Sophistication (3) Innovation. The index scores have been calculated for 274 regions of the European Union.

For comparing the RCI with REDI, the missing NUTS1 level data were calculated as the population weighted average of NUTS2 level RCI data (Austria, Belgium, Germany, France, Greece, Italy, The Netherlands, Poland, Romania and United Kingdom). In the REDI we applied several parts of the RCI: three RCI Business Sophistication variables /(1) Employment in J,K sectors, (2) GVA in J,K sectors and (3) FDI intensity/ were used as part of the REDI Business Strategy institutional variable (Competition pillar). The data of Employment in J,K variable was updated. Also five RCI Innovation variables /(1) Total patent application, (2) Scientific publications, (3) High-tech inventors, (4) ICT inventors, (5) Biotechnology inventors/ were used to create REDI Technology Transfer institutional variable (Product Innovation pillar). Except Scientific publications variable, all variables were updated. Furthermore, the three RCI Infrastructure variables /(1) Motorway density, (2) Railway density, (3) Number of passenger flights/ were used to determine the Connectivity institutional variable (Internationalization pillar).

The connection between the REDI Index and the EU Regional Competitiveness Index (RCI 2013) is positive and significant, as expected. Using third degree polynomial trend-line, it explains 76% of the variance between the two indices (*Figure 15*).

Figure 15. The connection between the Regional Entrepreneurship and Development Index (REDI) and the EU Regional Competitiveness Index (RCI 2013)



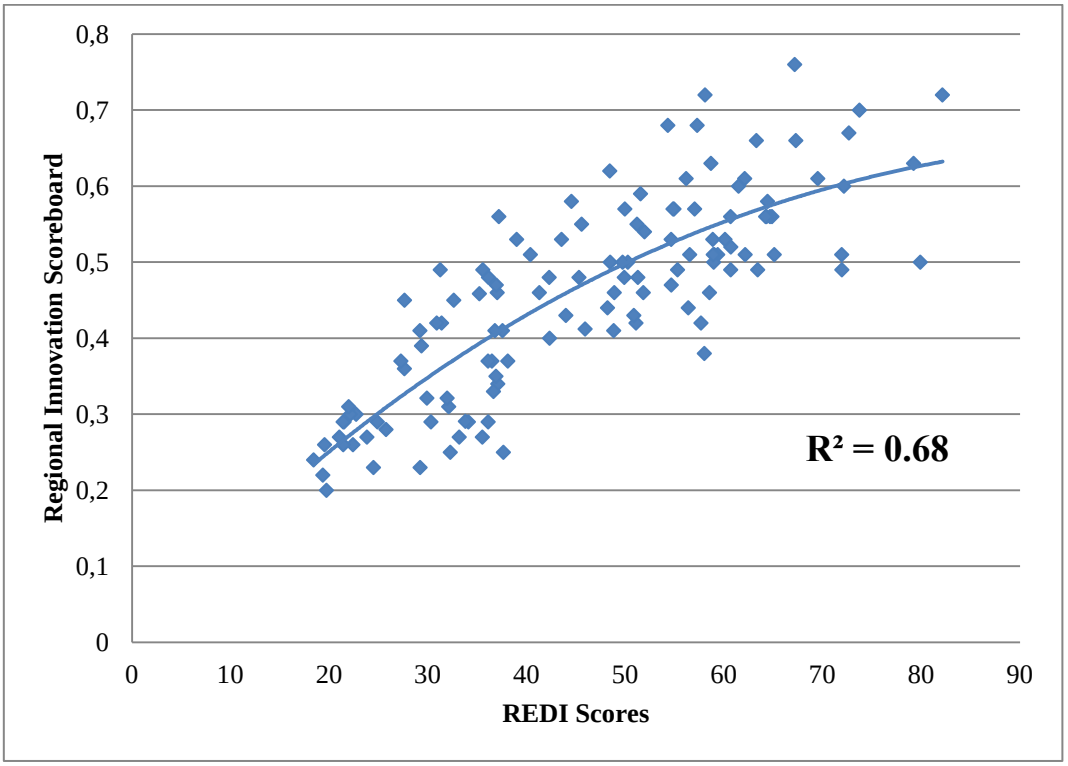
Note: Third degree of polynomial adjustment. Number of observations=125

For examining the connection between regional level entrepreneurship measured by REDI and innovation we used the Regional Innovation Scoreboard 2012 edition (RIS 2012). The Regional Innovation Scoreboard is the metric that incorporates the several aspects of the regional innovativeness such as creative workers, life-long learning, hi-tech sectors, R&D and patenting."The Regional Innovation Scoreboard 2012 provides a comparative assessment of how European regions perform with regard to innovation. The Regional Innovation Scoreboard 2012 classifies the European regions into four innovation performance groups, similarly to the Innovation Union Scoreboard. The report covers 190 regions across the European Union." Source: http://ec.europa.eu/enterprise/policies/innovation/policy/regional-innovation/index_en.htm (2013.09.28.)

For the comparison: there were no available data for Estonia, Croatia, Latvia and Lithuania. For the estimation, the *Innovations sub-index scores of WEF* data were used. For example, the Innovation sub-index score of Estonia is 4.08. Spain, Italy, Czech Republic and Portugal have very similar scores. Thus, Estonia score is calculated as the average value of these four countries. In the case of Croatia, the score is the average of Greece and Slovak Republic. Lithuania is the average of Slovenia and Portugal, while Latvia is the average of Poland and Hungary.

According to our calculation, the third degree polynomial line explains the variance between the between the REDI and Regional Innovation Scoreboard (RIS Index) is 0.68. (*Figure 16*).

Figure 16. The connection between the Regional Entrepreneurship and Development Index (REDI) and the Regional Innovation Scoreboard (RIS 2012)



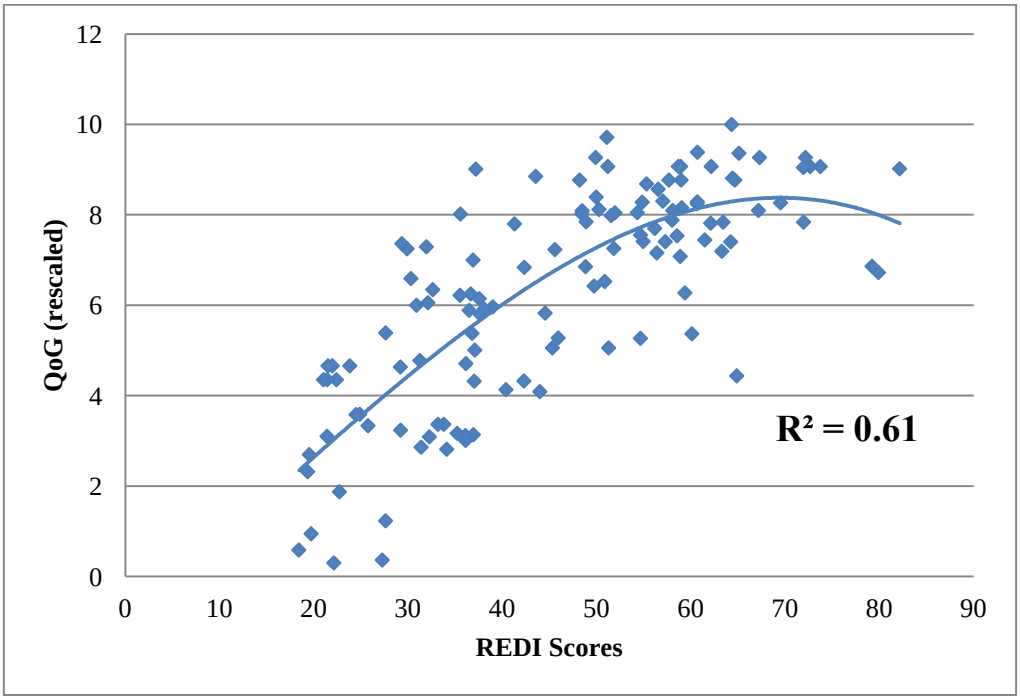
Note: Third degree of polynomial adjustment. Number of observations=125

The European *Quality of Government Index* (QoG Index) and the *Regional Corruption Index* are coming from the same survey. In fact, the Regional Corruption Index is a part of the QUG Index. "The QoG EU Regional Data is the result of a survey of corruption on a regional level within the EU conducted during 2010. It covers all 27 member states and a 172 NUTS 1 and NUTS 2 regions. In total the survey was answered by 34 000 respondents creating the most complete quantitative estimate of QoG to date. The national level estimates are taken from the World Bank Governance Indicators. The regional estimates are comprised of 16 separate indicators." (Source: http://www.qog.pol.gu.se/data/datadownloads/qogeuregionaldata/ 2013.09.28.)

The QoG Index was re-scaled (converted to a scale of 0 to 10). In the case of REDI, the QoG index was employed to measure REDI Business Environment institutional variable (Opportunity Startup pillar), and Regional Corruption Index was used in order to determine REDI Personal Freedom institutional variable (Cultural Support pillar). The Regional Corruption Index is the only institutional variable that appears two times in the REDI, first as a part of the QoG Index and second as an independent regional institutional variable in the Cultural Support.

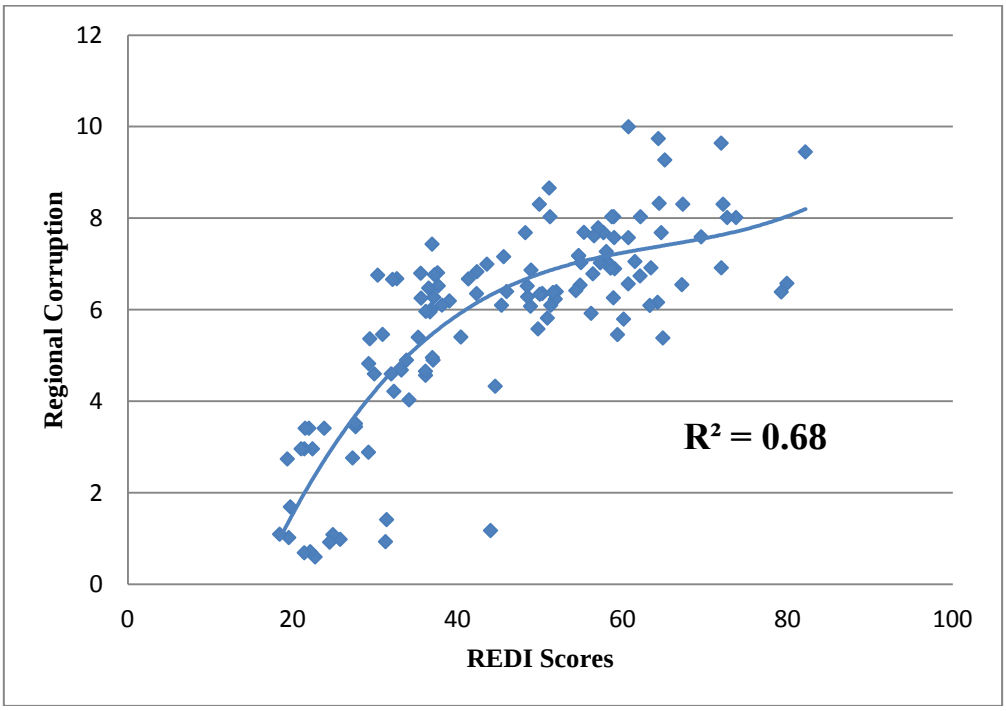
The third degree polynomial line explains 61 percent of the variation in the case of the QoG (*Figure 17*) and 68 percent in the case of the Regional Corruption Index (*Figure 18*).

Figure 17. The connection between the Regional Entrepreneurship and Development Index (REDI) and the Quality of Governance Index (QoG Index)



Note: Third degree polynomial trend-line

Figure 18. The connection between the Regional Entrepreneurship and Development Index (REDI) and the Regional Corruption Index



Note: Third degree polynomial trend-line

Furthermore, as we can see from the correlation table (*Table 14*) that all the four indices correlate significantly with the Regional Entrepreneurship and Development Index. Moreover, all five regional indices have a strong connection with the per capita GDP. This finding is not a surprise since all of them aim to explain different dimensions of regional development.

Table 14. Correlations coefficients between REDI GDP per capita and four regional indices

		1	2	3	4	5	6
1	REDI	1	0.70	0.82	0.86	0.75	0.77
2	GDP per capita		1	0.72	0.74	0.48	0.47
3	Regional Innovation Scoreboard			1	0.85	0.68	0.63
4	Regional Competitiveness Index				1	0.72	0.69
5	Quality of Government					1	0.85
6	Regional Corruption Index						1

Note: All correlations are significant at the 0.01 level

5 Policy Application of the REDI Methodology

5.1 Entrepreneurship Policy in the European Union

The shift from a 'managed' economy to an 'entrepreneurial' economy is among the most important challenges developed economies have faced over the last few decades. This challenge is closely coupled with the increasing importance of non-physical capital, such as human and intellectual capital for wealth creation. The most notable signs of this shift are the following: (1) knowledge is increasingly replacing physical capital and labor as the key driving force of economic growth; (2) individuals rather than large firms are the leading factor in new knowledge creation; (3) alongside with large conglomerates, new and small firms play a dominant role in translating newly created knowledge into marketable goods and services; (4) traditional industrial policy, with antitrust laws and small business protection, has been replaced by a much broader entrepreneurship policy aiming to promote entrepreneurial innovation and facilitate high-growth potential start-ups (*Audretsch*, 2007; *Audretsch – Thurik*, 2001; *Henrekson – Stenkula*, 2009; *Autio et al.*, 2007).

This re-location of emphasis from 'dinosaurs to mice' first begun in the United States, as it took the lead in the transformation from managed to an entrepreneurial economy (Acs, Carlsson and Karlsson, 1999; *Grilo – Thurik, 2005*; *Freytag –Thurik*, 2007). In Europe, this transformation begun a little later, but by 2000, the European Union had fully recognized the importance of entrepreneurship in promoting economic dynamism. In the 2000 Lisboa Strategy former European Commission president Romano Prodi confirmed that "…*there is mounting evidence that the key to economic growth and productivity improvements lies in the entrepreneurial capacity of an economy*" (cited by *Audretsch*, 2009: 256). In 2003, the Green Paper on entrepreneurship provided further detail to the Member States on how to strengthen entrepreneurship (*Green Paper*, 2003).

With an improved understanding of the economic contributions of entrepreneurship, also policy emphasis has gradually evolved. Initially, much of the policy focus was on 'small business', and entrepreneurship was often interpreted as small business activity. Consistent with this interpretation, the EU launched several initiatives, from encouraging entrepreneurial attitudes, supporting entrepreneurial education, culture, and decreasing the administrative and financial burdens to foster business start-up. The *Small Business Act* (2008) summarizes the most important tenet of small business support and entrepreneurship as "Think small first".

Alongside with an early emphasis on small business, there has been a consistent focus on promoting innovation and technology transfer through small start-ups. This emphasis has been reflected in policy initiatives designed to support new business incubators and science parks, notably in the vicinity of universities and higher education institutions. There have also been initiatives to promote networking among science parks (both nationally and internationally), as well as promoting investment in R&D and associated collaboration in new and small firms. This emphasis is also reflected in policy initiatives targeting 'Knowledge-Intensive Services' (KIS).

A major re-orientation in policy thinking was subsequently prompted by the gradual observation that not all new firms contribute equally to employment creation. Instead, studies have shown that only a small minority of new firms in any given cohort will end up creating the bulk of the economic impact created by any new firm cohort (*Autio*, 2006). This observation has prompted a number of initiatives to elaborate the implications of this observation for policy design, including the 'Gazelles' expert

work group under the EU Innova Program (*Autio – Hoeltzl*, 2008). Among the most visible manifestations of this thinking are encapsulated in the EU Knowledge Intensive Services program and the evolving new venture accelerator initiatives.

Summarizing, three distinct foci can be identified in EU entrepreneurship policy, as it has evolved over time: (1) focus on SMEs; (2) focus on innovation through SMEs; and (3) focus on high-growth SMEs. These co-existing foci reflect evolution in the understanding of the varied roles that entrepreneurship can play in economic development. However, although each of these focus areas adds important elements to the European economic policy toolbox, none of them alone provides a definitive answers to the diverse and varied challenges that different European regions face, as they seek to implement policies to enhance regional dynamism and competitiveness.

The most recent evolution in entrepreneurship policy – an increasing emphasis on taking a more holistic and multi-pronged view of entrepreneurship, as advocated by the 'entrepreneurship support ecosystem' thinking – represents yet another evolution in European policy thinking. The focus on 'entrepreneurship ecosystems' calls attention to entrepreneurship support policies and initiatives over the entire lifecycle of the new venture, the key insight being that entrepreneurship support should be considered in a wider regional context. Thus, this emphasis naturally shifts focus towards a regional level of analysis, consistent with the focus of this current report and its 'Systems of Entrepreneurship' approach. Yet, although similar on the surface, the two concepts are fundamentally different. Whereas the notion of 'Entrepreneurship Ecosystems' focuses on entrepreneurship *support* policies and initiatives from a policy perspective, the notion of 'Systems of Entrepreneurship' draws attention to the entrepreneurial dynamic that ultimately drives productivity growth in regions. The two approaches therefore complement one another, and the REDI index should provide important guidance for the design of entrepreneurship support ecosystems.

The REDI index should also lend itself for supporting another, perhaps even more important recent evolution in EU regional and economic policy, notably, the EU Smart Specialization policy. This is a new and evolving focus that has particular relevance in the context of EU regional and cohesion policy. In the following, we suggest that the 'Systems of Entrepreneurship' approach, as described earlier in this report, and the systemic REDI index exhibit features that resonate positively with the Smart Specialization policy emphasis.

5.2 Regional Systems of Entrepreneurship and Smart Specialization

In this report we have argued that at the regional level, entrepreneurship should be treated as a systemic phenomenon, and it should be measured accordingly. Although entrepreneurial actions are ultimately undertaken by individuals, these individuals are always embedded in a given regional context. This context regulates who becomes an entrepreneur, what the ambition level of the entrepreneurial effort is, and what the consequences of entrepreneurial actions are. Because of this embeddedness and the regulating influence of context, we have chosen to develop a complex composite index that captures both individual-level actions as well as contextual influences. The key idea of this systemic index is that system performance is "co-produced" by its constituent elements. This means that the different system components are inter-related. For example, even ambitious entrepreneurs cannot grow their ventures if they cannot access the necessary resources. Technology-based new ventures will find it difficult to innovate if the regional job market does not supply

workforce with the required specialist skills. In a regional system of entrepreneurship, it is the combination of the different components that ultimately determines whether the system will function well or not. The REDI index has been designed to provide a holistic view into the functioning of EU's Regional Systems of Entrepreneurship, and we believe that it should be of particular utility when identifying gaps and bottlenecks that prevent a given region from fully exploiting its entrepreneurial potential.

National and Regional Research and Innovation Strategies for Smart Specialization represent European Commission's answer to the challenge of improving European competitiveness. Set out in the Innovation Union document published in 2010 (*EU Commission*, 2010), Smart Specialization Strategies are policy agendas that build on each country's and region's strengths to focus policy initiatives on key national and regional priorities, challenges and needs for knowledge-based development (*EU Commission*, 2012). At the heart of this approach is the identification and leveraging of each region's distinctive strengths and unique characteristics that can be harnessed to facilitate innovation-based regional competitive advantages (*Foray et al.*, 2009). According to EU definition, "*Smart specialization means identifying the unique characteristics and assets of each country and region, highlighting each region's competitive advantages, and rallying regional stakeholders and resources around an excellence-driven vision of their future*" (*EU Commission*, 2012).

The centrality of Smart Specialization Strategies is for EU competitiveness policy is highlighted by the fact that an explicit Smart Specialization Strategy will be a precondition for using the European Regional Development Fund (ERDF) funding to support investments in research and innovation in EU regions (*EU Commission*, 2012). To receive funding from ERDF and from EU Structural and Cohesion funds, EU regions need to be able to articulate their strategies for building on their distinctive regional strengths. This, for its part, makes it necessary for regions to recognize their strengths – as well as their weaknesses. Identifying these strengths and weaknesses will therefore be a priority, as EU moves towards implementing the 'Horizon 2020' strategy.

However, implementing Smart Specialization strategies is challenging because of the well-known 'Picking the Winners' problem: how can policy-makers decide which regional strengths to pick and invest in, and which ones to abandon? Predicting technological progress is notoriously difficult, and consequently, it is difficult to predict which regional features will provide the foundation for future strengths and weaknesses. As an answer to this conundrum, the Smart Specialization concept advocates the notion of 'Entrepreneurial Discovery' (*Foray et al.*, 2009; *McCann – Ortega-Argilés*, 2013). As defined by the European Commission, the process of Entrepreneurial Discovery is not a top-down process, but rather, "…*involves businesses, research centers and universities working together to identify a Member State or region's most promising areas of specialization, but also the weaknesses that hamper innovation there*" (*EU Commission*, 2012). As noted by *Foray et al* (2009:2), "…*entrepreneurial actors are likely to play leading roles in discovering promising areas of future specialization*" in exploring needed adaptations to local skills, materials, market access conditions, and environmental conditions. However, the authors do not elaborate on how this process is supposed to operate in practice. *McCann et al* (2013:9) shed a little more light on this question, noting that entrepreneurs should play a leading role in identifying viable technological diversification opportunities in regions: "…*it is the entrepreneurs and not the regional policy-makers who are assumed to be best equipped for identifying smart specialization opportunities*…". The implication here is that regional policy-makers should facilitate conditions in which entrepreneurs can effectively search and discover opportunities for smart specialization. Regional policy-makers, then, can learn

from the discoveries made by entrepreneurs and translate these into Smart Specialization Strategies for the region.

While the above guidance provides some pointers as to how the Entrepreneurial Discovery process is assumed to work, it also leaves many questions unanswered: how do entrepreneurs know when they have discovered new regional strengths? How will policy-makers know this? How exactly are policy-makers supposed to learn from entrepreneurs, and how are salient lessons going to be encapsulated in Smart Specialization Strategies for the region? Clearly, while some progress has been made in treating Smart Specialization challenges at conceptual and theoretical levels, practical guidance is still rather vague.

We suggest that the distinctive features of the REDI index – notably, its systemic approach and the Penalty for Bottleneck feature – can be leveraged to support Entrepreneurial Discovery processes in two distinct ways, as EU regions develop Smart Specialization Strategies. First, the index itself provides initial clues on whether a given region's strengths and weaknesses might be found. Second – and more importantly, the REDI index can be used as a platform that facilitates the design of effective policies to support Entrepreneurial Discovery. If used in a correct way, therefore, the REDI index can support the preconditions for creating Smart Specialization Strategies.

As is clear from our discussion of the Systems of Entrepreneurship theory, entrepreneurial dynamics in regions are complex, and an understanding of them requires a holistic approach. This is why the REDI index was designed to incorporate 14 different pillars, each created as a product of individual-level and system-level data. A careful scrutiny of the relative differences between individual pillars, both within a given region and across benchmark regions, should provide good initial guidance for the search of prospective strengths and weaknesses within regions. From a policy perspective, it is important to recognize that the portfolio of policy measures to address regional are likely to be equally complex and intertwined as is the system itself. Therefore, a complex and multi-dimensional index (as opposed to a uni-dimensional one) should be mirrored by a systemic approach to policy portfolio design (as opposed to a siloed approach).

Second, and as a more important aspect, the REDI index should assist regions in creating conditions for effective Entrepreneurial Discovery – i.e., in creating conditions in which the region's entrepreneurial dynamic operates efficiently. Achieving this requires a deep understanding of how the region's System of Entrepreneurship works, what the most important bottlenecks are, and how these could be alleviated. To achieve this understanding, it is important to go beyond the 'hard' numbers, as suggested by the REDI index. Any System of Entrepreneurship will be infinitely more complex than what an index like the REDI index can capture. Therefore, in order to gain an understanding of how a given region's System of Entrepreneurship works, it is important to complement the REDI index with a stakeholder engagement process that is designed to draw out 'soft' insights from various policy stakeholders on what makes the Regional System of Entrepreneurship really work. A suggested approach could work as follows:

- First, conduct a REDI analysis of the region, creating a preliminary list of regional strengths and weaknesses, as suggested by the REDI index
- Second, invite regional entrepreneurship policy stakeholders into a Stakeholder Engagement Workshop that debates the REDI analysis

- Third, draw on the stakeholders' varied perspectives and insights to enrich the REDI analysis and complement REDI data with stakeholders' experience-based insights on the regional realities and entrepreneurial dynamics
- Fourth, collect additional data to further analyze the region's entrepreneurial strengths and weaknesses
- Fifth, conduct further workshops to identify policy actions that can alleviate regional bottlenecks and further improve regional strengths
- Sixth, design an implementation plan to improve the dynamic of the Regional System of Entrepreneurship

Used this way, the REDI index should provide a platform that can be leveraged for the design and facilitation of Smart Specialization Strategies in EU regions.

Finally, the REDI index can be used to identify regional policy priorities through an Entrepreneurship Policy Portfolio Optimization Exercise. An important implication of the REDI analysis is that reducing the differences between the pillars is the best way to increase the value of the indicator. In order to reduce the differences between the pillars the most straightforward way of doing it is by enhancing the weakest REDI pillar. However, another pillar may become the weakest link constraining the performance in the overall entrepreneurship activity. This system dynamics leads to the problem of "optimal" allocation of the additional resources. In other words, if a particular region were to allocate additional resources to improving its REDI Index performance, how should this additional effort be allocated to achieve an "optimal"[9] outcome?

5.3 Regional entrepreneurship policy: Optimizing the resource allocation

As a systemic index, the REDI permits the exploration of different policy scenarios. Because of the Penalty for Bottleneck algorithm, one tempting use of the REDI index is in exploring alternative scenarios for enhancing the entrepreneurial performance of the regional System of Entrepreneurship – as captured by the REDI index. This is because the PFB algorithm 'penalises' system pillars according to gaps exhibited by the most poorly performing pillar – i.e., the 'Bottleneck' pillar. As explained above, the idea is that systems with strong weaknesses cannot fully leverage their strengths: to put another way, weakly performing Bottleneck pillars hold back system performance in situations where system pillars co-produce system performance. A corollary implication of this assumption is that policy effort is allocated most effectively when it seeks to alleviate systemic bottlenecks. Instead of further enhancing systemic strengths, it may be more effective to alleviate the bottlenecks that prevent the system from fully leveraging its strengths.

Using the logic above, we performed a series of simulations exploring the effect of policies designed to alleviate systemic bottlenecks. We have conducted the simulation for all 125 regions but analyze the outcomes only briefly for regional policy implications. The simulation seeks to identify the 'most efficient' allocation of policy effort that seeks to increase the REDI index score by 10 points. The PFB method calculation implies that the greatest improvement in system performance can be achieved by alleviating the weakest performing pillar – the Bottleneck Pillar. In the simulation, each Bottleneck Pillar is alleviated to a point where it seazes to be a bottleneck. At this point, any further effort is

[9]'Optimal' is interpreted in the sense of maximizing the REDI value.

allocated to the second-most binding constraint within the system, again up to a point where this constraint is no longer the most binding constraint within the system. By successively alleviating most binding constraints, our simulation therefore provides an idea of how policy effort should be allocated to achieve an 'optimal' outcome, defined as the largest possible increase in the REDI index score. Table 15 shows the result of this optimization exercise for all the 125 regions of the 24 EU countries.

Note that our simulation rests on a number of constraining assumptions. First, the optimization focuses on the REDI index score, assuming that this score fully reflects the entrepreneurial performance of the system. As we have already noted, systems of entrepreneurship are inherently more complex than any index can capture, so this assumption is restrictive. Second, the simulation assumes that all pillars are equally amenable to manipulation through policy effort. In reality, some pillars can be addressed more easily than others. Third, we have assumed that the cost of improving the value of any pillar is constant. Obviously, some pillars can be more costly to change than others. Across regions, the cost of an improvement of a pillar in larger region like London could also be considerably higher than in a smaller region like Dél Dunántúl in Hungary. Fourth, the PFB is applied equally to all pillars, assuming that all system pillars are equally connected. In reality, some pillars may obviously be more closely connected to one another than to some other pillars. These assumptions mean that the results of the simulation exercise should not be taken as a final truth or as normative policy prescriptions. Instead, the purpose of the simulation exercise is simply to illustrate possible system dynamics under different scenarios. These simulations should then be debated case by case in different regions. Such a debate, we believe, will serve to extract and illuminate region-specific aspects and specialities, which then could inform, e.g., the design of Smart Specialisation Strategies in regions.

Even if the assumptions are restrictive and should be kept in mind, the policy portfolio simulation offers many benefits that go above and beyond what traditional indices can offer. The most important benefit is in drawing attention and highlighting system dynamics in Regional Systems of Entrepreneurship. This reinforces a *systemic perspective* to policy analysis and design over a traditional, *siloed* perspective. A policy scenario simulation that highlights *interconnections within the system* also forces policy analysts and policy-makers to think outside individual policy silos and consider the system performance as a whole. This, then, should help policy-makers also to think about trade-offs between different allocations of policy effort and judge their effectiveness against a system-level performance benchmark. If correctly used, therefore, a policy portfolio simulation should facilitate agreement on system-level policy priorities. This kind of simulation should also help promote awareness of different policy scenarios and associated trade-offs.

The tables below assume a constant amount of additional policy effort, which is distributed across constraining pillars until a 10-point increase in the REDI index score has been achieved. The percentages indicate the distribution of 100 units of this additional policy effort across the constraining pillars, reflecting the relative severity of the pillars in the respective region. In Table 15, there are two rows for each region. A number in row A represents the amount of resources necessary to add to the particular pillar value in order to reach the required allevation of the pillar constraint. Zero value indicates that no additional resource is needed, as the pillar is currently not a binding constraint. The total effort column of Line A provides the overall sum of the required resources. Larger numbers indicate that more resources are necessary for overall performance improvement in a given region, as compared to regions with lower scores. The relative distribution of the required resources is indicated in row B. In the last column we show the percentage increase of the total resources (the sum of the fourteen pillars) necessary

for the 10 point increase of the REDI scores under the assumption of optimal resource allocation.

Note that the values in the 'Total Effort' column (the rightmost one) may vary across regions. This variance reflects the evenness of entrepreneurship system profiles in regions. More uneven profiles are ones where significant relative differences exist across different pillars – in particular, where some pillars exhibit significantly lower values than other pillars. Thus, a more uneven profile signals the existence of more pressing constraints. Conversely, an uneven profile also means that greater benefit can be achieved by focusing most of the additional policy effort into a small number of bottleneck pillars, because bottleneck alleviation enables the system to more fully utilize its existing strengths. The most 'efficient' outcome can be achieved in regions where there is one single pressing bottleneck, which is able to absorb all of the additional policy effort required to produce a 10-point increase in the REDI index value. An example of such regions is Brandenburg (DE4), where the 10-point increase can be produced by alleviating the Process Innovation bottleneck alone. This is reflected in the relatively small additional resource allocation required (0.25 units, as indicated in Row A, or 3% increase in the total policy effort). Another such region is the Bremen region (DE5). In contrast, the Nordrhein-Westfalen region (DEA) has an 'even' profile, and the simulation suggests that additional policy effort needs to be distributed more evenly across system pillars there. This also means that there are few pressing bottlenecks in the Nordrhein-Westfalen region – the implication being that greater overall resources are required to achieve a 10-point increase in system performance. This is because bottlenecks do not similarly constrain overall system performance in the Nordrhein-Westfalen region, and less leverage effect can therefore be achieved by alleviating constraining bottlenecks.

Table 15. Simulation of 'optimal' policy allocation to increase the GEDI score by 10 in the 125 regions

Region code	Region		Opportunity Perception	Startup Skills	Risk Perception	Networking	Cultural Support	Opportunity Startup	Technology Absorption	Human Capital	Competition	Product Innovation	Process Innovaiton	High Growth	Globalization	Financing	Total Effort
AT1	Ostösterreich	A	0	0	0.21	0	0.13	0	0	0.21	0	0	0.08	0.24	0	0	0.87
AT1		B	0%	0%	24%	0%	15%	0%	0%	24%	0%	0%	9%	28%	0%	0%	9%
AT2	Südösterreich	A	0.16	0	0.16	0.01	0.05	0	0	0.26	0.09	0	0.05	0.19	0	0	0.97
AT2		B	16%	0%	16%	1%	5%	0%	0%	27%	9%	0%	5%	20%	0%	0%	12%
AT3	Westösterreich	A	0	0	0.11	0	0.02	0	0.09	0.27	0	0	0.12	0.21	0	0	0.82
AT3		B	0%	0%	13%	0%	2%	0%	11%	33%	0%	0%	15%	26%	0%	0%	11%
BE1	Région de Bruxelles-Capitale	A	0	0	0	0.08	0.21	0.24	0	0	0	0	0.08	0	0	0	0.61
BE1		B	0%	0%	0%	13%	34%	39%	0%	0%	0%	0%	13%	0%	0%	0%	6%
BE2	Vlaams Gewest	A	0.19	0.01	0	0.21	0.18	0	0.05	0	0	0.24	0	0.16	0	0	1.04
BE2		B	18%	1%	0%	20%	17%	0%	5%	0%	0%	23%	0%	15%	0%	0%	11%
BE3	Région wallonne	A	0.18	0	0	0.22	0.25	0.17	0.07	0	0	0.07	0	0	0	0	0.96
BE3		B	19%	0%	0%	23%	26%	18%	7%	0%	0%	7%	0%	0%	0%	0%	11%
CZ	Czech Republic	A	0	0	0.2	0.06	0.12	0.15	0.07	0.19	0.11	0	0	0	0	0	0.9
CZ		B	0%	0%	22%	7%	13%	17%	8%	21%	12%	0%	0%	0%	0%	0%	14%
DE1	Baden-Württemberg	A	0.1	0.02	0.27	0.11	0	0	0	0.2	0	0	0.25	0.03	0.06	0	1.04
DE1		B	10%	2%	26%	11%	0%	0%	0%	19%	0%	0%	24%	3%	6%	0%	12%
DE2	Bayern	A	0.18	0.04	0.26	0.03	0	0.02	0	0.15	0	0.14	0.21	0	0	0	1.03
DE2		B	17%	4%	25%	3%	0%	2%	0%	15%	0%	14%	20%	0%	0%	0%	12%
DE3	Berlin	A	0	0	0.27	0.09	0.09	0	0	0	0	0	0.25	0	0	0	0.7
DE3		B	0%	0%	39%	13%	13%	0%	0%	0%	0%	0%	36%	0%	0%	0%	7%
DE4	Brandenburg	A	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0.25
DE4		B	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	3%
DE5	Bremen	A	0	0	0	0	0	0	0	0	0	0	0	0.27	0	0	0.27
DE5		B	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	3%

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DE6	Hamburg	A	0	0	0.02	0	0	0	0	0	0	0	0.18	0.26	0	0	0.46
DE6		B	0%	0%	4%	0%	0%	0%	0%	0%	0%	0%	39%	57%	0%	0%	5%
DE7	Hessen	A	0.04	0.05	0.29	0.09	0.07	0.13	0.01	0	0	0	0.13	0	0	0	0.81
DE7		B	5%	6%	36%	11%	9%	16%	1%	0%	0%	0%	16%	0%	0%	0%	8%
DE8	Mecklenburg-Vorpommern	A	0.14	0	0.01	0	0	0	0	0.22	0.06	0.18	0.14	0.23	0	0	0.98
DE8		B	14%	0%	1%	0%	0%	0%	0%	22%	6%	18%	14%	23%	0%	0%	18%
DE9	Niedersachsen	A	0.25	0.11	0.24	0.03	0.01	0.02	0.04	0.18	0	0.03	0.22	0	0.01	0	1.14
DE9		B	22%	10%	21%	3%	1%	2%	4%	16%	0%	3%	19%	0%	1%	0%	15%
DEA	Nordrhein-Westfalen	A	0.01	0.19	0.24	0.02	0	0.02	0.03	0.1	0.12	0.1	0.21	0	0	0.1	1.14
DEA		B	1%	17%	21%	2%	0%	2%	3%	9%	11%	9%	18%	0%	0%	9%	14%
DEB	Rheinland-Pfalz	A	0.22	0.07	0.27	0.02	0.1	0.01	0.11	0.13	0.04	0.03	0	0	0	0.06	1.06
DEB		B	21%	7%	25%	2%	9%	1%	10%	12%	4%	3%	0%	0%	0%	6%	13%
DEC	Saarland	A	0.02	0.24	0.22	0.06	0.05	0.01	0	0.18	0.06	0	0.12	0	0	0.11	1.07
DEC		B	2%	22%	21%	6%	5%	1%	0%	17%	6%	0%	11%	0%	0%	10%	13%
DED	Sachsen	A	0.16	0.11	0.2	0	0	0	0	0	0.01	0.27	0.14	0.17	0	0	1.06
DED		B	15%	10%	19%	0%	0%	0%	0%	0%	1%	25%	13%	16%	0%	0%	14%
DEE	Sachsen-Anhalt	A	0.15	0	0.06	0	0	0	0	0.11	0	0	0	0.23	0	0.25	0.8
DEE		B	19%	0%	8%	0%	0%	0%	0%	14%	0%	0%	0%	29%	0%	31%	12%
DEF	Schleswig-Holstein	A	0.1	0	0.05	0	0	0	0	0.03	0	0.3	0	0.08	0	0	0.56
DEF		B	18%	0%	9%	0%	0%	0%	0%	5%	0%	54%	0%	14%	0%	0%	8%
DEG	Thüringen	A	0.1	0	0	0	0	0	0	0	0	0	0.26	0.28	0	0	0.64
DEG		B	16%	0%	0%	0%	0%	0%	0%	0%	0%	0%	41%	44%	0%	0%	10%
DK01	Hovedstaden	A	0	0.08	0.16	0	0	0	0	0	0	0	0	0	0.27	0.1	0.61
DK01		B	0%	13%	26%	0%	0%	0%	0%	0%	0%	0%	0%	0%	44%	16%	5%
DK02	Sjalland	A	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0.25
DK02		B	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	2%
DK03	Syddanmark	A	0	0.14	0	0	0	0	0.08	0	0	0	0.24	0.04	0.17	0	0.67

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DK03		B	0%	21%	0%	0%	0%	0%	12%	0%	0%	0%	36%	6%	25%	0%	7%
DK04	Midtjylland	A	0	0.06	0	0	0	0	0	0	0	0	0.23	0	0.2	0	0.49
DK04		B	0%	12%	0%	0%	0%	0%	0%	0%	0%	0%	47%	0%	41%	0%	5%
DK05	Nordjylland	A	0	0.26	0.05	0	0	0	0	0	0	0	0	0	0.25	0	0.56
DK05		B	0%	46%	9%	0%	0%	0%	0%	0%	0%	0%	0%	0%	45%	0%	5%
EE	Estonia	A	0	0	0	0.13	0.23	0.13	0.04	0	0.05	0.01	0	0	0	0.28	0.87
EE		B	0%	0%	0%	15%	26%	15%	5%	0%	6%	1%	0%	0%	0%	32%	12%
EL1	Voreia Ellada	A	0	0	0.24	0.1	0.26	0.2	0.01	0	0.08	0	0	0.08	0	0	0.97
EL1		B	0%	0%	25%	10%	27%	21%	1%	0%	8%	0%	0%	8%	0%	0%	26%
EL2	Kentriki Ellada	A	0.04	0.05	0.21	0.1	0.21	0.12	0.04	0.03	0.12	0	0	0.15	0.08	0	1.15
EL2		B	3%	4%	18%	9%	18%	10%	3%	3%	10%	0%	0%	13%	7%	0%	37%
EL3	Attiki	A	0	0	0.27	0.08	0.28	0.02	0	0	0.06	0	0	0.01	0	0	0.72
EL3		B	0%	0%	38%	11%	39%	3%	0%	0%	8%	0%	0%	1%	0%	0%	14%
EL4	Nisia Aigaiou. Kriti	A	0.02	0	0.23	0.07	0.24	0.08	0.06	0.07	0.08	0	0	0.15	0.05	0	1.05
EL4		B	2%	0%	22%	7%	23%	8%	6%	7%	8%	0%	0%	14%	5%	0%	30%
ES11	Galicia	A	0.13	0.07	0.1	0.09	0	0	0	0	0.15	0	0.01	0.23	0.23	0.12	1.13
ES11		B	12%	6%	9%	8%	0%	0%	0%	0%	13%	0%	1%	20%	20%	11%	21%
ES12	Principado de Asturias	A	0.1	0.16	0.14	0.12	0	0	0	0	0.15	0	0	0.19	0.22	0.07	1.15
ES12		B	9%	14%	12%	10%	0%	0%	0%	0%	13%	0%	0%	17%	19%	6%	18%
ES13	Cantabria	A	0.1	0.09	0.09	0.03	0	0.01	0	0	0.08	0	0.08	0.25	0.21	0.16	1.1
ES13		B	9%	8%	8%	3%	0%	1%	0%	0%	7%	0%	7%	23%	19%	15%	20%
ES21	País Vasco	A	0	0.03	0.09	0.09	0	0	0	0	0.18	0.07	0	0.2	0.25	0	0.91
ES21		B	0%	3%	10%	10%	0%	0%	0%	0%	20%	8%	0%	22%	27%	0%	13%
ES22	Comunidad Foral de Navarra	A	0.09	0.06	0.07	0.06	0	0	0.01	0	0.17	0.02	0	0.21	0.26	0	0.95
ES22		B	9%	6%	7%	6%	0%	0%	1%	0%	18%	2%	0%	22%	27%	0%	16%
ES23	La Rioja	A	0.07	0.12	0.06	0.04	0	0	0	0	0.15	0.12	0	0.21	0.24	0.02	1.03
ES23		B	7%	12%	6%	4%	0%	0%	0%	0%	15%	12%	0%	20%	23%	2%	18%

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ES24	Aragón	A	0	0	0.03	0	0	0	0	0	0.13	0.31	0.03	0.08	0.19	0	0.77
ES24		B	0%	0%	4%	0%	0%	0%	0%	0%	17%	40%	4%	10%	25%	0%	15%
ES30	Comunidad de Madrid	A	0.02	0.05	0.22	0.17	0	0.18	0	0	0.09	0	0	0.07	0.16	0.08	1.04
ES30		B	2%	5%	21%	16%	0%	17%	0%	0%	9%	0%	0%	7%	15%	8%	13%
ES41	Castilla y León	A	0.16	0.12	0.12	0.09	0	0.08	0.01	0	0.11	0	0	0.24	0.19	0.04	1.16
ES41		B	14%	10%	10%	8%	0%	7%	1%	0%	9%	0%	0%	21%	16%	3%	21%
ES42	Castilla-la Mancha	A	0.21	0.1	0.1	0.06	0	0	0.14	0	0.13	0.16	0	0.19	0.13	0.02	1.24
ES42		B	17%	8%	8%	5%	0%	0%	11%	0%	10%	13%	0%	15%	10%	2%	27%
ES43	Extremadura	A	0.18	0.02	0.05	0.01	0	0	0.04	0	0.11	0.05	0.05	0.24	0.19	0.19	1.13
ES43		B	16%	2%	4%	1%	0%	0%	4%	0%	10%	4%	4%	21%	17%	17%	25%
ES51	Cataluna	A	0.01	0.05	0.15	0.09	0	0.21	0	0	0.11	0.02	0.2	0.16	0.16	0.07	1.23
ES51		B	1%	4%	12%	7%	0%	17%	0%	0%	9%	2%	16%	13%	13%	6%	20%
ES52	Comunidad Valenciana	A	0.04	0.08	0.12	0.09	0	0.05	0.01	0	0.14	0	0.02	0.25	0.22	0.12	1.14
ES52		B	4%	7%	11%	8%	0%	4%	1%	0%	12%	0%	2%	22%	19%	11%	20%
ES53	Illes Balears	A	0.13	0.08	0.09	0.05	0	0	0.12	0	0.09	0	0.06	0.24	0.24	0	1.1
ES53		B	12%	7%	8%	5%	0%	0%	11%	0%	8%	0%	5%	22%	22%	0%	19%
ES61	Andalucía	A	0.15	0.1	0.14	0.09	0	0.15	0.06	0	0.12	0	0	0.19	0.21	0.02	1.23
ES61		B	12%	8%	11%	7%	0%	12%	5%	0%	10%	0%	0%	15%	17%	2%	23%
ES62	Región de Murcia	A	0.15	0.17	0.11	0.1	0	0	0.04	0	0.12	0.01	0	0.22	0.22	0.08	1.22
ES62		B	12%	14%	9%	8%	0%	0%	3%	0%	10%	1%	0%	18%	18%	7%	23%
ES70	Canarias (ES)	A	0.08	0.11	0.1	0.07	0	0	0.13	0	0.11	0.08	0.07	0.23	0.18	0.08	1.24
ES70		B	6%	9%	8%	6%	0%	0%	10%	0%	9%	6%	6%	19%	15%	6%	24%
FI19	Länsi-Suomi	A	0	0	0	0	0	0	0	0	0.09	0	0	0	0.23	0.15	0.47
FI19		B	0%	0%	0%	0%	0%	0%	0%	0%	19%	0%	0%	0%	49%	32%	5%
FI1B	Helsinki-Uusimaa	A	0	0	0	0	0	0	0	0	0	0	0	0.24	0.22	0.13	0.59
FI1B		B	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	41%	37%	22%	6%
FI1C	Etelä-Suomi	A	0	0	0	0	0	0	0	0	0.02	0	0	0.09	0.17	0.27	0.55

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FI1C		B	0%	0%	0%	0%	0%	0%	0%	0%	4%	0%	0%	16%	31%	49%	6%
FI1D	Pohjois- ja Ita-Suomi	A	0	0	0	0	0	0	0	0	0.05	0	0	0.07	0.26	0.15	0.53
FI1D		B	0%	0%	0%	0%	0%	0%	0%	0%	9%	0%	0%	13%	49%	28%	6%
FR1	Île de France	A	0.08	0.18	0	0.23	0.23	0.25	0	0	0	0	0	0	0	0	0.97
FR1		B	8%	19%	0%	24%	24%	26%	0%	0%	0%	0%	0%	0%	0%	0%	8%
FR2	Bassin Parisien	A	0.14	0.2	0	0	0	0	0	0.25	0	0	0	0.15	0	0	0.74
FR2		B	19%	27%	0%	0%	0%	0%	0%	34%	0%	0%	0%	20%	0%	0%	9%
FR3	Nord - Pas-de-Calais	A	0	0.18	0	0.04	0	0	0	0.03	0	0.31	0	0	0	0	0.56
FR3		B	0%	32%	0%	7%	0%	0%	0%	5%	0%	55%	0%	0%	0%	0%	7%
FR4	Est (FR)	A	0.23	0.21	0	0.05	0	0.12	0	0.25	0	0	0	0	0.09	0	0.95
FR4		B	24%	22%	0%	5%	0%	13%	0%	26%	0%	0%	0%	0%	9%	0%	13%
FR5	Ouest (FR)	A	0.22	0.24	0	0.01	0	0	0	0.14	0	0.04	0.07	0.22	0.08	0	1.02
FR5		B	22%	24%	0%	1%	0%	0%	0%	14%	0%	4%	7%	22%	8%	0%	13%
FR6	Sud-Ouest (FR)	A	0.27	0.22	0	0.01	0	0.01	0	0	0.01	0	0	0.09	0.2	0.08	0.89
FR6		B	30%	25%	0%	1%	0%	1%	0%	0%	1%	0%	0%	10%	22%	9%	10%
FR7	Centre-Est (FR)	A	0.18	0.29	0	0.1	0.05	0.02	0	0.09	0	0	0	0	0	0.01	0.74
FR7		B	24%	39%	0%	14%	7%	3%	0%	12%	0%	0%	0%	0%	0%	1%	8%
FR8	Méditerranée	A	0.14	0.16	0	0.05	0.09	0.18	0	0.19	0	0	0	0.07	0.08	0.15	1.11
FR8		B	13%	14%	0%	5%	8%	16%	0%	17%	0%	0%	0%	6%	7%	14%	13%
HR03	Jadranska Hrvatska (Adriatic Croatia)	A	0	0	0.27	0.11	0.12	0	0.02	0.16	0	0.13	0	0	0	0	0.81
HR03		B	0%	0%	33%	14%	15%	0%	2%	20%	0%	16%	0%	0%	0%	0%	15%
HR04	Kontinentalna Hrvatska (Continental Croatia)	A	0	0.01	0.26	0.13	0.1	0.02	0.04	0.13	0	0.14	0	0	0	0.07	0.9
HR04		B	0%	1%	29%	14%	11%	2%	4%	14%	0%	16%	0%	0%	0%	8%	18%
HU10	Közép-Magyarország	A	0	0	0.17	0.03	0.25	0.17	0	0	0.04	0.1	0.06	0	0.03	0	0.85
HU10		B	0%	0%	20%	4%	29%	20%	0%	0%	5%	12%	7%	0%	4%	0%	16%
HU21	Közép-Dunántúl	A	0.1	0	0.15	0.06	0.12	0.01	0.02	0.05	0.09	0.21	0.06	0	0.03	0.25	1.15
HU21		B	9%	0%	13%	5%	10%	1%	2%	4%	8%	18%	5%	0%	3%	22%	34%

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HU22	Nyugat-Dunántúl	A	0	0	0.16	0.06	0.12	0	0	0.01	0.13	0.26	0.15	0.04	0	0.2	1.13
HU22		B	0%	0%	14%	5%	11%	0%	0%	1%	12%	23%	13%	4%	0%	18%	34%
HU23	Dél-Dunántúl	A	0.1	0	0.17	0.06	0.14	0	0.06	0.07	0.13	0.11	0.09	0	0	0.24	1.17
HU23		B	9%	0%	15%	5%	12%	0%	5%	6%	11%	9%	8%	0%	0%	21%	32%
HU31	Észak-Magyarország	A	0.07	0	0.16	0.07	0.13	0.03	0	0.06	0.06	0.22	0.07	0	0.09	0.21	1.17
HU31		B	6%	0%	14%	6%	11%	3%	0%	5%	5%	19%	6%	0%	8%	18%	33%
HU32	Észak-Alföld	A	0.16	0	0.17	0.1	0.14	0.05	0	0.09	0.1	0.17	0	0	0.06	0.22	1.26
HU32		B	13%	0%	13%	8%	11%	4%	0%	7%	8%	13%	0%	0%	5%	17%	40%
HU33	Dél-Alföld	A	0.14	0	0.16	0.09	0.14	0.07	0.07	0.12	0.11	0.11	0.06	0	0.03	0.19	1.29
HU33		B	11%	0%	12%	7%	11%	5%	5%	9%	9%	9%	5%	0%	2%	15%	42%
IE01	Border. Midland and Western	A	0.19	0	0	0.06	0	0.1	0.01	0	0.1	0.29	0.06	0	0.05	0.07	0.93
IE01		B	20%	0%	0%	6%	0%	11%	1%	0%	11%	31%	6%	0%	5%	8%	10%
IE02	Southern and Eastern	A	0.21	0	0	0.04	0.05	0.16	0.08	0	0	0.03	0.08	0.04	0.26	0.05	1
IE02		B	21%	0%	0%	4%	5%	16%	8%	0%	0%	3%	8%	4%	26%	5%	10%
ITC	Nord-Ovest	A	0	0.07	0	0.21	0.1	0.19	0	0.26	0	0.1	0.02	0	0	0	0.95
ITC		B	0%	7%	0%	22%	11%	20%	0%	27%	0%	11%	2%	0%	0%	0%	15%
ITF	Sud	A	0	0	0	0.06	0.12	0.3	0	0.11	0	0	0	0.02	0.09	0	0.7
ITF		B	0%	0%	0%	9%	17%	43%	0%	16%	0%	0%	0%	3%	13%	0%	15%
ITG	Isole	A	0.02	0	0	0.1	0.1	0.29	0.08	0.12	0	0.04	0	0.04	0.05	0.04	0.88
ITG		B	2%	0%	0%	11%	11%	33%	9%	14%	0%	5%	0%	5%	6%	5%	20%
ITH	Nord-Est	A	0.02	0.08	0	0.14	0.03	0.11	0.01	0.17	0	0	0	0.27	0.2	0	1.03
ITH		B	2%	8%	0%	14%	3%	11%	1%	17%	0%	0%	0%	26%	19%	0%	19%
ITI	Centro (IT)	A	0.02	0.04	0	0.17	0.11	0.25	0.03	0.19	0	0.02	0	0.13	0.07	0	1.03
ITI		B	2%	4%	0%	17%	11%	24%	3%	18%	0%	2%	0%	13%	7%	0%	18%
LT	Lithuania	A	0	0	0	0.14	0.15	0.22	0.11	0	0.15	0.15	0	0	0	0.07	0.99
LT		B	0%	0%	0%	14%	15%	22%	11%	0%	15%	15%	0%	0%	0%	7%	18%
LV	Latvia	A	0	0	0	0.18	0.19	0.21	0.09	0	0.03	0.2	0.11	0	0	0.09	1.1

Region code	Region		Opportunity Perception	Startup Skills	Risk Perception	Networking	Cultural Support	Opportunity Startup	Technology Absorption	Human Capital	Competition	Product Innovation	Process Innovaiton	High Growth	Globalization	Financing	Total Effort
LV		B	0%	0%	0%	16%	17%	19%	8%	0%	3%	18%	10%	0%	0%	8%	21%
NL1	Noord-Nederland	A	0.11	0	0.21	0	0	0	0.05	0.2	0	0	0.22	0.08	0.02	0	0.89
NL1		B	12%	0%	24%	0%	0%	0%	6%	22%	0%	0%	25%	9%	2%	0%	11%
NL2	Oost-Nederland	A	0	0	0.27	0	0	0	0	0.25	0	0	0.08	0	0.11	0	0.71
NL2		B	0%	0%	38%	0%	0%	0%	0%	35%	0%	0%	11%	0%	15%	0%	8%
NL3	West-Nederland	A	0	0	0.27	0	0	0	0	0	0	0	0.14	0	0	0	0.41
NL3		B	0%	0%	66%	0%	0%	0%	0%	0%	0%	0%	34%	0%	0%	0%	4%
NL4	Zuid-Nederland	A	0	0	0.29	0	0	0	0	0.11	0	0	0.19	0.09	0	0	0.68
NL4		B	0%	0%	43%	0%	0%	0%	0%	16%	0%	0%	28%	13%	0%	0%	8%
PL1	Region Centralny	A	0	0	0	0	0	0.25	0.21	0	0.03	0	0	0	0	0.11	0.6
PL1		B	0%	0%	0%	0%	0%	42%	35%	0%	5%	0%	0%	0%	0%	18%	9%
PL2	Region Poludniowy	A	0	0	0	0	0.01	0.24	0.11	0.08	0.09	0	0.13	0	0	0	0.66
PL2		B	0%	0%	0%	0%	2%	36%	17%	12%	14%	0%	20%	0%	0%	0%	11%
PL3	Region Wschodni	A	0	0	0	0	0	0.24	0.23	0.15	0.12	0	0	0	0	0.12	0.86
PL3		B	0%	0%	0%	0%	0%	28%	27%	17%	14%	0%	0%	0%	0%	14%	18%
PL4	Region Pólnocno-Zachodni	A	0	0	0	0	0.02	0.23	0.17	0.13	0.16	0	0	0	0	0	0.71
PL4		B	0%	0%	0%	0%	3%	32%	24%	18%	23%	0%	0%	0%	0%	0%	13%
PL5	Region Poludniowo-Zachodni	A	0	0	0	0	0.06	0.23	0.18	0.1	0.15	0	0.05	0	0	0	0.77
PL5		B	0%	0%	0%	0%	8%	30%	23%	13%	19%	0%	6%	0%	0%	0%	13%
PL6	Region Pólnocny	A	0	0	0	0	0	0.21	0.2	0.19	0.16	0	0	0	0	0	0.76
PL6		B	0%	0%	0%	0%	0%	28%	26%	25%	21%	0%	0%	0%	0%	0%	13%
PT11	Norte	A	0	0.05	0	0.11	0.1	0.01	0.22	0.14	0.09	0.16	0	0.22	0	0	1.1
PT11		B	0%	5%	0%	10%	9%	1%	20%	13%	8%	15%	0%	20%	0%	0%	25%
PT15	Algarve	A	0	0.03	0	0.09	0	0	0.08	0.19	0.03	0.25	0.01	0.09	0	0.22	0.99
PT15		B	0%	3%	0%	9%	0%	0%	8%	19%	3%	25%	1%	9%	0%	22%	20%
PT16	Centro (PT)	A	0.19	0	0	0.09	0.02	0	0.22	0.06	0.1	0.09	0	0.11	0	0.18	1.06
PT16		B	18%	0%	0%	8%	2%	0%	21%	6%	9%	8%	0%	10%	0%	17%	24%

Region code	Region		Opportunity Perception	Startup Skills	Risk Perception	Networking	Cultural Support	Opportunity Startup	Technology Absorption	Human Capital	Competition	Product Innovation	Process Innovaiton	High Growth	Globalization	Financing	Total Effort
PT17	Lisboa	A	0	0	0	0.2	0.14	0.08	0.27	0	0.1	0.12	0	0	0	0	0.91
PT17		B	0%	0%	0%	22%	15%	9%	30%	0%	11%	13%	0%	0%	0%	0%	13%
PT18	Alentejo	A	0	0	0	0.04	0	0	0.26	0.06	0.04	0.18	0	0	0	0.19	0.77
PT18		B	0%	0%	0%	5%	0%	0%	34%	8%	5%	23%	0%	0%	0%	25%	15%
RO1	Macroregiunea unu	A	0	0.21	0	0.16	0.1	0.16	0.11	0.01	0.04	0.22	0	0.01	0	0.08	1.1
RO1		B	0%	19%	0%	15%	9%	15%	10%	1%	4%	20%	0%	1%	0%	7%	34%
RO2	Macroregiunea doi	A	0	0.2	0	0.16	0.17	0.21	0.13	0.07	0.04	0.08	0	0	0	0	1.06
RO2		B	0%	19%	0%	15%	16%	20%	12%	7%	4%	8%	0%	0%	0%	0%	33%
RO3	Macroregiunea trei	A	0	0.17	0	0.12	0.18	0.21	0.03	0	0.04	0.12	0	0	0	0.09	0.96
RO3		B	0%	18%	0%	13%	19%	22%	3%	0%	4%	13%	0%	0%	0%	9%	24%
RO4	Macroregiunea patru	A	0	0.19	0	0.14	0.13	0.2	0.05	0	0.04	0.19	0	0	0	0.13	1.07
RO4		B	0%	18%	0%	13%	12%	19%	5%	0%	4%	18%	0%	0%	0%	12%	31%
SE11	Stockholm	A	0	0	0	0	0	0	0	0	0.04	0	0.19	0.26	0.08	0	0.57
SE11		B	0%	0%	0%	0%	0%	0%	0%	0%	7%	0%	33%	46%	14%	0%	5%
SE12	Östra Mellansverige	A	0	0.12	0	0	0	0	0.14	0.18	0.2	0	0.2	0	0.19	0	1.03
SE12		B	0%	12%	0%	0%	0%	0%	14%	17%	19%	0%	19%	0%	18%	0%	10%
SE21	Smaland med öarna	A	0	0	0	0	0	0	0.05	0.07	0	0.21	0.17	0.22	0.09	0	0.81
SE21		B	0%	0%	0%	0%	0%	0%	6%	9%	0%	26%	21%	27%	11%	0%	10%
SE22	Sydsverige	A	0	0	0	0	0	0	0.08	0	0.05	0.1	0.29	0	0.12	0	0.64
SE22		B	0%	0%	0%	0%	0%	0%	13%	0%	8%	16%	45%	0%	19%	0%	6%
SE23	Vastsverige	A	0	0.08	0	0	0	0	0.17	0	0.11	0.22	0	0.18	0.21	0.02	0.99
SE23		B	0%	8%	0%	0%	0%	0%	17%	0%	11%	22%	0%	18%	21%	2%	9%
SE31	Norra Mellansverige	A	0	0.02	0	0	0	0	0.06	0	0.15	0.23	0.16	0.16	0.08	0	0.86
SE31		B	0%	2%	0%	0%	0%	0%	7%	0%	17%	27%	19%	19%	9%	0%	10%
SE32	Mellersta Norrland	A	0	0	0	0	0	0	0	0	0	0.02	0.12	0.22	0	0	0.36
SE32		B	0%	0%	0%	0%	0%	0%	0%	0%	0%	6%	33%	61%	0%	0%	4%
SE33	Övre Norrland	A	0	0	0	0	0	0	0.26	0	0.04	0.01	0	0.24	0.17	0	0.72

Region code	Region		Opportunity Perception	Startup Skills	Risk Perception	Networking	Cultural Support	Opportunity Startup	Technology Absorption	Human Capital	Competition	Product Innovation	Process Innovaiton	High Growth	Globalization	Financing	Total Effort
SE33		B	0%	0%	0%	0%	0%	0%	36%	0%	6%	1%	0%	33%	24%	0%	7%
SI01	Vzhodna Slovenija	A	0.1	0.06	0.28	0.02	0.01	0.13	0.04	0.08	0.21	0	0	0	0	0.07	1
SI01		B	10%	6%	28%	2%	1%	13%	4%	8%	21%	0%	0%	0%	0%	7%	15%
SI02	Zahodna Slovenija	A	0.02	0	0.28	0	0.05	0.16	0	0	0.12	0	0	0.02	0	0.17	0.82
SI02		B	2%	0%	34%	0%	6%	20%	0%	0%	15%	0%	0%	2%	0%	21%	10%
SK01	Bratislavsky kraj	A	0	0	0.07	0	0.24	0.06	0	0	0.03	0	0	0	0	0	0.4
SK01		B	0%	0%	18%	0%	60%	15%	0%	0%	8%	0%	0%	0%	0%	0%	5%
SK02	Západné Slovensko	A	0.08	0	0.07	0	0.22	0.12	0	0.15	0.16	0.17	0	0	0	0	0.97
SK02		B	8%	0%	7%	0%	23%	12%	0%	15%	16%	18%	0%	0%	0%	0%	22%
SK03	Stredné Slovensko	A	0.1	0	0.06	0	0.21	0.12	0.06	0.13	0.15	0.18	0	0	0	0	1.01
SK03		B	10%	0%	6%	0%	21%	12%	6%	13%	15%	18%	0%	0%	0%	0%	25%
SK04	Vychodné Slovensko	A	0.07	0.04	0.07	0	0.22	0.13	0.11	0.16	0.15	0.02	0	0	0	0	0.97
SK04		B	7%	4%	7%	0%	23%	13%	11%	16%	15%	2%	0%	0%	0%	0%	24%
UKC	North East (UK)	A	0	0	0	0	0	0	0	0	0	0	0.16	0	0.28	0.2	0.64
UKC		B	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	25%	0%	44%	31%	8%
UKD	North West (UK)	A	0	0.03	0	0.06	0	0	0	0.06	0	0.14	0.04	0	0.22	0.28	0.83
UKD		B	0%	4%	0%	7%	0%	0%	0%	7%	0%	17%	5%	0%	27%	34%	9%
UKE	Yorkshire and The Humber	A	0	0.02	0	0.03	0	0	0	0.08	0	0.15	0.26	0	0.27	0.1	0.91
UKE		B	0%	2%	0%	3%	0%	0%	0%	9%	0%	16%	29%	0%	30%	11%	11%
UKF	East Midlands (UK)	A	0.05	0.02	0	0	0	0	0	0.06	0	0.27	0.15	0.05	0.23	0.1	0.93
UKF		B	5%	2%	0%	0%	0%	0%	0%	6%	0%	29%	16%	5%	25%	11%	11%
UKG	West Midlands (UK)	A	0.02	0.06	0	0.1	0	0	0	0.08	0	0.19	0.22	0	0.15	0.24	1.06
UKG		B	2%	6%	0%	9%	0%	0%	0%	8%	0%	18%	21%	0%	14%	23%	12%
UKH	East of England	A	0.09	0	0	0.04	0.02	0	0	0.18	0	0.01	0	0	0.19	0.28	0.81
UKH		B	11%	0%	0%	5%	2%	0%	0%	22%	0%	1%	0%	0%	23%	35%	9%
UKI	London	A	0	0	0	0.12	0.19	0.24	0	0	0	0.07	0.18	0	0	0.14	0.94
UKI		B	0%	0%	0%	13%	20%	26%	0%	0%	0%	7%	19%	0%	0%	15%	8%

Region code	Region		Opportunity Perception	Startup Skills	Risk Perception	Networking	Cultural Support	Opportunity Startup	Technology Absorption	Human Capital	Competition	Product Innovation	Process Innovaiton	High Growth	Globalization	Financing	Total Effort
UKJ	South East (UK)	A	0.08	0	0	0.06	0.03	0	0	0.02	0	0.26	0.19	0	0.13	0.15	0.92
UKJ		B	9%	0%	0%	7%	3%	0%	0%	2%	0%	28%	21%	0%	14%	16%	9%
UKK	South West (UK)	A	0.18	0.02	0	0.01	0	0	0.03	0.06	0	0.14	0.15	0.02	0.26	0.13	1
UKK		B	18%	2%	0%	1%	0%	0%	3%	6%	0%	14%	15%	2%	26%	13%	11%
UKL	Wales	A	0.13	0.06	0	0.02	0	0	0	0	0	0.13	0.21	0	0.14	0.26	0.95
UKL		B	14%	6%	0%	2%	0%	0%	0%	0%	0%	14%	22%	0%	15%	27%	12%
UKM	Scotland	A	0.1	0.02	0	0	0	0	0	0	0	0.19	0.13	0	0.1	0.25	0.79
UKM		B	13%	3%	0%	0%	0%	0%	0%	0%	0%	24%	16%	0%	13%	32%	9%
UKN	Northern Ireland (UK)	A	0.11	0.13	0	0.13	0	0	0.03	0.17	0	0.11	0.14	0	0.19	0.17	1.18
UKN		B	9%	11%	0%	11%	0%	0%	3%	14%	0%	9%	12%	0%	16%	14%	14%

Legend: A = required increase in pillar; B = percentage of total effort.

The 'urgency' of action relative to different pillars can be inferred from the relative effort required to produce a 10-point increase in the REDI index score: the higher the relative effort required (as percentage of total additional policy effort to produce a 10-point score increase), the more 'urgent' that bottleneck can be tought to be, as a pressing bottleneck prevents the system from fully leveraging all of its strengths. In Table 16 we categorize the pillars and classify the policy actions for each region according to the 'urgency' of action suggested by our simulation.

In Table 16 we categorize the pillars and classify the policy actions for each region according to the 'urgency' of action suggested by our simulation.

Table 16. Urgency of bottleneck alleviation implied by the portfolio simulation

% of required resource allocation/ Affected regions	All regions in the country	More than 50% of the regions in the country	25- 50 percent of the regions in the country	1-25 percent of the regions in the country
15 percent and up	Top national priority	Top regional priority	Medium regional priority	Low regional priority
10-14 percent	Top national priority	Medium regional priority	Medium regional priority	Low regional priority
5-9 percent	Medium national priority	Low regional priority	Low regional priority	Watch list
3- 5 percent	Low national priority	Watch list	Watch list	Watch list

While perfect categorization is not possible because of the large number of variations, this approach still provides a useful implication of the magnitude of the bottleneck caused by a particular pillar within a given system. In the following we use this categorization to discuss each of the 24 countries included in the REDI index. It is important to remember that bottlenecks are identified and evaluated not on an absolute but on a relative basis, as compared to the other pillar values in the same region. So, it could happen that a region with high REDI score could have a bottleneck pillar value of around 0.60 - for example, the Île de France's lowest pillar score is 0.59 for *Opportunity perception* - that could equal the best pillar score for a less developed region – e.g., the Greek Kentriki Ellada's highest individual pillar value is *Financing* with 0.59 pillar score.

Austria

Austria's three NUTS-1 regions are listed in the first part of ranking with relatively high REDI scores between 60.7 (Ostösterreich) and 50.3 (Westösterreich). The entrepreneurial profiles of the three regions are rather homogeneous with respect to bottleneck pillars. *Human capital*, *Risk perception*, and *High growth* are the weakest pillars that our simulation suggests as top country-wide policy priorities. *Process innovation* is categorized as medium level country wide priority. *Cultural support* constitutes a bottleneck in two out of the three Austrian regions, Ostösterreich and Sudösterreich, so this pillar is indicated as the top regional policy priority. *Opportunity perception* and *Technology absorption* score relatively low in

Südösterreich and Westösterrech, respectively (low policy priority). Moreover, Südösterrech should pay attention to its *Competitiveness* pillar (watch list).

Belgium

Belgium has three NUTS1 regions that perform rather similarly. The leading Région de Bruxelles-Capitale is ranked at the 13th place while Région wallonne is at the 26th place in the overall REDI ranking. The REDI score differences are also minimal, between 64.9 and 60.1. Country-wide problems can be found in two attitude pillars, *Cultural support* and *Networking*. These bottlenecks appear to require country-wide policy action. *Opportunity startup* is the weakest pillar of Région de Bruxelles-Capitale, and it is also a binding constraint for Region Wallonne. *Opportunity perception* score is acceptable in the case of Région de Bruxelles-Capitale, but not for the other two regions. Therefore regional policy should address these two pillars in the affected regions (top priority). *Product innovation* is particularly low in Vlaams Gewest and relatively week in Region Wallonne (medium-level regional policy priority). *Process innovation* is problematic for Région de Bruxelles-Capitale, and *High growth* is for Vlaams Gewest (low priority). Moreover, Vlaams Gewest should pay attention to *Startup skills*. The most developed Région de Bruxelles-Capitale requires the least additional policy effort (0.61) to improve its REDI score by 10 points.

Czech Republic

The Czech Republic consists of only one NUTS1 region, so we do not have the possibility to carry out a regional level analysis. The overall entrepreneurial performance of the country is fair with a REDI score of 37.0 – similar to the Spanish and German regions. There are three pillars, *Risk perception, Human capital* and *Opportunity startup* that are the most binding constraints requiring altogether 60 percent of the additional policy effort to increase the REDI index score by 10 points. *Cultural support* and *Competition* are in the medium level policy priority category. *Technology absorption* and *Networking* are also amongst the least binding constraints. The Czech Republic performs particularly strongly in aspirations related pillars.

Croatia

Croatia, the newest EU member state, has only two NUTS1 regions that have a very similar entrepreneurship level and profile with REDI scores of 32.0 (Jadranska Hrvatska) and 29.9 (Kontinentalna Hrvatska) respectively. At the NUTS1 level it is not worth discussing regional policy in Croatia; national level policy measures are necessary. The most binding constraints are *Risk perception* and *Product innovation.* However, *Human capital*, *Networking* and *Cultural support* all appear to require policy intervention (top priority). *Technology absorption* and *Finance* should be on the watch list.

Denmark

Danish NUTS2 regions are amongst the most entrepreneurial EU regions. In fact Hovedstaden ranks as number one and the worst Danish region, Sjalland ranks at the 23rd place with a still impressive score of 60.7. According to Table 15, seven out of the fourteen pillars perform

well in all five Danish regions. These are: *Opportunity perception, Networking, Cultural support, Opportunity startup, Human capital, Competition*, and *Product innovation*. Minor high growth and a little bit more severe technology absorption problems are suggested in the case of Syddanmark (Watch list). Hovedstaden appears to need to address Financing (low regional priority). Risk perception is indicated as problematic (relatively speaking) for Hovedstaden and for Nordjylland (low regional priority). *Process innovation* is relatively low only in two cases but Syddanmark and Midtjylland should use 36% and 47% of their additional policy effort to improve this pillar (medium level regional priority). *Startup skills* signal need for improvement in four out of the five Danish regions (top regional policy priority). Country-wide action is necessary to improve Globalization that is signaled as the most binding constraint for three Danish regions and the second most important for the remaining two Danish regions.

Estonia

Estonia represents a NUTS1 region as a country. Its 45.9 REDI score is the second highest amongst the former socialist countries after the Slovenian Zahodna Slovenija. Estonia's most problematic pillars are *Financing, Cultural Support, Networking*, and *Opportunity startup*, all requiring more than 15% of the additional resources required for a ten-point REDI score increase. Smaller problems can be noticed in the case of *Competition* and *Technology absorption*. Product innovation is on the watch list with 1% of the required additional resources.

Finland

All Finnish regions can be found in the top half of the REDI ranking. Helsinki-Uusimaa is the best performing region with a REDI score of 62.2. The worst performing region is Pohjois- ja Ita-Suomi with a 51.2 REDI score. Thus, regional differences are relatively small in Finland, as compared to some other EU countries. The same can be noticed about the weak pillars. The relatively low level of *Globalization, High growth* and *Financing* restrict the REDI score of all Finnish regions, implying national level top priorities. *Competition*, the fourth problematic pillar appears to require attention in three out of the four regions. It is categorized as medium level regional policy priority.

France

France is large country with diversely entrepreneurial regions. Íle de France is the top performing French region and is ranked third out of 125 EU regions with a 79.2 REDI score. At the same time, Nord - Pas-de-Calais, the least well performing French NUTS1 region has only a 48.8 REDI score, or 62% lower than the leading Íle de France's score. This is mainly due to the low value of the *Product innovation* pillar. The two most binding pillars, holding back almost all regions, *Startup skills* and *Opportunity perception,* appear to require national, country-wide policy intervention. At the same time, *Risk perception, Startup skills* and *Competition* are properly developed. Five regions are affected by the lack of *Human capital,* and four regions appear to face *High growth* challenges. These are grouped into the top

regional policy priority category. Minor regional policy intervention aååears necessary to improve the *Opportunity startup*, *Globalization* and *Networking* pillars. Interestingly, *Opportunity startup* is the (relatively) weakest pillar of Íle de France. *Cultural support, Financing* and *Product innovation* seem to be problematic for 2-3 regions. Out of these, only Nord - Pas-de-Calais' low product innovation pillar value requires further attention; the others are on the watch list.

Germany

Reflecting lingering post-unification challenges, Germany is probably the most diverse EU country in terms of regional entrepreneurial performance. German regions rank from the 13th to 89th places of the overall REDI ranking. While Berlin is the top performing German region with a 67.2 REDI score, Mecklenburg-Vorpommern has only 35.6 REDI score. All the other former East German regions (Berlin excluded) - Brandenburg, Mecklenburg-Vorpommern, Sachsen, Sachsen-Anhalt, and Thüringen - are at the bottom half of the REDI ranking. Examining the pillar level entrepreneurial profile, there is no pillar that would constitute a bottleneck for all sixteen German regions. On the other hand, each of the fourteen pillars are flagged as bottlenecks for at least one German region. Perhaps a little surprisingly, *Process innovation* is flagged as a binding constraint for twelve out of the sixteen regions. More than 30 percent of the additional resources are necessary to improve process innovation for Berlin, Brandenburg, Hamburg, and Thüringen. To a lesser extent, *Risk perception* is flagged as a bottleneck for thirteen regions. *Opportunity perception* is problematic for nine regions, including all five former East German regions. These three pillars – *Process innovation*, *Risk perception* and *Opportunity perception* – are suggested top regional policy focus. While *High growth* pillar is critically low in seven regions, it severely constraints Bremen's, Thüringen's, Sachsen-Anhalt's, and Hamburg's REDI index score. *Human capital* is found to hold back significantly Baden-Württemberg, Bayern, Mecklenburg-Vorpommern, Niedersachsen, and Saarland and to a lesser extent Nordrhein-Westfalen, Rheinland-Pfalz, and Sachsen-Anhalt. Four regions appear in need to improve *Startup skills* considerably – Niedersachsen, Nordrhein-Westfalen, Saarland, and Sachsen – while two other regions - Rheinland-Pfalz, and Hessen – need a marginal improvement. These three pillars, *High growth, Human capital*, and *Startup skills* are classified as medium level regional policy priorities. *Product innovation*, *Networking* limit less than one-fourth of the regions, so they are in the low regional policy priority category. The other six pillars constraint 1-3 regions in some extent. However, *Risk capital* is flagged as a serious challenge for Sachsen-Anhalt and less serious for Saarland. *Cultural support* is low in Berlin, Opportunity startup in Hessen, technology absorption is problematic in Rheinland-Pfalz, and *Competition* is in Nordrhein-Westfalen. In all these cases the need for local policy intervention is indicated by the simulation.

Greece

The REDI ranks of Greece regions reflect their challenging economic situation: Attiki, the top performing Greece region is ranked 100th, and the other three are ranked between 114th and 123rd places out of 125 regions. Greece's regions appear very similar with respect to their

binding constraints. The two most problematic pillars are *Cultural support* and *Risk perception*. *Networking*, the third pillar in the attitudes and *Competition* are also at a low level in all four regions. *Opportunity Startup* and *High growth* are flagged as problems in three out of the four regions. Altogether Greece's country-level and regional-level entrepreneurship profile seems inconsistent: Relatively good values are indicated for Opportunity recognition, Startup skills, and Product and Process innovation; but values for Risk perception, High growth and Competition.

Hungary

The entrepreneurial profile of Hungarian regions appears polarized: the Közép-Magyarország region exhibits a 31.4 REDI score, wheras all the other six NUTS2 regions' scores are within the 23.8-21.0 REDI score range. All Hungarian regions rank close to the bottom of the European REDI ranking with an overall ranking between 99 (Közép-Magyarország) and 121 (Dél-Alföld). Viewing the problematic fields, four pillars – *Financing, Risk perception, Product innovation,* and *Cultural support* are flagged as top national priorities. *Competition* and *Networking* appear less problematic pillars but both need country-level attention (medium level country level priority). *Opportunity perception* appears problematic for five regions, similar to *Process innovation* and *Opportunity startup.* All three are categorized in the top regional policy priority category. *Human capital* is assigned to the medium-level regional policy priority category. Two other pillars, *Technology adsorption* and *Globalization* are assigned into the low-level regional policy priority group. *High growth* and *Technology absorption* are on the watch list.

Ireland

Despite the hard years since 2008, the two Irish NUST1 regions are amongst the top European performers according to their REDI scores: Southern and Eastern Ireland (72.0) is ranked 7th overall in Europe, and the Border, Midland and Western region (63.4) is ranked as 18th. The entrepreneurial profile of the two regions is pretty similar. *Opportunity perception* and *Opportunity startup* are flagged as constraints for both regions. At the same time, *Product innovation* is the weakest pillar of Midland and Western region, and *Globalization* is the weakest pillar of Border, Midland and Western region. Besides these four pillars, *Process innovation, Financing* and *Networking* appear to require attention.

Italy

It is difficult to describe the entrepreneurial profile of such a large country as Italy according to its limited number, five, NUTS1 regions. While the two top performing Italian regions, Nord-Ovest and Centro are perform similarly to Spanish and the former Eastern German regions, Isole and Sud rank just ahead of some Slovakian and Hungarian regions. While the differences in the level of entrepreneurship are significant – between 40.4 and 27.3 – the pillar profiles of the regions are very similar. Although the population's *Opportunity perception* and *Risk perception* are on a relatively acceptable level, *Opportunity startup* appears the most binding pillar for four regions. Besides *Opportunity startup, Human capital, Networking* and

Cultural support all appear to require national action. *Globalization* and *High growth*, problematic for four regions more, are categorized as top regional policy priorities. *Product innovation* is flagged a binding constraint only for Nord-Ovest. Finally, *Startup skills* pillar is relatively low in three regions, constituting a low level regional policy priority.

Latvia

Latvia is very similar to Lithuania in many respects. It is a small Baltic country constituting one NUTS1 region. Its 33.8 REDI score is just below to that of Lithuania's. The differences are only marginal with respect to the entrepreneurial profile. *Opportunity startup, Product innovation, Cultural support* and *Networking* belong to the top policy priority category. *Process innovation, Technology absorption,* and *Financing* are categorized as secondary important, medium level policy priorities.

Lithuania

Lithuania is one of those countries that constitute a single NUTS1 region. Lithuania's REDI score is 35.2, deserving the 91st ranking, similar to Spanish and Polish regions. The country's entrepreneurial profile is relatively well balanced, having weaknesses mainly in the attitude and ability related pillars, except *Product innovation* that exhibits the second smallest pillar value. Together with *Product innovation,* other three pillars *Opportunity startup, Cultural support,* and *Competition* belong to the top regional policy priority category. *Networking* is just marginally below the 15% threshold value of the required new resources. *Technology absorption* and *Financing* are moderately and weakly binding constraints.

Netherlands

The four Dutch NUTS1 regions rank between 15th and the 53rd places in the REDI ranking. The regional differences in REDI score are moderate, the score values ranging in between 64.4 and 51.1. Unlike many other countries, the Netherlands is characterized by a few bottlenecks only. *Risk perception* is by far the worst performing pillar for three out of the four regions, followed by *Process innovation*. These two pillars are assigned to the country-wide policy priority category. *Human capital* is also low for three regions, except West-Nederland (top regional policy priority). Besides these three pillars, *High growth* and *Globalization* can be problematic for two Dutch regions; they belong to the low-level policy priority category. Moreover, *Technology absorption* appears a minor problem in Noord-Nederland.

Poland

The Polish regions' entrepreneurial level is consistent with their economic development: The six NUT1 regions rank between the 87-88th and the 105th places in the EU REDI ranking. Five out of the six regions look fairly similar, exhibiting REDI scores between 36.1-32.3. The only exception is Region Wschodni with 29.2 REDI score. The similarity continues when we have a look at the entrepreneurial profile of the regions: The most problematic pillars for all regions are in the Entrepreneurial Abilities sub-index. *Opportunity startup* pillar is the most limiting constraint of entrepreneurship followed by *Technology absorption*, and *Competition.* All of

these three pillars are assigned to the national-level policy priority category. *Human capital* is only acceptable in Region Centralny, so it is viewed as a major regional policy priority. *Financing* appears problematic for only two regions, Region Centralny and Region Wschodni, and *Process innovation* for Region Poludniowy and Region Poludniowo-Zachodni. Both *Financing* and *Process innovation* belong to the low policy priority category. Besides these, *Cultural support* is a minor problem for three regions, it worth putting to the watch list.

Portugal

The five Portugal NUTS2 regions exhibit diverse performance for the level and profile of entrepreneurship. Lisboa, the best performing Portugal region is ranked 67th overall with a solid 44.6 REDI score. This is at the same level with some Spanish and the best performing former socialist country regions of Estonia, Germany, Slovenia, and Slovakia. The other four regions are ranked in the bottom third of the ranking with 30.9-27.6 REDI scores. The low level of the *Technology absorption* and the *Product innovation* pillars holds back the entrepreneurial performance of all five regions. *Competition* and *Networking*, to a lesser extent, are also problematic for all Portuguese regions. *Technology absorption* and *Product innovation* are assigned to the top-level policy priority category, while *Competition* and *Networking* are assigned to the medium country-level policy priority category. *Human capital* constraints four regions, while inadequate *Finance* and the lack of *High growth* withholds three regions; all three pillars are assigned to the top-priority regional policy category. *Opportunity perception* appears problematic only for Centro and *Opportunity startup* for Lisboa (low-level regional policy priority). Finally, Startup skills pillar is assigned to the watch list.

Romania

Romania has four NUTS1 regions with very similar, low-level entrepreneurial performance together with some Greek and Hungarian regions. The entrepreneurial profile of the regions is very similar. The REDI scores of the Romanian regions range from 22.1 to 18.4. There are five pillars that do not appear as priorities, relatively speaking: *Opportunity perception, Risk perception, Process innovation, High growth* and *Globalization*. For most of the bottleneck pillars, national-level policy actions appear necessary. These are the cases in the *Opportunity startup, Startup skills, Networking, Product innovation*, and *Cultural support* pillars. *Financing* appears a minor problem for three regions (medium level regional policy priority). *Human capital* appears marginally problematic (from the perspective of bottleneck alleviation) only for Macroregiunea doi (minor regional policy priority).

Spain

Spain is a large EU country with a very diverse level of regional economic development from Extremadura to Madrid. The REDI scores mirror this variety. Extremadura ranks as the bottom Spanish performer with a 30.3 REDI score, and Madrid ranks top with a 54.7 REDI score, out of the total of 17 NUTS2 Spanish regions. At the same time, the problematic pillars, more or less, are about the same across regions: The aspiration related *Globalization*

and *High growth* appear to require country-wide policy intervention. All regions are affected. *Competition* appears a little less problematic: four regions exhibit severe, and eleven regions a moderate bottlenecks for this pillar, relatively speaking. Four out of the five aspiration related pillars, except Cultural support, are also categorized somewhere between the top and medium national priority. Interestingly, Comunidad de Madrid's two out of the three weakest pillar values, *Risk perception* and *Networking*, are in the attitudes. Also interestingly, financial problems do not appear in the top priority list, *Finance* pillar appears really problematic for Cantabria and Extremadura only. Other two regions - Comunidad Valenciana, and Galicia, are relatively less affected by lack of finance when region-specific policy priorities are considered. Less than ten percent of the additional resources required to effect a 10-point REDI score increase are necessary for Comunidad de Madrid, Principado de Asturias, Cataluna, Región de Murcia, and Canarias. In sum, *Finance* can be categorized as medium-level regional policy priority. *Opportunity startup, Technology absorption, Product innovation,* and *Process innovation* pillars all hold back only a few regions, therefore they are assigned to the low level regional policy priority list. *Technology absorption* is at a medium while *Competition* pillar is at a low level national priority list.

Sweden

Most of the eight NUTS2 level Swedish regions are close to the top of the EU REDI ranking. Stockholm, Östra Mellansverige, Vastsverige, and Sydsverige all rank among the top ten regions of the EU with 73.8-67.3 REDI scores. Övre Norrland and Norra Mellansverige REDI scores are also impressive 64.7-57.7, and many regions would happily switch places with the "rank-closer" two Swedish regions Småland med Öarna and Mellersta Norrland that still exhibit 49.9 and 48.2 REDI scores, respectively. While the entrepreneurial profiles of the Swedish regions are rather similar, there is no pillar that stands out as a binding constraint for all eight regions. However, there are several top regional priority pillars, mainly in the aspirations category. *Globalization* constrains seven regions' entrepreneurial performance; *High growth, Process innovation* and *Technology absorption* limit six regions, and *Product innovation* and *Competition* withhold five regions. All of these belong to the top regional policy priority list. Besides these, *Startup skills* and *Human capital* influence negatively two regions, so they are categorized as low-level regional policy priorities.

Slovenia

The two Slovenian NUTS2 regions are the best performers amongst the former socialist countries with their 51.3-45.3 REDI scores. This performance is similar to some Austrian, German, and French regions. By no surprise, the two Slovenian regions face very similar challenges. In such a small country, it is not really fitting to talk about NUTS2-level regional policy. *Risk perception* is the lowest pillar score followed by *Competition* and *Opportunity startup*. The improvement of these pillars could be the priority aim of entrepreneurship policy. *Finance* is more problematic for Zahodna Slovenija, and Vzhodna Slovenija has lower pillar values in *Opportunity perception*, *Human capital* and *Startup skills* than the other regions.

Slovakia

Slovakia's four NUTS2 regions simultaneously exhibit important differences and similarities. The leading Bratislavsky kraj has a 44.0 REDI score and ranks between Lisboa and Schleswig-Holstein. On the other hand, the other three Slovakian regions have 25.8-24.5 REDI scores and rank between some Italian and Hungarian regions at the bottom of the EU REDI ranking. Looking at the entrepreneurial profile of the regions, similar diversity can be noticed. *Cultural support* is the most binding constraint for all regions but particularly so for Bratislavsky kraj. *Cultural support*, together with *Opportunity startup* and *Competition* are assigned to the national policy priority list. *Risk perception* is a medium-level policy priority pillar. *Human capital* is problematic for three regions, except Bratislavsky kraj (top regional policy priority). We assign two pillars, *Product innovation* and *Opportunity perception* to the medium regional policy priority category. Finally Technology absorption, as a marginally problematic pillar is categorized in the low regional policy priority list.

United Kingdom

The UK's regional entrepreneurship performance is amongst the top in the EU. Two leading UK NUTS1 regions, London and South East appear in the top ten of the EU REDI ranking. Most UK regions rank between 22-45 places with good, 61.5-54.7 REDI scores. Only North East looks lagging behind the other regions with a still fair, 48.9 REDI score. Examining the entrepreneurial profile varieties, the two leading regions seem to differ a little bit from the other ten regions. *Financing* is flagged as the most binding constraint for almost all UK regions, suggesting national-level policy action. *Globalization* is also flagged as challenging for most regions except London. *Process innovation* is flagged as a challenge everywhere except for East of England. *Product innovation* holds back ten regions' entrepreneurial performance in terms of the REDI score. The two exceptions are East of England and North East. These pillars are all assigned to the top level regional policy priority category. Seven regions are somewhat limited by the low level of *Opportunity perception* and *Human capital* (medium level regional policy priority). In five regions it appears necessary to improve marginally the *Networking* and *Startup skills* pillars (low level regional policy priority). In contrast to other regions, London faces two binding constraints, *Opportunity startup* and *Cultural support* pillars, that do not characterize the other UK regions.

Policy Portfolio Optimization: Conclusion

In this chapter, we have looked at regions in different EU countries through the lens of REDI policy portfolio optimization exercise. The purpose has been to identify policy priorities in individual regions and countries – as seen through the lens provided by the REDI index. It is important to remember that the priorities have been identified on the basis of REDI's Penalty for Bottleneck algorithm, and the prioritization is condicted relative to the other index pillars within the same region. We have not compared individual pillars across countries but kept our focus strictly on bottleneck alleviation *within* the given region (or country). Even if the overall performance may differ considerably between countries and regions, even the best performing

regions can still have their own bottlenecks and policy priorities, when only that region's strengths and weaknesses are considered.

As noted in Chapter 5.2, the REDI index scores should not be taken as the final truth, but rather, as a first, speculative suggestion on where each region's strengths and weaknesses could be found. Ideally, simulations such as the ones above should be taken as an initial step in a policy debate designed to identify the 'real' strengths and weaknesses of the region. Used this way, we believe that the REDI index can provide a potentially potent platform to facilitate the design in Smart Specialisation Strategies in EU regions.

6 REFERENCES

Acemoglu, D. – Johnson, S. (2005): Unbundling Institutions. *Journal of Political Economy*, 113(5), 947–997.

Acs, Z. J. (1997): Local Geographic Spillovers between University Research and High Technology Innovations. *Journal of Urban Economics*, 42(3), 422–448.

Acs, Z. J. – Audretsch, D. B. –Evans, D. (1994): *Why does the self-employment rate vary across countries and over time?* CERP Working Paper No. 871, Center for Economic Policy Research.

Acs, Z. J. – Audretsch, D. B. – Feldman M. P. (1992). Real Effects of Academic Research. *American Economic Review*, 82(1), 363–367.

Acs, Z. J. – Arenius, P. –Hay, M. – Minniti, M. (2005): *Global Entrepreneurship Monitor: 2004 Executive Report*. London Business School and Babson College, MA, London.

Acs, Z. J. – Braunerhjelm, P. – Audretsch, D. B. – Carlsson, B. (2009): The knowledge spillover theory of entrepreneurship. *Small Business Economics*, 32(1), 15–30.

Acs, Z. J. – Carlsson B. – Karlsson C. (1999): *Entrepreneurship, Small &Medium-Sized Enterprises and the Macroeconomy.* Cambridge University Press, Cambridge, UK

Acs, Z. J. – Desai, S. – Hessels, J. (2008): Entrepreneurship, Economic Development and Institutions. *Small Business Economics*, 31(3), 219–234.

Acs, Z. J. – Szerb, L. (2009): The Global Entrepreneurship Index (GEINDEX). *Foundations and Trends in* Entrepreneurship, 5(5), 341–435.

Acs, Z. J. – Szerb, L. (2010): *The Global Entrepreneurship and Development Index 2011*, Edward Elgar,

Acs, Z. J. – Szerb, L. (2011): *The Global Entrepreneurship and Development Index 2012*, Edward Elgar,

Acs, Z. J. – Autio, E. – Szerb,L. (2013a): National Systems of Entrepreneurship: Measurement issues and policy implications, *Research Policy*, Available online 11 October 2013, ISSN 0048-7333, http://dx.doi.org/10.1016/j.respol.2013.08.016.

Acs, Z. J. – Szerb,L. – Autio, E. (2013b): *The Global Entrepreneurship and Development Index 2013*. Edward Elgar Publishers, Cheltenham.

Acs, Z.J. – Szerb, L. – Ortega-Argilés, R. – Coduras, A. – Aidis, R. (2012): The Regional Entrepreneurship and Development Index (REDI): The Case of Spain. *GMU School of Public Policy Research Paper*, (2012-04).

Acs, Z.J. – Varga (2005): Agglomeration, entrepreneurship and technological change. *Journal of Small Business Economics*, 24(3), 323–334.

[A European Paradise 2009] A European Paradise – turning the European Union into the world's most competitive region, Svenkst Näringsliv, Stockholm

Aghion, P. –Bloom, N. – Blundell, R. – Griffith, R. – Howitt, P. (2005): Competition and Innovation: An Inverted-U Relationship. *Quartely Journal of Economics*, 120(2), 701–728.

Aidis, R. – Estrin, S. – Mickiewicz, T. (2010): Institutions, Finance and the Level of Development: the Impact on Entrepreneurship in Transition, *Review of Economics and Institutions*, 1(1), 1–26.

Aidis, R. – Estrin, S. – Mickiewicz, T. (2008): Institutions and entrepreneurship development in Russia: A comparative perspective. *Journal of Business Venturing*, 23(6), 656–672.

Aldrich, H. E. – Fiol, C. M. (1994): Fools rush in? The institutional context of industry creation. *The Academy of Management Review*, 19(4), 645–670.

Amable, B. (2000): Institutional complementarity and diversity of social systems of innovation and production. *Review of International Political Economy*, 7(4), 645–687.

Andersson R. – Quigley, J. M. –Wilhelmsson, M. (2005): Agglomeration and the spatial distribution of creativity. *Papers in Regional Science*, 84(3), 445–464.

Andersson, M. – Koster, S. (2011): Sources of persistence in regional start-up rates-evidence from Sweden. *Journal of Economic Geography* 11(1), 179–201.

Andersson, M. – Braunerhjelm, P. –Thulin, P. (2011): *Creative Destruction and Productivity – entrepreneurship by type, sector and sequence*. Working Paper Series in Economics and Institutions of Innovation 256, Royal Institute of Technology, CESIS - Centre of Excellence for Science and Innovation Studies.

Annioni, P. –Kozovska, K. (2010): *EU regional competitiveness index 2010*, JRC Scientific and Technical Reports, European Union Luxembourg: Publications Office of the European Union.

Anselin L. – Varga, A. – Acs, Z. J. –Audretsch, D. B. –Feldman M. P. (1992). Real Effects of Academic Research. *American Economic Review, 82(1),* 363-367.

Anokhin, S. – Schulze, W.S. (2009): Entrepreneurship, innovation, and corruption. *Journal of Business Venturing*, 24 (5), 465–476.

Armington C. – Acs, Z. J. (2002): The Determinants of Regional Variation in New Firm Formation. *Regional Studies*, 36(1), 33–45.

Asheim, B. –Gertler, M. (2005): The geography of innovation. *The Oxford handbook of innovation*, 291–317.

Audretsch, D. B. (2009): The entrepreneurial society. *The Journal of Technology Transfer*, 34(3), 245–254,

Audretsch D.B. – Feldman, M. P. (1996): R&D Spillovers and the Geography of Innovation and Production. *American Economic Review*, 86(3), 630–640.

Audretsch, D.B. – Fritsch, M. (1994): The geography of firm births in Germany. *Regional Studies*, 28(4), 359–365.

Audretsch D.B. – Keilbach, M. (2008): Resolving the knowledge paradox: Knowledge spillover entrepreneurship and economic growth. *Research Policy*, 37(10), 1697–1705.

Audretsch D.B. – Keilbach, M. (2007): The localisation of entrepreneurship capital: Evidence from Germany. *Papers in Regional Science*, 86(3), pages 351–365.

Audretsch, D.B. – Keilbach, M.C. – Lehmann, E. E. (2006): *Entrepreneurship and Economic Growth*. Oxford University Press, USA.

Audretsch, D. B. –Thurik, R. A. (2001): What's New about the New Economy? Sources of Growth in the Managed and Entrepreneurial Economies. *Industrial and Corporate Change*, 10(1), 267–315.

Autio, E. (2006): Economic impact of high-growth firms. Report to EU Commissioner for innovation and enterprise. European Commission, Brussels.

Autio, E. (2005): *Global Entrepreneurship Monitor: 2005 Report on high-expectation entrepreneurship.* London Business School and Babson College, London, U.K., and Babson Park, MA.

Autio, E. (2007): *Global entrepreneurship monitor: 2007 Global report on high growth entrepreneurship*. Wellesley, MA/London: Babson College and London Business School.

Autio, E. (2007): *Global Entrepreneurship Monitor: 2007 Global report on high-growth entrepreneurship.* London Business School, Babson College, London, U.K., and Babson Park, MA.

Autio E. – Dahlander L. – Frederiksen, L. (2013): Information exposure, opportunity evaluation and entrepreneurial action: an empirical investigation of an online user community. *Academy of Management Journal* Vol:n/a.

Autio, E. – Hoeltzl, W. (2008): Europe Innova Gazelles Panel Summary Report. In: Innova, E. (Ed.): *Europe Innova Panel Reports*. Brussels: EU DG Innovation.

Autio, E. – Matthew, C. – Hart, M. – Levie, J. – Acs, Z. J. –Szerb, L. (2012): Entrepreneurial Profile of the UK in the Light of the Global Entrepreneurship and Development Index (April 24, 2012). Available at SSRN: http://ssrn.com/abstract=2070320

Baltzopoulos A. – Broström, A. (2011): Attractors of Entrepreneurial Activity: Universities, Regions and Alumni Entrepreneurs. *Regional Studies*, online first

Bartelsman, E. – Haltiwanger, J. – Scarpetta, S. (2004): Microeconomic Evidence of Creative Destruction in Industrial and Developing Countries. *Policy Research Working Paper Series. World Bank*, Washington, D.C.

Bartik, T.J. (1989): Small Business Start-Ups in the United States: Estimates of the Effects of Characteristics of States. *Southern economic journal*, 55(4), 1004–1018.

Bates, T. (1995): Self-employment entry across industry groups. *Journal of Business Venturing*, 10(2): 143–156.

Batjargal, B. (2003): Social Capital and Entrepreneurial Performance in Russia: A Longitudinal Study. *Organization studies*, 24 (4), 535–556.

Baumol, W J. (1993): Formal entrepreneurship theory in economics: existence and bounds. *Journal of Business Venturin*, 8(3): 197–210.

Baumol, W. (1990): Entrepreneurship: productive, unproductive, and destructive. *Journal of Political Economy*, 98(5), 893–921.

Berger, N. A. – Udell, G. F. (1998): The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle. *Journal of Banking & Finance*, 22(6), 613–673.

Birch, D.L. – Medoff, J. (1994): Gazelles. In: Solomon L.C. – Levenson, A. R. (Eds): *Labor markets, employment policy and job creation*. Westview Press.

Blanchflower, D.G. – Oswald, A. – Stutzer, A. (2001): Latent entrepreneurship across nations. *European Economic Review* 45(4–6), pp. 680–691.

Boschma R. – Lambooy, J. (1999): Evolutionary economics and economic geography, *Journal of Evolutionary Economics*, 9(4), 411–429.

Boschma, R.A. – Fritsch, M. (2009): Creative class and regional growth. Empirical evidence from seven European countries. *Economic Geography*, 85(4), 391–423.

Bosma, N. (2013): The Global Entrepreneurship Monitor (GEM) and Its Impact on Entrepreneurship Research. Foundations and Trends in Entrepreneurship, 9(2), 143–248.

Bosma, N. – Acs, Z.J. – Autio, E. – Coduras, A. – Levie, J. (2009.): *GEM executive report 2008*. Babson College, Universidad del Desarrollo, and Global Entrepreneurship Research Consortium.

Bosma, N. – Van Stel, A. – Suddle, K. (2008): The geography of new firm formation: evidence from independent start-ups and new subsidiaries in the Netherlands. *International Entrepreneurship and Management Journal*, 4(2), 129–146.

Bosma, N. – Jones, K. –Autio, E. – Levie, J. (2008): *GEM executive report 2007*. Babson College, London Business School, and Global Entrepreneurship Research Consortium

Bosma, N. – Stam, E. – Wennekers, S. (2012): *Entrepreneurial Employee Activity: A Large Scale International Study*. Tjalling Koopmans Institute Working Paper 12–12. Utrecht University School of Economics, Utrecht.

Bourdieu, P. – Wacquant, L. J. D. (1992): *An Invitation to Reflexive Sociology*. University of Chicago Press, Chicago, IL.

Bygrave, W. D. – Hunt, S. A. (2004) '2004 Financing Report.' *GEM – Global Entrepreneurship Monitor.*

Bygrave, W. – Quill, M. (2007): Global Entrepreneurship Monitor. 2006 Financing Report, Babson College and London Business. School, Wellesley-London.
http://new.gemconsortium.org/assets/uploads/1313508038GEM_2006_Financing_Report.pdf

Canever, M.D. – Carraro,A. – Kohls, V. – Teles, M. (2010): Entrepreneurship in the Rio Grande do Sul, Brazil: the determinants and consequences for the municipal development. *Revista de Economia e Sociologia Rural*, 48(1), 85–108.

Carree, M. – van Stel, A. – Thurik, R. – Wennekers, S. (2002): Economic development and business ownership: An analysis using data of 23 OECD countries in the period 1976–1996. *Small Business Economics*, 19(3), 271–290.

Capello and Lenzi (Eds.) (2013):, Territorial Patterns of Innovation: an Inquiry of the Knowledge Economy in European regions, Routledge, London.

Chatterji, A. – Glaeser, E. L. –Kerr, W. R. (2013): *Clusters of entrepreneurship and innovation*. NBER Working Paper 19013.

Coleman, J.S. (1990): Foundations of Social Theory. Harvard University Press, Cambridge, MA.

Companys, Y. – McMullen, J.S. (2007): Strategic Entrepreneurs at Work: The Nature, Discovery, and Exploitation of Entrepreneurial Opportunities. *Small Business Economics*, 28(4), 301–322.

Cooke, P. N. – Heidenreich, M. – Braczyk, H. J. (2004): Regional Innovation Systems: The role of governance in a globalized world. Psychology Press.

Cooke, P. – Gomez Uranga, M. – Etxebarria, G. (1997): Regional innovation systems: Institutional and organisational dimensions. *Research policy*, 26(4), 475–491.

Cooper A. C. – Dunkelberg, W. C. (1986): Entrepreneurship and paths to business ownership. *Strategic Management Journal*, 7(1), 53–68.

Cooper, A. C. – Gimeno-Gascon, F. J. – Woo, C. Y. (1994): Initial human and financial capital as predictors of new venture performance. *Journal of Business Venturing*, 9(5), 371–395.

Cooper, A.C. – Dunkelberg, W. C. (1987): Entrepreneurship and paths to business ownership. *Strategic management journal*, 7(1), 53–68.

Dahl M. S. – Sorenson, O. (2009): The embedded entrepreneur. *European Management Review*, 6(3), 172–181.

Dahl M. S. – Sorenson, O. (2012): Home sweet home: Entrepreneurs' location choices and the performance of their ventures. *Management Science* (advance access), 1–13.

Davidsson, P. (2004): *Researching entrepreneurship. International Studies in Entrepreneurship*. Springer, Boston.

Davidsson, P. (2004): *Researching entrepreneurship*. Springer, New York.

Davidsson P. – Henrekson, M. (2002): Determinants of the prevalence of start-ups and high-growth firms. *Small Business Economics*, 19(2), 81–104

Davidsson, P. –Lindmark, L. –Olofsson, C. (1994): New Firm Formation and Regional Development in Sweden. *Regional Studies*, 28(4), 395–410.

Delgado, M. – Porter, M.E. – Styern, S. (2010): Clusters and entrepreneurship. *Journal of economic geography*, 10(4), 495–518.

Delmar, F. – Davidsson, P. (2000): Where do they come from? Prevalence and characteristics of nascent entrepreneurs. *Entrepreneurship & Regional Development*, 12(1), 1–23

Denis, D. J. (2004): Entrepreneurial finance: an overview of the issues and evidence. *Journal of Corporate Finance*, 10(2); 301–326

Desai, S. – Acs, Z. J. (2007): A theory of destructive entrepreneurship. *Jena Economic Research Paper, 85.*

Dess, G. G. – Newport, S. – Rasheed, A. A. (1993): Configuration research in strategic management: Key issues and suggestions. *Journal of Management*, 19(4), 775–796.

Ebert U. – Welsch H. (2004): Meaningful environmental indices: a social choice approach, *Journal of Environmental Economics and Management*, 47(2), 270–283.

Edquist C. (1997): *Systems of Innovation. Technologies, institutions and organizations*. Routledge.

Edquist, C. (2005). Systems of innovation. *The Oxford handbook of innovation*, 181–208.

Edquist, C. – Johnson, B. (1997): *Institutions and organizations in systems of innovation*. In: Edquist, C. (Ed.): System of Innovation, Technologies, Institutions and Organizations. Pinter, London, 41–63.

Estrin, S. – Korosteleva, J. – Mickiewicz, T. (2009): *Better Means More: Property Rights and High-Growth Aspiration Entrepreneurship*. IZA Discussion Paper No. 4396

Estrin, S. – Korosteleva, J. – Mickiewicz, T. (2012). Which institutions encourage entrepreneurial growth aspirations? *Journal of Business Venturing*, 28, 564–580.

EU Commission, 2010, Industrial Policy for the Globalisation ERA,

EU Commission. 2010. Innovation Union: Europe 2020 Flagship Initiative. Brussels: European Commission.

EU Commission, Eurostat, Nuts.
http://epp.eurostat.ec.europa.eu/portal/page/portal/nuts_nomenclature/introduction (Available: 21 October 2013).

EU Commission. 2012. Research and innovation strategies for smart specialisation factsheet. In EU Joint Research Centre (Ed.): 7. Seville: Institute for Prospective Technological Studies.

European Commission. (2003). Green Paper Entrepreneurship in Europe. Retrieved 20 November 2007, from http://europa.eu.int/comm/enterprise/entrepreneurship/green_paper/

European Commission (2008a), Think small first: A Small Business Act for Europe, DG Enterprise, Brussels, Belgium.

Falk M. – Leoni, T. (2009): Characteristics of self-employment among university graduates. *Applied Economic Letters*, 16(10), 1065–1071.

Freeman, C. (1988): Inventions, innovations and economic-growth in Sweden - an appraisal of the schumpeterian theory. *Economic Journal*, 98(393), 1232–1234.

Feldman, M. (2001): The entrepreneurial event revisited: firm formation in a regional context. *Industrial and Corporate Change*, 10(4), 861–891.

Freytag, A. – Thurik, A.R. (2007): Entrepreneurship and its determinants in a cross-country setting, *Journal of Evolutionary Economics*, 17(2) 117–131.

Figueiredo O. – Guimarães, P. – Woodward, D. (2002): Home-field Advantage: Location Decisions of Portuguese Entrepreneurs. *Journal of Urban Economics* 52(2), 341–361.

Florida R. (2002a): The Economic Geography of Talent. *Annals of the Association of American Geographers* 92(4), 743–755.

Florida R. (2002b): *The rise of the creative class*. Basic Books.

Foray, D. – David, P. A. – Hall, B. (2009): Smart specialisation – The concept. In: E. D. Research (Ed.). Brussels: European Commission.

Fornahl, D. (2003): Entrepreneurial activities in a regional context. In: Fornahl, D. – Brenner, T. (Eds.): *Cooperation, networks and institutions in regional innovation systems*. Edward Elgar, Cheltenham, 38–57.

Fotopolous G. – Spence, N. (1999): Spatial Variations in New Manufacturing Plant Openings: Some Empirical Evidence from Greece. *Regional Studies*, 33(3), 219–229.

Fritsch, M. (1992): Regional differences in new firm formation: evidence from West Germany. *Regional studies* 26(3), 233–241.

Fritsch M. – Mueller, P. (2007): The persistence of regional new business formation-activity over time – assessing the potential of policy promotion programs. *Journal of Evolutionary Economics*, 17(3), 299–315.

Fritsch, M. – Wyrwich, M. (2012): The Long Persistence of Regional Entrepreneurship Culture: Germany 1925–2005. *Papers in Evolutionary Economic Geography (PEEG)* 1214, Utrecht University, Section of Economic Geography, revised Jul 2012.

Garofoli, G. (1994). New firm formation and regional development: the Italian case. Regional Studies 28 (4), 381-393.

Gartner W. B. (1985): A conceptual framework for describing the phenomenon of new venture creation. *The Academy of Management Review*, 10(4), 696–706.

Gartner, W. B. (1990): What are we talking about when we talk about entrepreneurship? *Journal of Business Venturing*, 5(1), 15–28.

Glaeser, E. – Kerr, W. (2009): Local industrial conditions and entrepreneurship: how much of the spatial distribution can we explain? *Journal of Economics and Management Strategy*, 18(3), 623–663.

Glaeser, E. L. – Saiz, A. (2003): *The rise of the skilled city* (No. w10191). National Bureau of Economic Research.

Grilo, I. –Thurik R.(2005): Latent and Actual Entrepreneurship in Europe and the US: Some Recent Developments. *The International Entrepreneurship and Management Journal*, 1(4), 441-459.

Godin, K. – Clemens, J. Veldhuis, N. (2008): Measuring entrepreneurship conceptual frameworks and empirical indicators. *Studies in Entrepreneurship Markets, 7.*

Goldratt, E. M. (1994): *The goal: A process of ongoing improvement*, 2nd ed., North River Press, Great Barrington, MA.

Gompers, P. A. (1995). Optimal investment, monitoring, and the staging of venture capital. *The journal of finance*, 50(5), 1461–1489.

Gompers, P. – Lerner, J., – Scharfstein, D. (2005): Entrepreneurial spawning: Public corporations and the genesis of new ventures, 1986 to 1999. *The Journal of Finance*, 60(2), 577–614.

Grilo, I. – Thurik, R. A. (2008): Determinants of entrepreneurship in Europe and the U.S. *Industrial and Corporate Change*, 17(6), 1113–1145.

Giovannini, E. – Nardo, M. – Saisana, M. – Saltelli, A. –Tarantola, A., –Hoffman, A. (2008): *Handbook on constructing composite indicators: methodology and user guide. Paris* : Organisation for Economic Cooperation and Development (OECD).

Groh, A. – Liechtenstein, H. – Lieser, K. (2012): The Global Venture Capital and Private Equity Country Attractiveness Index 2012.

Gustafsson, R. – Autio, E. (2011): A failure trichotomy in knowledge exploration and exploitation. *Research Policy*, 40(6), 819–831

Harrison G. W. – Hirshleifer, J. (1989): An experimental evaluation of weakest link/best shot models of public goods. *The Journal of Political Economy*, 97(1), 201–225.

Hart, M. – Gudgin, G. (1994): Spatial variations in new firm formation in the Republic of Ireland, 1980–1990. *Regional Studies*, 28(4), 367–380.

Hausman, N. (2012): University Innovation, Local Economic Growth, and Entrepreneurship. *US Census Bureau Center for Economic Studies Paper No. CES-WP-12-10*.

Hellmann, T. – Puri, M. (2002): Venture Capital and the Professionalization of Start-Up Firms: Empirical Evidence. *The Journal of Finance*, 57(1), 169–197.

Henning, M. – Moodysson, J. – Nilson, M. (2010): Innovation and Regional Transformation. From Clusters to New Combinations, Region Skåne, Malmo, Sweden.

Henrekson M. (2005): Entrepreneurship: A weak link in the welfare state. *Industrial and Corporate Change*, 14(3), 437–467.

Henrekson M. (2007): Entrepreneurship and Institutions. *IFN Working Paper* No. 707.

Henrekson M. – Johansson, D. (2011): Firm growth, institutions, and structural transformation. In: Fritsch M. (Ed.): *Handbook of research on entrepreneurship and regional development*. Edward Elgar Publishers, Cheltenham.

Henrekson, M. – Mikael, Sz. (2009): *Why are There so Few Female Top Executives in Egalitarian Welfare States?* IFN Working Paper No. 786. Available at SSRN: http://ssrn.com/abstract=1331396

Hofstede, G. – Noorderhaven, N. G. – Thurik, A. R. – Uhlaner, L. M. – Wennekers, A. – Wildeman, R. E. (2004): Culture's role in entrepreneurship: Self-employment out of dissatisfaction. In: Brown, T.E. – Ulijn, J. M. (Eds.): *Innovation, Entrepreneurship and Culture*, Edward Elgar, London, 162–198.

Hofstede, G. – Noorderhaven, N. G. – Thurik, A. R. – Uhlaner, L. M. – Wennekers, A. R. – Wildeman, R. E. (2004): Culture's role in entrepreneurship: self-employment out of dissatisfaction. In: Brown, T.E. – Ulijn, J. M. (Eds.): *Innovation, Entrepreneurship and Culture*, Edward Elgar, London, 162-203.

Hung, SC. – Whittington, R. (2011): Agency in national innovation systems: Institutional entrepreneurship and the professionalization of Taiwanese IT. *Research Policy*, 40(4), 526–538.

Iversen J. – Malchow-Møller, N. – Sørensen, A. (2010): Returns to schooling in self-employment. *Economic Letters*, 109(3), 179–182.

Jaffe, A. B. (1993): Manuel Trajtenberg, Rebecca HendersonGeographic Localization of Knowledge Spillovers as Evidenced by Patent Citations *The Quarterly Journal of Economics*, 108 (3), 577–598.

Jaffe, A. B. (1989): Real Effects of Academic Research. *The American Economic Review*, 79(5), 957–970.

Jones-Evans, D. –Thompson, P. (2009): The Spatial Dispersion of Informal Investment at a Regional Level: Evidence from the UK. *European Planning Studies*, 17(5), 659-675

Johansson, B. – Karlsson, C. – Stough, R. R. (Ed.) (2001): *Theories of Endogenous Regional Growth, Lessons for Regional Policies*, Springer, Berlin.

Johnson, S. – McMillan, J. – Woodruff, C. (2002): *Property rights and finance* (No. w8852). National Bureau of Economic Research.

Kangasharju, A. (2000): Regional variations in firm formation: Panel and cross-section data evidence from Finland. *Papers in Regional Science*, 79(4), 355-373.

Kangasharju, A. – Pekkala, S. (2004): Increasing Regional Disparities in the 1990s: The Finnish Experience, *Regional Studies*, 38(3), 255–267.

Kanniainen, V. – Keuschnigg, C. (2004): Start-up investment with scarce venture capital support. *Journal of Banking & Finance*, 28(8), 1935–1959.

Keeble, D. – Walker, S. (1994): New firms, small firms and dead firms: spatial patterns and determinants in the United Kingdom. *Regional studies*, 28(4), 411–427.

Keller, W. (2002): Trade and the Transmission of Technology. *Journal of Economic Growth March* 2002, 7(1), 5–24.

Kern, P. – Runge, J. (2009): KEA briefing: towards a European Creativity Index. *Measuring Creativity*, 191–207. http://ec.europa.eu/education/lifelong-learning-policy/doc/creativity/report/kea.pdf

Kerr W. – Nanda, R. (2009): *Financing constraints and entrepreneurship*. NBER working paper 15498. Cambridge, Mass.

Kirzner, I.M. (1997): Entrepreneurial discovery and the competitive market process: An Austrian approach. *Journal of economic Literature*, 35(1), 60–85.

Koo, J. – Cho, K. (2011): New Firm Formation and Industry Clusters: A Case of the Drugs Industry in the U.S. *Growth and Change*, 42(2), 179–199.

Lazear E. P. (2004): Balanced skills and entrepreneurship. *The American Economic Review*, 94(2), 208–211.

Lazear, E. (2005): Entrepreneurship. *Journal of Labor Economics*, 23(4), 649–680.

Lazerson, M. H. – Lorenzoni, G. (1999): The firms that feed industrial districts: a return to the Italian source. *Industrial and corporate change*, 8(2), 235–266.

Lee, Y. – Florida, R. – Acs, Z. J. (2004): Creativity and Entrepreneurship: A Regional Analysis of New Firm Formation. *Regional Studies*, 38(8), 879–891.

Love, J. H. (1995): The Measurement of Entry Rates: Reconsideration and Resolution. *Empirica*, 22, 1–7.

Lundvall, B. A. (1992): *National systems of innovation: An analytical framework*. Pinter, London.

Lundvall, B. Å. (1999): National business systems and national systems of innovation. *International Studies of Management & Organization*, 29(2), 60–77.

Malecki, E. J. (1997): Entrepreneurs, networks, and economic development: A review of recent research. *Advances in entrepreneurship, firm emergence and growth*, *3*, 57–118.

Malerba, F. (2004): *Sectoral systems of innovation: concepts, issues and analyses of six major sectors in Europe*. Cambridge University Press.

Malerba, F. – Breschi, S. (1997): *Sectoral Innovation Systems*. In: Edquist, C. (Ed.): *Innovation System*. Edgar, London.

Marshall, A. 1920. *Principles of Economics*. London: Macmillan, 8th edition

Martin,R. –Sunley, P. – Turner, D. (2002): Taking risks in regions: the geographical anatomy of Europe's emerging venture capital market. *Journal Economic Geography*, 2(2), 121–150.

Mason, C. – Harrison, R. (2003): Closing the Regional Equity Gap? A Critique of the Department of Trade and Industry's Regional Venture Capital Funds Initiative. *Regional Studies*, 37(8), 855–868.

McCann, P. – Acs, Z. J. (2011): Globalization: Countries, Cities and Multinationals. *Regional Studies*, 45(1), 17–32.

McCann, P. – Ortega-Argilés, R. (2013): Smart Specialization, Regional Growth and Applications to European Union Cohesion Policy. *Regional Studies*, 1–12.

McCann, P. – Van Oort, F. G. (2009): Theories of agglomeration and regional economic growth: a historical review. *Handbook of Regional Growth and Development Theories*, 19–32.

McMullen, J. S. – Shepherd, D. A. (2006): Entrepreneurial action and the role of uncertainty in the theory of the entrepreneur. *Academy of Management Review*, 31(1), 132–152.

Meyer, K. E. – Peng, M. W. (2005): Probing theoretically into Central and Eastern Europe: Transactions, resources, and institutions. *Journal of international business studies*, 36(6), 600–621.

Miller, D. (1986): Configurations of strategy and structure: Towards a synthesis. *Strategic Management Journal*, 7(2), 233–249.

Miller, D. (1996): Configurations revisited. *Strategic Management Journal*, 17(7), 505–512.

Moodysson, J. (2007): *Sites and modes of knowledge creation: on the spatial organization of biotechnology innovation*. Department of Social and Economic Geography, Lund University.

Moretti, E. (2004): Workers' education, spillovers, and productivity: evidence from plant-level production functions. *American Economic Review*, 94(3), 656–690.

Nave, D. (2002): How to compare six sigma, lean and the theory of constraints," *Quality Progress*, 35(3), 73–78.

Nelson, R. R. (1993): *National Innovation Systems: A Comparative Analysis*. University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship. Available at SSRN: http://ssrn.com/abstract=1496195

Norden (2012): The Nordic Growth Entrepreneurship Review 2012, Nordic Innovation Report 2012:25, December 2012.

North, D. (1990): *Institutions, institutional change and economic performance*, Cambridge University Press, Cambridge.

North, D. C. (1994): Economic performance through time. *The American economic review*, 84(3), 359–368.

North, D.C. (1981): *Structure and Change in Economic History*. W.W. Norton, New York.

Ojala, A. – Tyrväinen, P. (2007): Market entry and priority of small and medium-sized enterprises in the software industry: An empirical analysis of cultural distance, geographic distance, and market size. *Journal of International Marketing*, 15(3), 123–149.

Okamuro, H. – Kobayashi, N. (2006): The Impact of Regional Factors on the Start-Up Ratio in Japan*. *Journal of Small Business Management*, 44(2), 310–313.

Parker, S. C. (2004): *The economics of self-employment and entrepreneurship*. Cambridge University Press.

Percoco, M. (2012): Entrepreneurship, social capital and institutions: evidence from Italy. *Spatial Economic Analysis*, 7(3), 339–355.

Piergiovanni, R. – Carree, M. A. – Santarelli, E. (2009): *Creative industries, new business formation and regional economic growth* (No. 2009, 020). Jena economic research papers.

Polanyi, M. (1966): *The Tacit Dimension*, London, Routledge.

Porter, M. (1990): *The competitive advantage of nations*. FreePress, New York.

Porter, M. E. (2000): Location, competition, and economic development: Local clusters in a global economy. *Economic development quarterly*, 14(1), 15–34.

Powell, W. W. – Koput, K. W. – Bowie, J. I. – Doerr, LS (2002): The Spatial Clustering of Science and Capital: Accounting for Biotech Firm-Venture Capital Relationships. *Regional Studies*. 36(3), 291–305.

Radosevic, S. (2007): National systems of innovation and entrepreneurship: In search of a missing link.

Rajan, R. S. – Bird, G. (2001): Still the weakest link: The domestic financial system and post-1998 recovery in East Asia. Adelaide University Discussion Paper No. 0133.

[Regions in the EU 2011]=*Regions in the European Union Nomenclature of territorial units for statistics NUTS 2010/EU-27*, Eurostat, Methodologies & Working Papers. Luxembourg: Publications Office of the European Union, 2011, 143 p.http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-RA-11-011/EN/KS-RA-11-011-EN.PDF (Available: 21 October 2013).

Regulation (EC) No 1059/2003 establishing the common classification of territorial units for statistics (NUTS). Regulation (ec) no 1059/2003 of the European Parliament and of the Council of 26 May 2003 on the establishment of a common classification of territorial units for statistics (NUTS)(OJ L 154, 21.6.2003, p. 1) http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2003R1059:20110207:EN:PDF (Available: 21 October 2013).

Reynolds, P. (1994): Autonomous firm dynamics and economic growth in the United States, 1986–1990. *Regional Studies*, 28(4), 429–442.

Reynolds, P. D. (2007): Entrepreneurship in the United States: The future is now series. *International Studies in Entrepreneurship, 15.*

Reynolds, P. – Bosma, N. – Autio, E. – Hunt, S. – De Bono, N. – Servais, I., ... – Chin, N. (2005): Global entrepreneurship monitor: Data collection design and implementation 1998–2003. *Small Business Economics*, 24(3), 205–231.

Reynolds, P. D. – Storey, D. J. – Westhead, P. (1994): Cross-national comparisons of the variation in new firm formation rates. *Regional Studies*, 28(4) 443–456.

Reynolds, P. – Bosma, N. – Autio, E. –Hunt, S. – De Bono, N. – Servais, I. – Lopez-Garcia, P. – Chin, N. (2005): Global entrepreneurship monitor: Data collection design and implementation 1998–2003. *Small Business Economics* 24 (3): 205–231.

Rocha, H. O. – Sternberg, R. (2005): Entrepreneurship: The role of clusters theoretical perspectives and empirical evidence from Germany. *Small Business Economics*, 24(3), 267-292.

Rodríguez-Pose, A. (2012): Trade and Regional Inequality, *Economic Geography*, 88(2), 109–136, 04.

Rodrik, D. (2008): Second-Best Institutions. *American Economic Review*, 98(2), 100–104.

Rodrik, D. – Subramanian. A. – Trebbi, F. (2004): Institutions Rule: The Primacy of Institutions over Geography and Integration in Economic Development. *Journal of Economic Growth*, 9(2), 131–165.

Rosenberg, N. – Nelson, R. R. (1994): American universities and technical advance in industry. *Research Policy*, 23(3), 323–348.

Rosenberg, N. – Birdzell, L. E. (1986): *How the West Grew Rich: The Economic Transformation of the Industrial World*. Basic Books, New York.

Rotefoss, B. – Kolvereid, L. (2005): Aspiring, nascent and fledgling entrepreneurs: an investigation of the business start-up process. *Entrepreneurship & Regional Development*, 17(2), 109–127.

Schmid, A. A. (2004): Conflict and Cooperation: Institutional and Behavioral Economics. Blackwell, Oxford.

Schramm, C. J. (2008): Economic fluidity: A crucial dimension of economic freedom. In: *2008 Index of Economic Freedom*. Washington, DC: The Heritage Foundation, chap. 1.

Schutjens, V. – Völker, B. (2010): Space and social capital: the degree of locality in entrepreneurs' contacts and its consequences for firm success. *European Planning Studies*, 18(6), 941–963.

Scott, W. R. (1995): *Institutions and organizations*. Thousand Oaks, Calif., Sage.

Shane, S. (2000): Prior knowledge and the discovery of entrepreneurial opportunities. *Organization science*, 11(4), 448–469.

Shane, S. A. (2003): *A general theory of entrepreneurship: The individual-opportunity nexus*. Edward Elgar Pub.

Shane, S. – Venkataraman, S. (2000): The promise of entrepreneurship as a field of research. *Academy of Management Review*, 25(1), 217–226.

Sobel, R. (2008): Testing Baumol: Institutional quality and the productivity of entrepreneurship. *Journal of Business Venturing*, 23(6), 641–655

Sorenson, O. – Audia, P. G. (2000): The Social Structure of Entrepreneurial Activity: Geographic Concentration of Footwear Production in the United States, 1940–19891. *American Journal of Sociology*, 106(2), 424–462.

Spilling, O. R. (1996): Regional variation of new firm formation: the Norwegian case. *Entrepreneurship & Regional Development*, 8(3), 217–244.

Stam, E. (2007): Why Butterflies Don‘t Leave: Locational Behavior of Entrepreneurial Firms. *Economic Geography*, 83(1), 27–50.

Stam, E. – Wennberg, K. (2009): The roles of R&D in new firms growth, *Small Business Economics*, 33(1), 77–89.

Stamatis, D. H. 2004. *Six sigma fundamentals: A complete guide to the system, methods, and tools.* New York: Productivity Press.

Sterberg, R. (2004): *Regional Dimensions of Entrepreneurship.* 5(5) Foundations and Trends in Entrepreneurship, 5, 211–340.

Sternberg, R. (2012). Regional determinants of entrepreneurial activities – theories and empirical design. In: Fritsch, M. (Ed.): *Handbook of research on entrepreneurship and regional development. National and regional perspectives*. Edward Elgar.

Sternberg, R. (2009): Regional dimensions of entrepreneurship. Foundations and Trends in Entrepreneurship 5, Now Publishers.

Sternberg, R. – Rocha, H. O. (2007): Why entrepreneurship is a regional event: Theoretical arguments, empirical evidence, and policy consequences. *Entrepreneurship: The engine of growth*, 3, 215–238.

Sternberg, R. – Litzenberger, T. (2004): Regional Clusters in Germany – their Geography and their Relevance for Entrepreneurial Activities. *European Planning Studies*, 12(6), 767–791.

Szerb, L. – Acs, Z.J. – Autio, E (2013): Entrepreneurship and Policy: The National System of Entrepreneurship in the European Union and in its member countries, *Entrepreneurship Research Journal*. 3(1), 9–34,

Tarabusi, C. E. – Guarini, G. (2012): An Unbalance Adjustment Method for Development Indicators *Social Indicators Research*, 1–27. http://dx.doi.org/10.1007/s11205-012-0070-4

Tarabusi, C. E. – Palazzi, P. (2004): *An index for sustainable development*. *BNL Quarterly Review*, 229,185–206.

Todling, F. – Trippl, M. (2005): One size fits all?: Towards a differentiated regional Innovation policy approach. *Research Policy*, 34 (8), 1203–1219.

Tol, R. S. J. –Yohe, G. W. (2006): The weakest link hypothesis for adaptive capacity: An empirical test," Working paper FNU-97, Forschungsstelle Nachhaltige Umweltentwicklung

Uhlaner, L. – Thurik, R. (2007): Post-materialism: A cultural factor influencing total entrepreneurial activity across nations. *Journal of Evolutionary Economics*, 17(2), 161–185.

Van der Sluis J. – Van Praag, M. – Vijverberg, W. (2008): Education and entrepreneurship selection and performance: A review of the empirical literature. *Journal of Economic Surveys*, 22(5), 795–841.

Van Praag, C. M. – Versloot, P. H. (2007): What is the value of entrepreneurship? A review of recent research. *Small Business Economics*, 29(4), 351–382.

Van Stel, A. – Suddle, K. (2008): The impact of new firm formation on regional development in the Netherlands. *Small Business* Economics, 30(1), 30–47.

Varga, A. (2000): Local academic knowledge transfers and the concentration of economic activity. *Journal of Regional Science*, 40(2), 289–309.

Verheul, I. – Wennekers, S. – Audretsch, D. –Thurik, R. (2002): An Eclectic Theory of Entrepreneurship: Policies, Institutions and Culture. In: Audretsch, D. – Thurik, R. – Verheul, I. –Wennekers, S. (Eds.): *Entrepreneurship: Determinants and policy in a European-US comparison*. Springer, Dordrecht.

Von Mises, L. (1949): *Human Action,* Yale University Press, New Haven, CT.

Wagner, J. – Sternberg, R. (2004): Start-up activities, individual characteristics, and the regional milieu: Lessons for entrepreneurship support policies from German micro data. *The Annals of Regional Science*, 38(2), 219–240.

Wennekers, S. – Thurik, R. (1999): Linking entrepreneurship to economic growth. *Small Business Economics*, 13(1), 27–55.

Westlund, H. (2006): *Social Capital in the Knowledge Economy*. Theory and Empirics, Springer, Berlin.

Westlund, H. – Bolton, R. (2003): Local social capital and entrepreneurship. *Small Business Economics*, 21(2), 77–113.

Winton, A. – Yerramilli, V. (2008):Entrepreneurial finance: Banks versus venture capital. *Journal of Financial Economics*, Volume 88, 51–79.

Yager, R. R. (1996): Quantifier guided aggregation using OWA operators International Journal of Intelligent Systems, 11(1), 49–73.

Yasuhiro, S. – Takatoshi, T. – Kazuhiro, Y. (2012): *Market Size and Entrepreneurship* (No. 12002).

Yohe, G. – Tol, R. S. J. (2001): Indicators for social and economic coping capacity: Moving toward a working definition of adaptive capacity. *Global Environmental Change*, 12(1), 25–40

Young, A. (1992): A tale of two cities: factor accumulation and technical change in Hong Kong and Singapore. In Olivier J. Blanchard and Stanley Fischer, eds., *NBER Macroeconomics Annual,* Cambridge. MIT Press, MA.

Zook, M. A. (2008): Economic Clusters, Knowledge Circulation, and Venture Capital, in *The Geography of the Internet Industry: Venture Capital, Dot-Coms, and Local Knowledge*, Oxford, UK, Blackwell Publishing Ltd.

7 APPENDICES

7.1 Appendix A: The description of the individual variables and indicators used in the REDI

Individual variable	Description	Source of data
Opportunity Recognition	The percentage of the 18-64 aged population recognizing good conditions to start business next 6 months in area he/she lives,	GEM 2007-2011
Skill Perception	The percentage of the 18-64 aged population claiming to possess the required knowledge/skills to start business	GEM 2007-2011
Risk Acceptance	The percentage of the 18-64 aged population stating that the fear of failure would not prevent starting a business	GEM 2007-2011
Know Entrepreneurs	The percentage of the 18-64 aged population knowing someone who started a business in the past 2 years	GEM 2007-2011
Career	The percentage of the 18-64 aged population saying that people consider starting business as good career choice	GEM 2007-2011
Status	The percentage of the 18-64 aged population thinking that people attach high status to successful entrepreneurs	GEM 2007-2011
Career Status	The status and respect of entrepreneurs calculated as the average of Career and Status	GEM 2007-2011
Opportunity Motivation	Percentage of the TEA businesses initiated because of opportunity start-up motive (rather than necessity)	GEM 2007-2011
Technology Level	Percentage of the TEA businesses that are active in technology sectors (high or medium) and belong to the creative sector	GEM 2007-2011
Educational Level	Percentage of the TEA businesses owner/managers having participated over secondary education	GEM 2007-2011
Competitors	Percentage of the TEA businesses started in those markets where not many businesses offer the same product	GEM 2007-2011
New Prod	Percentage of the TEA businesses offering products that are new to at least some of the customers	GEM 2007-2011
New Tech	Percentage of the TEA businesses using new technology that is less than 5 years old average (including 1 year)	GEM 2007-2011

*Prod innovation**	The percentage of the enterprises answering yes to the following question: "During the three years 2008 to 2010, did your enterprise introduce new or significantly improved goods or services?"	Poli-KIT database, in Capello and Lenzi (eds.) (2013), Territorial Patterns of Innovation: an Inquiry of the Knowledge Economy in European regions, Routledge, London, ch. 5
*Tech Innovation**	The percentage of enterprises answering yes to the following question "During the three years 2008 to 2010, did your enterprise introduce New or significantly improved methods of manufacturing or producing goods or services?"	Poli-KIT database, in Capello and Lenzi (eds.) (2013), Territorial Patterns of Innovation: an Inquiry of the Knowledge Economy in European regions, Routledge, London, ch. 5
New Product	New Prod x Prod innovation	GEM 2007-2011
New Technology	New Tech x Tech innovation	GEM 2007-2011
Gazelle	Percentage of the TEA businesses having high job expectation average (over 10 more employees and 50% in 5 years)	GEM 2007-2011
Export	Percentage of the TEA businesses where at least some customers are outside country (over 1%)	GEM 2007-2011
*Informal Investment Mean**	The mean amount of 3 year informal investment	GEM 2007-2011
*Business Angel**	The percentage of the 18-64 aged population who provided funds for new business in past 3 years excluding stocks & funds, average	GEM 2007-2011
Informal Investment	The amount of informal investment calculated as INFINVMEAN* BUSANG	GEM 2007-2011

*Legend: *these are indicators all the others are variables*

7.2 Appendix B: The standard errors of the GEM Adult Population Survey based individual variables for the 125 regions

Code	Region	*Opportunity Recognition*	*Skill Perception*	*Risk Acceptance*	*Know Entrepreneurs*	*Career*	*Status*	*Opportunity Motivation*	*Technology Level*	*Educational Level*	*Competitors*	*New Prod*	*New Tech*	*Gazelle*	*Export*	*Business Angel*	*Informal Investment Mean*
AT1	Ostösterreich	0.012	0.011	0.010	0.010	0.011	0.010	0.025	0.032	0.033	0.038	0.033	0.028	0.017	0.033	0.012	3241
AT2	Südösterreich	0.017	0.016	0.015	0.015	0.016	0.013	0.041	0.050	0.049	0.056	0.050	0.041	0.030	0.052	0.027	5497
AT3	Westösterreich	0.013	0.012	0.011	0.011	0.012	0.010	0.032	0.037	0.038	0.054	0.040	0.033	0.023	0.041	0.017	15806
BE1	Région de Bruxelles-Capitale	0.022	0.020	0.017	0.018	0.020	0.020	0.061	0.072	0.057	0.073	0.072	0.064	0.054	0.063	0.005	7111
BE2	Vlaams Gewest	0.008	0.008	0.007	0.007	0.008	0.008	0.024	0.031	0.033	0.045	0.032	0.031	0.021	0.031	0.002	13755
BE3	Région wallonne	0.010	0.010	0.009	0.009	0.010	0.010	0.032	0.038	0.039	0.053	0.041	0.040	0.030	0.032	0.003	10576
CZ	Czech Republic	0.011	0.011	0.011	0.010	.	0.012	0.037	0.033	0.033	0.048	0.040	0.041	0.036	0.027	0.006	3094
DE1	Baden-Württemberg	0.012	0.011	0.011	0.010	0.012	0.010	0.037	0.040	0.042	0.053	0.041	0.031	0.028	0.043	0.003	19771
DE2	Bayern	0.011	0.010	0.010	0.010	0.011	0.009	0.036	0.039	0.040	0.049	0.036	0.031	0.029	0.039	0.003	12166
DE3	Berlin	0.021	0.020	0.020	0.019	0.021	0.019	0.064	0.068	0.067	0.095	0.068	0.051	0.049	0.065	0.006	20939
DE4	Brandenburg	0.021	0.022	0.022	0.020	0.025	0.022	0.098	0.097	0.090	0.118	0.099	0.049	0.091	0.085	0.006	30943
DE5	Bremen	0.048	0.056	0.057	0.055	0.053	0.046	0.235	0.209	0.132	0.236	0.237	0.182	0.000	0.210	0.017	3469
DE6	Hamburg	0.025	0.023	0.023	0.022	0.026	0.023	0.067	0.072	0.072	0.097	0.071	0.050	0.026	0.072	0.007	16715
DE7	Hessen	0.015	0.015	0.015	0.013	0.016	0.012	0.057	0.057	0.057	0.077	0.060	0.050	0.051	0.057	0.005	13695
DE8	Mecklenburg-Vorpommern	0.021	0.028	0.028	0.025	0.031	0.025	0.122	0.117	0.094	0.125	0.105	0.088	0.040	0.122	0.007	48160

Code	Region	*Opportunity Recognition*	*Skill Perception*	*Risk Acceptance*	*Know Entrepreneurs*	*Career*	*Status*	*Opportunity Motivation*	*Technology Level*	*Educational Level*	*Competitors*	*New Prod*	*New Tech*	*Gazelle*	*Export*	*Business Angel*	*Informal Investment Mean*
DE9	Niedersachsen	0.013	0.013	0.013	0.012	0.015	0.012	0.062	0.063	0.066	0.077	0.065	0.052	0.053	0.066	0.004	16968
DEA	Nordrhein-Westfalen	0.009	0.009	0.009	0.008	0.009	0.008	0.032	0.033	0.034	0.044	0.034	0.029	0.026	0.033	0.002	5633
DEB	Rheinland-Pfalz	0.018	0.019	0.018	0.017	0.020	0.017	0.068	0.069	0.075	0.083	0.074	0.068	0.054	0.072	0.006	19925
DEC	Saarland	0.037	0.036	0.036	0.033	0.036	0.032	0.151	0.156	0.156	0.165	0.156	0.142	0.107	0.154	0.009	30520
DED	Sachsen	0.016	0.017	0.018	0.017	0.020	0.018	0.065	0.067	0.067	0.067	0.059	0.054	0.037	0.065	0.005	22150
DEE	Sachsen-Anhalt	0.021	0.024	0.024	0.022	0.026	0.021	0.092	0.085	0.087	0.094	0.091	0.088	0.029	0.088	0.005	3095
DEF	Schleswig-Holstein	0.019	0.021	0.022	0.019	0.025	0.021	0.082	0.084	0.093	0.133	0.064	0.088	0.040	0.085	0.006	5729
DEG	Thüringen	0.024	0.027	0.029	0.026	0.028	0.024	0.137	0.133	0.134	0.129	0.133	0.071	0.000	0.137	0.007	48926
DK01	Hovedstaden	0.011	0.010	0.010	0.010	0.014	0.011	0.033	0.041	0.035	0.060	0.039	0.041	0.036	0.041	0.003	14450
DK02	Sjalland	0.016	0.014	0.014	0.014	0.021	0.018	0.054	0.059	0.061	0.085	0.062	0.060	0.048	0.053	0.004	26957
DK03	Syddanmark	0.013	0.011	0.012	0.011	0.017	0.014	0.038	0.051	0.053	0.075	0.053	0.048	0.034	0.054	0.003	29988
DK04	Midtjylland	0.012	0.011	0.011	0.011	0.016	0.013	0.040	0.051	0.051	0.073	0.052	0.042	0.040	0.052	0.003	18441
DK05	Nordjylland	0.018	0.016	0.017	0.017	0.024	0.020	0.063	0.079	0.078	0.130	0.079	0.073	0.060	0.080	0.005	50586
EE	Estonia	0.014	0.012	0.012	0.012	0.013	0.013	0.026	0.028	0.032	0.043	0.032	0.029	0.027	0.031	0.013	1326
EL1	Voreia Ellada	0.008	0.010	0.010	0.010	0.010	0.010	0.030	0.027	0.032	0.041	0.032	0.031	0.016	0.032	0.003	10206
EL2	Kentriki Ellada	0.010	0.012	0.012	0.011	0.011	0.011	0.031	0.028	0.033	0.041	0.033	0.032	0.011	0.033	0.004	6141
EL3	Attiki	0.009	0.011	0.011	0.011	0.011	0.011	0.031	0.034	0.035	0.046	0.035	0.034	0.016	0.035	0.003	5948
EL4	Nisia Aigaiou0. Kriti	0.016	0.020	0.019	0.019	0.018	0.017	0.041	0.044	0.050	0.072	0.052	0.050	0.020	0.052	0.005	17531
ES11	Galicia	0.005	0.005	0.005	0.005	0.005	0.005	0.017	0.020	0.021	0.028	0.021	0.019	0.011	0.019	0.002	2294

Code	Region	*Opportunity Recognition*	*Skill Perception*	*Risk Acceptance*	*Know Entrepreneurs*	*Career*	*Status*	*Opportunity Motivation*	*Technology Level*	*Educational Level*	*Competitors*	*New Prod*	*New Tech*	*Gazelle*	*Export*	*Business Angel*	*Informal Investment Mean*
ES12	Principado de Asturias	0.005	0.006	0.006	0.005	0.006	0.006	0.024	0.026	0.028	0.035	0.028	0.028	0.015	0.027	0.002	4194
ES13	Cantabria	0.006	0.008	0.008	0.007	0.008	0.008	0.028	0.032	0.032	0.048	0.032	0.028	0.014	0.030	0.002	2353
ES21	País Vasco	0.005	0.005	0.005	0.005	0.005	0.005	0.019	0.022	0.023	0.032	0.023	0.021	0.011	0.021	0.002	5384
ES22	Comunidad Foral de Navarra	0.005	0.006	0.006	0.005	0.005	0.006	0.020	0.021	0.023	0.033	0.023	0.021	0.011	0.021	0.002	4236
ES23	La Rioja	0.008	0.009	0.009	0.009	0.009	0.009	0.029	0.037	0.038	0.055	0.039	0.037	0.020	0.034	0.003	2874
ES24	Aragón	0.005	0.006	0.006	0.006	0.006	0.006	0.019	0.022	0.025	0.033	0.024	0.021	0.013	0.022	0.002	4673
ES30	Comunidad de Madrid	0.005	0.005	0.005	0.005	0.005	0.005	0.015	0.018	0.018	0.024	0.019	0.018	0.011	0.018	0.002	3747
ES41	Castilla y León	0.005	0.007	0.006	0.006	0.007	0.007	0.024	0.025	0.027	0.040	0.027	0.026	0.012	0.025	0.002	3153
ES42	Castilla-la Mancha	0.006	0.007	0.007	0.006	0.007	0.007	0.024	0.023	0.028	0.037	0.027	0.025	0.014	0.026	0.002	6277
ES43	Extremadura	0.006	0.007	0.007	0.007	0.007	0.008	0.026	0.029	0.031	0.042	0.030	0.026	0.012	0.028	0.002	1922
ES51	Cataluna	0.005	0.005	0.005	0.005	0.005	0.005	0.015	0.018	0.019	0.026	0.019	0.015	0.010	0.018	0.002	3850
ES52	Comunidad Valenciana	0.005	0.005	0.005	0.005	0.005	0.005	0.017	0.019	0.020	0.027	0.020	0.018	0.009	0.018	0.002	2058
ES53	Illes Balears	0.008	0.010	0.010	0.009	0.010	0.010	0.028	0.034	0.036	0.050	0.036	0.034	0.020	0.033	0.003	8476
ES61	Andalucía	0.005	0.006	0.006	0.005	0.006	0.006	0.020	0.021	0.022	0.032	0.021	0.020	0.011	0.020	0.002	3392
ES62	Región de Murcia	0.005	0.006	0.006	0.006	0.006	0.006	0.020	0.023	0.023	0.031	0.023	0.023	0.012	0.021	0.002	3621
ES70	Canarias (ES)	0.005	0.006	0.006	0.005	0.005	0.006	0.018	0.020	0.021	0.028	0.021	0.019	0.012	0.020	0.002	3448
FI19	Länsi-Suomi	0.012	0.010	0.010	0.010	0.010	0.008	0.028	0.037	0.034	0.041	0.034	0.031	0.025	0.032	0.003	3681
FI1B	Helsinki-Uusimaa	0.016	0.013	0.012	0.013	0.013	0.009	0.041	0.050	0.046	0.055	0.046	0.041	0.024	0.045	0.004	9496
FI1C	Etelä-Suomi	0.015	0.013	0.012	0.013	0.014	0.009	0.038	0.045	0.045	0.058	0.046	0.040	0.029	0.045	0.004	2344

Code	Region	*Opportunity Recognition*	*Skill Perception*	*Risk Acceptance*	*Know Entrepreneurs*	*Career*	*Status*	*Opportunity Motivation*	*Technology Level*	*Educational Level*	*Competitors*	*New Prod*	*New Tech*	*Gazelle*	*Export*	*Business Angel*	*Informal Investment Mean*
FI1D	Pohjois- ja Ita-Suomi	0.014	0.012	0.011	0.012	0.012	0.008	0.034	0.039	0.038	0.049	0.037	0.031	0.022	0.035	0.004	5003
FR1	Île de France	0.016	0.015	0.015	0.016	0.015	0.015	0.040	0.052	0.050	0.066	0.051	0.051	0.049	0.050	0.006	9870
FR2	Bassin Parisien	0.015	0.014	0.016	0.015	0.016	0.015	0.060	0.082	0.078	0.116	0.084	0.084	0.042	0.083	0.005	15306
FR3	Nord - Pas-de-Calais	0.021	0.022	0.024	0.023	0.023	0.023	0.101	0.113	0.132	0.169	0.116	0.127	0.109	0.111	0.006	15140
FR4	Est (FR)	0.019	0.020	0.022	0.021	0.022	0.020	0.079	0.076	0.080	0.118	0.084	0.080	0.057	0.084	0.007	21891
FR5	Ouest (FR)	0.017	0.016	0.018	0.018	0.017	0.016	0.055	0.064	0.065	0.080	0.065	0.058	0.033	0.065	0.005	14549
FR6	Sud-Ouest (FR)	0.019	0.020	0.020	0.020	0.019	0.018	0.053	0.067	0.068	0.080	0.069	0.068	0.042	0.069	0.007	4884
FR7	Centre-Est (FR)	0.019	0.018	0.019	0.019	0.018	0.018	0.059	0.073	0.076	0.100	0.077	0.072	0.060	0.074	0.007	14805
FR8	Méditerranée	0.020	0.020	0.020	0.020	0.020	0.019	0.064	0.066	0.070	0.087	0.070	0.070	0.044	0.070	0.007	4913
HR03	Jadranska Hrvatska (Adriatic Croatia)	0.010	0.010	0.010	0.010	0.010	0.011	0.029	0.030	0.028	0.039	0.028	0.030	0.025	0.026	0.003	13292
HR04	Kontinentalna Hrvatska (Continental Croatia)	0.008	0.008	0.008	0.008	0.008	0.008	0.027	0.028	0.027	0.036	0.025	0.028	0.024	0.026	0.002	6225
HU10	Közép-Magyarország	0.011	0.011	0.011	0.011	0.012	0.011	0.029	0.029	0.031	0.039	0.027	0.023	0.023	0.030	0.004	6737
HU21	Közép-Dunántúl	0.016	0.018	0.018	0.017	0.019	0.017	0.055	0.054	0.062	0.088	0.057	0.050	0.047	0.059	0.005	2427
HU22	Nyugat-Dunántúl	0.018	0.020	0.020	0.018	0.021	0.019	0.056	0.062	0.066	0.095	0.054	0.047	0.037	0.066	0.005	4457
HU23	Dél-Dunántúl	0.015	0.019	0.019	0.018	0.020	0.017	0.049	0.052	0.062	0.086	0.059	0.052	0.047	0.062	0.006	1421
HU31	Észak-Magyarország	0.015	0.018	0.018	0.016	0.019	0.017	0.056	0.057	0.062	0.088	0.060	0.048	0.058	0.057	0.005	1153
HU32	Észak-Alföld	0.013	0.016	0.016	0.014	0.017	0.014	0.051	0.052	0.055	0.081	0.048	0.045	0.035	0.053	0.004	1988
HU33	Dél-Alföld	0.013	0.017	0.017	0.015	0.018	0.015	0.050	0.044	0.050	0.066	0.047	0.040	0.037	0.051	0.005	1936

Code	Region	*Opportunity Recognition*	*Skill Perception*	*Risk Acceptance*	*Know Entrepreneurs*	*Career*	*Status*	*Opportunity Motivation*	*Technology Level*	*Educational Level*	*Competitors*	*New Prod*	*New Tech*	*Gazelle*	*Export*	*Business Angel*	*Informal Investment Mean*
IE01	Border0. Midland and Western	0.013	0.015	0.014	0.014	0.015	0.011	0.045	0.047	0.042	0.066	0.048	0.043	0.036	0.047	0.005	13305
IE02	Southern and Eastern	0.008	0.008	0.008	0.008	0.008	0.006	0.024	0.026	0.024	0.038	0.027	0.024	0.023	0.027	0.003	8214
ITC	Nord-Ovest	0.012	0.012	0.012	0.010	0.012	0.012	0.039	0.050	0.048	0.058	0.048	0.044	0.036	0.050	0.003	19944
ITF	Sud	0.012	0.012	0.012	0.012	0.012	0.012	0.045	0.050	0.049	0.062	0.049	0.049	0.028	0.047	0.003	7408
ITG	Isole	0.017	0.018	0.018	0.017	0.017	0.017	0.056	0.063	0.067	0.074	0.067	0.065	0.037	0.066	0.004	26221
ITH	Nord-Est	0.014	0.013	0.014	0.013	0.014	0.014	0.044	0.058	0.059	0.079	0.058	0.053	0.025	0.054	0.003	18207
ITI	Centro (IT)	0.013	0.014	0.014	0.012	0.014	0.014	0.048	0.058	0.058	0.069	0.060	0.059	0.036	0.060	0.003	7786
LT	Lithuania	0.010	0.011	0.011	0.010	.	.	0.030	0.026	0.027	0.047	0.032	0.032	0.030	0.032	0.005	5636
LV	Latvia	0.006	0.006	0.006	0.006	0.007	0.007	0.015	0.017	0.017	0.022	0.017	0.015	0.015	0.017	0.002	2922
NL1	Noord-Nederland	0.017	0.016	0.015	0.015	0.012	0.016	0.039	0.050	0.049	0.080	0.056	0.044	0.032	0.056	0.004	21016
NL2	Oost-Nederland	0.013	0.011	0.010	0.011	0.009	0.011	0.034	0.039	0.036	0.061	0.041	0.035	0.027	0.040	0.003	10921
NL3	West-Nederland	0.009	0.008	0.007	0.008	0.006	0.008	0.019	0.024	0.024	0.033	0.024	0.020	0.017	0.025	0.002	10771
NL4	Zuid-Nederland	0.013	0.012	0.011	0.011	0.009	0.011	0.034	0.038	0.038	0.054	0.038	0.031	0.024	0.039	0.003	20481
PL1	Region Centralny	0.017	0.018	0.017	0.017	0.016	0.018	0.062	0.035	0.061	0.068	0.056	0.056	0.050	0.049	0.006	1212
PL2	Region Poludniowy	0.018	0.018	0.018	0.017	0.017	0.018	0.057	0.043	0.052	0.074	0.051	0.041	0.047	0.048	0.007	10090
PL3	Region Wschodni	0.017	0.019	0.018	0.018	0.017	0.019	0.064	0.040	0.056	0.081	0.053	0.059	0.057	0.061	0.006	2593
PL4	Region Pólnocno-Zachodni	0.018	0.020	0.020	0.019	0.019	0.020	0.063	0.043	0.056	0.096	0.060	0.059	0.055	0.056	0.007	24837
PL5	Region Poludniowo-Zachodni	0.024	0.025	0.025	0.024	0.024	0.025	0.071	0.059	0.077	0.113	0.064	0.070	0.066	0.070	0.017	22460

Code	Region	*Opportunity Recognition*	*Skill Perception*	*Risk Acceptance*	*Know Entrepreneurs*	*Career*	*Status*	*Opportunity Motivation*	*Technology Level*	*Educational Level*	*Competitors*	*New Prod*	*New Tech*	*Gazelle*	*Export*	*Business Angel*	*Informal Investment Mean*
PL6	Region Pólnocny	0.020	0.020	0.020	0.020	0.018	0.020	0.065	0.040	0.050	0.082	0.058	0.063	0.052	0.053	0.007	33602
PT11	Norte	0.011	0.013	0.012	0.011	0.015	0.015	0.034	0.031	0.040	0.062	0.040	0.041	0.031	0.042	0.004	13973
PT15	Algarve	0.031	0.036	0.035	0.033	0.045	0.044	0.072	0.095	0.091	0.156	0.084	0.097	0.088	0.089	0.011	2686
PT16	Centro (PT)	0.012	0.013	0.013	0.012	0.017	0.016	0.036	0.029	0.044	0.064	0.042	0.045	0.028	0.043	0.004	3229
PT17	Lisboa	0.013	0.014	0.013	0.012	0.017	0.017	0.038	0.032	0.045	0.060	0.043	0.041	0.030	0.044	0.004	10623
PT18	Alentejo	0.027	0.034	0.033	0.031	0.042	0.039	0.100	0.044	0.109	0.173	0.107	0.114	0.084	0.098	0.010	.
RO1	Macroregiunea unu	0.011	0.011	0.012	0.011	0.014	0.011	0.041	0.033	0.041	0.060	0.041	0.039	0.034	0.039	0.004	4401
RO2	Macroregiunea doi	0.010	0.010	0.011	0.010	0.013	0.011	0.046	0.036	0.047	0.068	0.046	0.044	0.042	0.042	0.004	11543
RO3	Macroregiunea trei	0.011	0.012	0.012	0.012	0.014	0.012	0.046	0.038	0.047	0.059	0.047	0.046	0.041	0.047	0.004	1367
RO4	Macroregiunea patru	0.012	0.013	0.014	0.013	0.017	0.015	0.054	0.047	0.054	0.056	0.051	0.050	0.049	0.051	0.005	4320
SE11	Stockholm	0.017	0.016	0.015	0.015	0.019	0.017	0.042	0.056	0.058	0.082	0.059	0.047	0.032	0.062	0.011	14225
SE12	Östra Mellansverige	0.015	0.013	0.013	0.013	0.016	0.014	0.039	0.056	0.058	0.079	0.060	0.048	0.050	0.061	0.010	15178
SE21	Smaland med öarna	0.018	0.016	0.015	0.016	0.019	0.017	0.052	0.058	0.061	0.099	0.065	0.053	0.031	0.068	0.007	10856
SE22	Sydsverige	0.017	0.016	0.015	0.016	0.020	0.018	0.060	0.067	0.075	0.099	0.070	0.053	0.061	0.076	0.011	8997
SE23	Vastsverige	0.015	0.014	0.013	0.014	0.017	0.015	0.035	0.055	0.062	0.094	0.059	0.055	0.044	0.063	0.006	19290
SE31	Norra Mellansverige	0.020	0.018	0.017	0.018	0.021	0.020	0.060	0.073	0.079	0.117	0.078	0.069	0.049	0.080	0.018	22735
SE32	Mellersta Norrland	0.026	0.023	0.022	0.023	0.026	0.025	0.048	0.092	0.095	0.140	0.091	0.066	0.000	0.096	0.018	11721
SE33	Övre Norrland	0.024	0.022	0.021	0.022	0.026	0.024	0.070	0.070	0.087	0.121	0.084	0.081	0.054	0.090	0.018	29620
SI01	Vzhodna Slovenija	0.007	0.007	0.007	0.007	0.007	0.006	0.018	0.030	0.027	0.035	0.027	0.025	0.022	0.026	0.002	9955

Code	Region	*Opportunity Recognition*	*Skill Perception*	*Risk Acceptance*	*Know Entrepreneurs*	*Career*	*Status*	*Opportunity Motivation*	*Technology Level*	*Educational Level*	*Competitors*	*New Prod*	*New Tech*	*Gazelle*	*Export*	*Business Angel*	*Informal Investment Mean*
SI02	Zahodna Slovenija	0.008	0.008	0.007	0.008	0.008	0.007	0.019	0.030	0.026	0.035	0.026	0.024	0.020	0.025	0.002	5903
SK01	Bratislavsky kraj	0.024	0.023	0.022	0.023	0.023	0.022	0.047	0.050	0.056	0.090	0.058	0.058	0.052	0.052	0.013	19148
SK02	Západné Slovensko	0.012	0.014	0.013	0.013	0.014	0.013	0.036	0.034	0.034	0.047	0.039	0.038	0.028	0.039	0.011	15839
SK03	Stredné Slovensko	0.013	0.016	0.016	0.016	0.016	0.015	0.042	0.035	0.040	0.053	0.044	0.043	0.037	0.041	0.008	12805
SK04	Vychodné Slovensko	0.012	0.015	0.015	0.015	0.016	0.014	0.044	0.033	0.038	0.056	0.045	0.044	0.036	0.045	0.011	15918
UKC	North East (UK)	0.009	0.009	0.009	0.008	0.009	0.008	0.025	0.028	0.029	0.039	0.029	0.024	0.020	0.027	0.001	13506
UKD	North West (UK)	0.009	0.009	0.008	0.007	0.009	0.008	0.024	0.027	0.027	0.038	0.027	0.024	0.021	0.027	0.001	6177
UKE	Yorkshire and The Humber	0.007	0.007	0.007	0.006	0.007	0.006	0.019	0.023	0.023	0.031	0.022	0.020	0.018	0.022	0.001	10299
UKF	East Midlands (UK)	0.009	0.009	0.009	0.008	0.009	0.008	0.025	0.028	0.028	0.037	0.027	0.025	0.019	0.028	0.002	18373
UKG	West Midlands (UK)	0.008	0.008	0.008	0.007	0.009	0.007	0.021	0.025	0.025	0.034	0.025	0.022	0.019	0.025	0.002	10018
UKH	East of England	0.014	0.014	0.013	0.012	0.014	0.013	0.031	0.037	0.037	0.051	0.038	0.037	0.026	0.038	0.002	11782
UKI	London	0.010	0.010	0.009	0.009	0.010	0.009	0.024	0.027	0.027	0.035	0.027	0.026	0.023	0.026	0.002	12699
UKJ	South East (UK)	0.009	0.008	0.008	0.007	0.009	0.008	0.021	0.027	0.026	0.035	0.025	0.022	0.020	0.027	0.001	16071
UKK	South West (UK)	0.010	0.010	0.010	0.009	0.011	0.009	0.025	0.029	0.030	0.040	0.030	0.027	0.021	0.030	0.002	12647
UKL	Wales	0.006	0.007	0.006	0.006	0.007	0.006	0.017	0.019	0.020	0.028	0.020	0.017	0.016	0.020	0.001	8757
UKM	Scotland	0.010	0.010	0.010	0.009	0.011	0.009	0.028	0.036	0.036	0.051	0.035	0.031	0.026	0.036	0.001	12588
UKN	Northern Ireland (UK)	0.008	0.008	0.008	0.007	0.009	0.007	0.024	0.027	0.028	0.036	0.028	0.024	0.023	0.028	0.002	7667

7.3 Appendix C: The description and source of the institutional variables and indicators used in the REDI

Institutional variable	Description	Source of data	Data availability *(Available: August 8, 2013)*
Market Agglomeration	***1)*** ***POPULATION GROWTH***: Population on 1 January by age and sex - NUTS 2 regions, 2005-2012: The inhabitants of a given area on 1 January of the year in question (or, in some cases, on 31 December of the previous year). The population is based on data from the most recent census adjusted by the components of population change produced since the last census, or based on population registers. (*regional level*). ***2)*** ***URBANIZATION***: World Urbanization Prospects: The 2011 Revision, Population of Urban and Rural Areas and Percentage Urban, 2011 (*country level*); Cluster Observatory *Degree of urbanization* data (2010–2011) (*regional level*) ***3)*** ***ACCESSIBILITY*** : Gravity model used to determine the sphere of influence of each central location by estimating where the breaking point between the two settlements (here regions) will be (*regional level*). Using *regional gross domestic product (GDP) by NUTS 2 regions (million EUR, 2010)* data and *total land area by NUTS 2 region (km², 2010)* (*regional level*)[10] — *GDP (gross domestic product) is an indicator of the output of a country or a region. It reflects the total value of all goods and services produced less the value of goods and services used for intermediate consumption in their production. Expressing GDP in PPS (purchasing power standards) eliminates differences in price levels between countries. Calculations on a per inhabitant basis allow for the comparison of economies and regions significantly different in absolute size. GDP per inhabitant in PPS is a key variable for determining the eligibility of NUTS 2 regions in the framework of the European Union's structural policy.* — *Total land area by NUTS 2 regions (km²): For calculation of population density, the land area (excluding inland water bodies like lakes or rivers) should be used when available. In several countries the total area, including area of lakes and rivers, is used because it is the only aspect for which data are available.* ***Calculation*****:** simple average of the indicators of *Population Growth*, *Urbanization* and *Accessibility* variables. Box-cox transformation[11] was used in the case of the *Accessibility* variable, because the skewness of the original variable was higher than 1 (original value: 5.459). Therefore λ = -0.05.	Eurostat Regional Database United Nations, Department of Economic and Social Affairs, Population Division Cluster Observatory (Regional Indicators – Degree of Urbanization)	http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tgs00096&plugin=1 http://esa.un.org/unpd/wup/CD-ROM/Urban-Rural-Population.htm http://www.clusterobservatory.eu/index.html#!view=regionalmapping;i=C22300;y=2011;r=NC10;rsl=2;rp=NC10;sp=CC20-STND;p=table http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tgs00003&plugin=1 http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tgs00002&plugin=1

[10] Gravity model is characterized by an indicator which measures the market potential of the different locations. The extent of the gravity depends on the mass of the two locations (that can be measured by population, GDP and so on) and on the distance between locations. The formula of the indicator is

$$G_i = \sum_{j=1}^{J} \frac{M_i M_j}{d_{ij}}$$

where i is index of the region, and j is the index of the other region. M is the indicator of the mass (here it is the GDP on PPS on a unit of area measured with square kilometer), and dij is the distance between the *i*th and the *j*th regions (here measured with calculated the Eucladean distance of the centroids of the given NUTS1 or NUTS2 regions).
GDP data originates from the Eurostat regional database.

[11] EU Regional Competitiveness Index, 2010 (Data transformation), page 52-53.

Quality of Education	***1) PISA*** *(country level)* - Low achievers in Reading of 15-year-olds, 2006. - Low achievers in Math of 15-year-olds, 2006. - Low achievers in Science of 15-year-olds, 2006. ***2) CREATIVE CLASS (SCIENTIFIC TALENT)*** *(regional level)* - Annual employment in creative class / economically active population, 2008. - Number of jobs in the creative workforce per active population, 2008. ***Calculation*****:** after subtracting from 100 the average of the three PISA variables, the average value was multiplied with the simple average of the two indicators of Creative Class (Scientific Talent). Box-cox transformation was used in the case of the average *PISA variable*, because the skewness of the original variable was higher than -1 (-2.119). Therefore $\lambda = 2$. Also a second transformation was necessary to handle the skewness of the variable (again $\lambda = 2$).	OECD – PISA database ESPON Database Portal (Theme: Information and Society – Employment in Creative Class) ESPON Database Portal (Project: CREA Update – Creative Workforce Update – Share of the creative workforce) ESPON Database Portal (Theme: Economy, finance and trade – Economically active population)	http://pisacountry.acer.edu.au/ http://database.espon.eu/db2/search;jsessionid=db8d55d87de9e3a650e2a3b1f293
Business Risk	***BUSINESS EXTENT OF DISCLOSURE INDEX*** *(country level)* Disclosure index measures the extent to which investors are protected through disclosure of ownership and financial information. The index ranges from 0 to 10, with higher values indicating greater disclosure, (0=least disclosure to 10=greatest disclosure), for year 2012. The indicators distinguish three dimensions of investor protections: transparency of related-party transactions (extent of disclosure index), liability for self-dealing (extent of director liability index) and shareholders' ability to sue officers and directors for misconduct (ease of shareholder suits index). The data come from a survey of corporate and securities lawyers and are based on securities regulations, company laws, civil procedure codes and court rules of evidence. Detailed description is available at: http://www.doingbusiness.org/methodology/protecting-investors (5 August 2013).	World Bank World Development Index	http://data.worldbank.org/indicator/IC.BUS.DISC.XQ
Social Capital	***1) SOCIAL CAPITAL*** *(country level)* The sub-index measures countries' performance in two areas: social cohesion and engagement; and community and family networks. This sub-index evaluates how factors such as volunteering, helping strangers, and donating to charitable organisations impact economic performance and life satisfaction. It also measures levels of trust, whether citizens believe they can rely on others, and assesses how marriage and religious attendance provide support networks beneficial to wellbeing. Empirical studies on social capital have shown that citizens' wellbeing improves through social trust, family and community ties, and civic group membership. Similarly, societies with lower levels of social capital have been shown to experience lower levels of economic growth. And so the term 'capital' in 'social capital' highlights the contribution of social networks as an asset that produces economic and wellbeing returns (for year 2011). The Social Capital sub-index contains 7 sub-indicators: (1) Donations, (2) Helping Strangers, (3) Formal Volunteering, (4) Marriage, (5) Perception of Social Support, (6) Religious Attendance, (7) Trust in Others. Data are available from 2011. Detailed description of the variable is available at: http://webapi.prosperity.com/download/pdf/PI2012_MethodologyV4.pdf (5 August 2013) ***2) TECHNOLOGICAL READINESS*** *(regional level)* - Households with access to broadband, 2011. - Individuals who ordered goods or services over the Internet for private use, 2011. - Households with access to Internet, 2011. ***Calculation*****:** re-scaled (converted to a scale of 0 to 10) Social Capital data were multiplied with the simple average of the three indicators of Technological Readiness.	LEGATUM Prosperity Index, Social Capital Eurostat Regional Database	http://www.prosperity.com/ExploreData.aspx http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_r_iacc_h&lang=en http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_r_blt12_i&lang=en http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_r_broad_h&lang=en
Open Society	***1) PERSONAL FREEDOM*** *(country level)* The Personal Freedom sub-index measures countries' performance in two areas: individual freedom and social tolerance. The Personal Freedom sub-index captures the effects of freedom of choice, expression, movement, and belief, on a country's per capita GDP and the subjective wellbeing of its citizens. It also assesses how levels of tolerance of ethnic minorities and immigrants impact countries' economic growth and citizens' life satisfaction. Societies that foster strong civil rights and	Charron et al.(2011) EU QoG Corruption Index (EQI) LEGATUM Prosperity Index, Personal Freedom	http://www.qog.pol.gu.se/data/datadownloads/qogeuregionaldata/ http://www.prosperity.com/ExploreData.aspx

	freedoms have been shown to enjoy increases in levels of satisfaction among their citizens. When citizens' personal liberties are protected, a country benefits from higher levels of national income (for year 2011). The Personal Freedom sub-index contains 5 sub-indicators: (1) Civil Liberties, (2) Civil Liberty and Free Choice, (3) Satisfaction with Freedom of Choice, (4) Tolerance of Immigrants, (5) Tolerance of Minorities. Detailed description of the variable is available at: http://webapi.prosperity.com/download/pdf/PI2012_MethodologyV4.pdf (5 August 2013) ***2) CORRUPTION*** *(regional level)* Data based on a standardized variable combining education (*EdCor*: region's aggregated score from survey question on the extent to which corruption persists in the education system in the region/area), health (*HelCor*: region's aggregated score from survey question on the extent to which corruption persists in the health care system in the region/area, and general public corruption (*OtherCor*: egion's aggregated score from survey question on the extent to which respondents felt other citizens in the region/area use bribery to obtain public services) in addition to law enforcement (*LawCor*: region's aggregated score from survey question on the extent to which corruption persists in the law enforcement in the region/area) and the payment of bribes (*HelBribe*: region's aggregated score from survey question asking whether the respondents were forced to pay a bribe in the last 12 months to obtain any health care in the region/area. . Data are from 2009-2010. [*Source*: Nicholas Charron , Lewis Dijkstra & Victor Lapuente (2013): Regional Governance Matters: Quality of Government within European Union Member States, Regional Studies, DOI:10.1080/00343404.2013.770141 To link to this article: http://www.qog.pol.gu.se/digitalAssets/1446/1446579_regional-studies-article.pdf (9 August 2013)] Detailed description of the variable is available at: http://www.qog.pol.gu.se/digitalAssets/1362/1362471_eqi---correlates-codebook.pdf (9 August 2013) ***Calculation*:** re-scaled (converted to a scale of 0 to 10) Corruption data were multiplied with re-scaled (converted to a scale of 0 to 10) Personal Freedom data.		
Business Environment	***1) BUSINESS FREEDOM*** *(country level)* 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 most free business environment. The score is based on 10 factors, all weighted equally, using data from the World Bank's Doing Business report. Each factor is converted to a scale of 0 to 100, after which the average of the converted values is computed. The result represents the country's business freedom score, 2013. Detailed description of the variable is available at: http://www.heritage.org/index/business-freedom (5 August 2013). ***2) EU QoG INDEX*** *(regional level)* Data shows quality of government. Data based on a study on regional variation in quality of government within the EU The dataset covers all 27 EU countries as well as 172 NUTS 1 and NUTS 2 regions within 18 of the 27 countries, thus the data is given for 181 separate units. The data for region ns was collected via a large survey of roughly 34,000 respondents in Europe in December of 2009. The national level estimates are taken from the World Bank Governance Indicators. The regional estimates are comprised of 16 separate indicators. Data are from 2009-2010. [*Source*: Nicholas Charron , Lewis Dijkstra & Victor Lapuente (2013): Regional Governance Matters: Quality of Government within European Union Member States, Regional Studies, DOI:10.1080/00343404.2013.770141 To link to this article: http://www.qog.pol.gu.se/digitalAssets/1446/1446579_regional-studies-article.pdf (9 August 2013)] Detailed description of the variable is available at: http://www.qog.pol.gu.se/data/datadownloads/qogeuregionaldata/ (5 August 2013). ***Calculation:*** Business Freedom indicator was multiplied with the re-scaled EU QoG index.	Heritage Foundation EU QoG Index	http://www.heritage.org/index/explore http://ec.europa.eu/regional_policy/sources/docgener/work/2012_02_governance.pdf
Absorptive Capacity	***1) FIRM-LEVEL TECHNOLOGY ABSORPTION*** *(country level)* This data is taken from the WEF Global Competitiveness Report. *Technological readiness* is the 9th pillar of the Global Competitiveness Index (GCI). The pillar contains two sub-indicators: (1) *Technological adoption* and (2) *ICT use*. In today's globalized world, technology is increasingly essential for firms to compete and prosper. The *Technological readiness* pillar measures the agility with which an economy adopts existing technologies to enhance the productivity of its industries, with	World Economic Forum Competitiveness Report 2012-2013, 489. p. Eurostat Regional Database	http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf http://epp.eurostat.ec.europa.eu/t

	specific emphasis on its capacity to fully leverage information and communication technologies (ICT) in daily activities and production processes for increased efficiency and enabling innovation for competitiveness. The variable of *Firm-level technology absorption* is a part of the Technological readiness pillar. The variable answer the question to what extent do businesses in a country absorb new technology (1 = not at all; 7 = aggressively absorb). Weighted average of 2011–12 data. Detailed description of the variable is available at: http://www3.weforum.org/docs/CSI/2012-13/GCR_Chapter1.1_2012-13.pdf (9 August 2013) ***2) EMPLOYMENT IN KNOWLEDGE INTENSIVE AND HIGH TECHNOLOGY ADOPTIONS*** *(regional level)* • *Employment in high-Technology Adoptions (high-tech manufacturing and knowledge-intensive services) by NUTS 2 region (2007-2008).* • *Employment in technology and knowledge-intensive sectors by NUTS 2 region and gender (from 2008 onwards, NACE Rev. 2) (2011)* • *Researchers, all sectors by NUTS 2 region, % of total employment (2009).* • *Annual data on Human resources in science and technology (HRST) and sub-groups by NUTS 2 region (2011).* ***Calculation*:** Firm-level Technology Absorption variable was multiplied with the average of variables related to employment in knowledge-intensive and high-Technology Adoptions.		gm/table.do?tab=table&init=1&language=en&pcode=tgs00039&plugin=1 http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=htec_emp_reg2&lang=en http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tgs00043&plugin=1 http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tgs00038&plugin=1
Education & Training	***HIGHER EDUCATION AND TRAINING AND LIFE-LONG LEARNING*** *(regional level)* - Share of population aged 25-64 years with higher educational attainment, 2011. [Source: Eurostat Regional Database: Persons aged 25-64 with tertiary education attainment by sex and NUTS 2 regions (from 2000 onwards) - %] - Share of population aged 25-64 years participating in education and training, 2011. [Source: Eurostat Regional Database: Participation of adults aged 25-64 in education and training by NUTS 2 regions (from 2000 onwards) - %] ***Calculation*:** The sum of the two variables is used.	Eurostat Regional Database	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=edat_lfse_11&lang=en http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=trng_lfse_04&lang=en
Business Strategy	***1) NATURE OF COMPETITIVE ADVANTAGE*** *(country level)* This data is taken from the WEF Global Competitiveness Report. *Business sophistication* is the 11th pillar of the Global Competitiveness Index (GCI). There is no doubt that sophisticated business practices are conducive to higher efficiency in the production of goods and services. Business sophistication concerns two elements that are intricately linked: the quality of a country's overall business networks and the quality of individual firms' operations and strategies. These factors are particularly important for countries at an advanced stage of development when, to a large extent, the more basic sources of productivity improvements have been exhausted. The quality of a country's business networks and supporting industries, as measured by the quantity and quality of local suppliers and the extent of their interaction, is important for a variety of reasons. When companies and suppliers from a particular sector are interconnected in geographically proximate groups, called clusters, efficiency is heightened, greater opportunities for innovation in processes and products are created, and barriers to entry for new firms are reduced. Individual firms' advanced operations and strategies (branding, marketing, distribution, advanced production processes, and the production of unique and sophisticated products) spill over into the economy and lead to sophisticated and modern business processes across the country's business sectors. The variable of *Nature of competitive advantage* is a part of the Technological readiness pillar. The data captures answers to the question: "What is the nature of competitive advantage of your country's companies in international markets based upon?" (1 = low-cost or natural resources; 7 = unique products and processes). Weighted average of 2011–12 data. Detailed description of the variable is available at: http://www3.weforum.org/docs/CSI/2012-13/GCR_Chapter1.1_2012-13.pdf (9 August 2013) ***2) BUSINESS SOPHISTICATION*** *(regional level)* - Share of employment in sophisticated sectors, 2011. [Employment in the J, K sectors as % of total employment,	World Economic Forum Competitiveness Report 2012-2013, 489. p. Eurostat Regional Database (Total – All NACE activities, J – Information and communication, K – Financial and insurance activities) EU Regional Competitiveness Index, 2010	http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do;jsessionid=9ea7d07d30e456f833bccf984d05b62de462168ef89f.e34MbxeSaxaSc40LbNiMbxeNaNeKe0 http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do http://www.urenio.org/wp-content/uploads/2010/09/Regional-Competitive-Index-EU-JRC2010.pdf

	J: Information and Communication, K: Financing and insurance activities.] - Share of Gross value added (GVA) in sophisticated sectors, 2007. [GVA in the J, K sectors as % of total GVA, J: Information and Communication, K: Financing and insurance activities.] - New foreign firms per one million inhabitants, 2005-2007. ***Calculation*:** The Nature of competitive advantage was multiplied with the unweighted average of the three indicators of the Business Sophistication variable. Box-cox transformation was used in the case of the 'Employment in JK Sectors' sub-indicator, because the skewness of the original variables were higher than 1 (1.499). Therefore $\lambda = -0.05$.		
Technology Transfer	***1) INNOVATION SUB-INDEX*** (same variables were used as in the EU Regional Competitiveness Index (2010), but data were updated) (***regional level***) - Total patent applications: Patent applications to the EPO by priority year by NUTS 2 regions. Number of applications per one million inhabitants (2008-2009 average). - Scientific publication: Publications per one million inhabitants (Thomson Reuters Web of Science & CWTS database (Leiden University). Average of years 2005-2006. - High-tech inventors: High-tech patent applications to the EPO by priority year by NUTS 2 regions. Number of applications per one million inhabitants (2008-2009 average). - ICT inventors: PCT patent applications (fractional count by inventor and priority year) in ICT, 2010. - Biotechnology inventors: PCT patent applications (fractional count by inventor and priority year) in biotech, 2010. ***Calculation*:** unweighted average of the five innovation related variables. Box-cox transformation was used in the case of the indicator, because the skewness of the original indicator was higher than 1 (1.139). Therefore $\lambda = -0.05$	Eurostat Regional Database OECD Regional Database (Innovation Indicators) EU Regional Competitiveness Index, 2010	http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tgs00040&plugin=1 http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tgs00041&plugin=1 http://stats.oecd.org/Index.aspx?datasetcode=REG_DEMO_TL2# http://www.urenio.org/wp-content/uploads/2010/09/Regional-Competitive-Index-EU-JRC2010.pdf
Technology Development	***GERD*** (***regional level***) Gross Domestic Expenditure in Research & Development (GERD) as a percentage of GDP, for year 2009. (***regional level***) ***Calculation:*** Box-cox transformation was used in the case of the GERD variable, because the skewness of the original variable was higher than 1 (1.095). Therefore $\lambda = -0.05$.	Eurostat Regional Database	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=rd_e_gerdreg&lang=en
Clustering	***CLUSTERS*** (***regional level***) Cluster Mix Index 1. Average EU wage per cluster is calculated across the reporting countries, weighted by the total number of employees they have in that cluster category at the national level. 2. Wages are normalized so that the cluster with the lowest average EU wage (that happened to be footwear) is equal to 1. 3. For each region, a wage cluster mix index is created by taking the sum across all clusters of the regional share in employment per cluster times the relevant cluster wage index calculated above. This gives a number for each region; the higher it is the more the region benefits from the cluster mix effect rather than strong performance within any individual cluster.	DGRegion Individual Dataset (not-published)	
Connectivity	***INFRASTRUCTURE SUB-INDEX*** (***regional level***) - Motorway density (average pop/area). EU27=100, Eurostat/DG TREN/EuroGeographics/National Statistical Institutes, 2006. - Railway density (average pop/area), EU27=100, Eurostat/DG TREN/EuroGeographics/National Statistical Institutes, 2007. - Number of passenger flights, daily number of passenger flights (accessible within 90-minute drive), Eurostat/EuroGeographics/National Statitical Institutes, 2007. *Calculation:* Average of the variables of motorway density, railway density and number of passenger flights. Box-cox transformation was used in the case of three transportation variables, because the skewness of the original variable was higher than 1 (1.674). Therefore $\lambda = -0.05$.	EU Regional Competitiveness Index, 2010	http://www.urenio.org/wp-content/uploads/2010/09/Regional-Competitive-Index-EU-JRC2010.pdf

Financial Institutions	***1) DEPTH OF CAPITAL MARKET*** *(country level)* 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 2006-2012 time period so comparisons across years are not perfect. The data set was provided by Alexander Groh, 2013. Detailed description about the indicator is available at: http://www.wall-street.ro/files/102434-82.pdf (5 August 2013). ***2) CONCENTRATION OF FINANCIAL SERVICES*** *(regional level)* Regional employment in financial services sector as percentage of total regional employment (for different years between 2005-2011). *Calculation*: Depth of Capital Market country level data were multiplied with the Concentration of Financial Services variable. Box-cox transformation was used in the case of three transportation variables, because the skewness of the original variable was higher than 1 (2.505). Therefore $\lambda = -0.05$.	Groh, A, H.Liechtenstein and K. Lieser 2012 The Global Venture Capital and Private Equity Country Attractiveness Index 2012 Annual, Cluster Observatory (Financial services – employees, Regional employment)	http://www.wall-street.ro/files/102434-82.pdf http://www.clusterobservatory.eu/index.html#!view=regionalmapping;i=V16140;y=2011;r=NC10;rsl=2;rp=NC10;s=CC20-fin;sp=CC20-STND;p=table http://www.clusterobservatory.eu/index.html#!view=regionalmapping;i=V16140,C20220;y=2011;r=NC10;rsl=2;rp=NC10;sp=CC20-STND;p=table

7.4 Appendix D: The availability of the institutional variables used in the GEDI

PILLARS	*INSTITUTIONAL VARIABLES*	VARIABLES OF INSTITUTIONAL VARIABLES	SOURCE OF VARIABLES	TIME	EL = GR	NL	BE	FR	ES	HU	IT	RO	AT	UK	DK	SE	PL	DE	PT	IE	FI	LT	LV	EE	HR	SI	CZ	SK
			GDP PER CAPITA (ppp)	***2010***	*NUTS1*	*NUTS 1*	*NUTS 1*	*NUTS 1*	*NUTS 2*	*NUTS 2*	*NUTS 1*	*NUTS 1*	*NUTS 1*	*NUTS 1*	*NUTS 2*	*NUTS 2*	*NUTS 1*	*NUTS 1*	*NUTS 2*	*NUTS 2*	*NUTS 2*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 2*	*NUTS 2*	*NUTS 0*	*NUTS 2*
I. OPPORTUNITY PERCEPTION PILLAR	*MARKET AGGLOMERATION*	**POPULATION GROWTH**		**2012/2005**	NUTS1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1*	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 2	NUTS 0	NUTS 0	NUTS 0	NUTS 2	NUTS 2	NUTS 0	NUTS 2
		URBANIZATION	Degree of urbanization (%) (EU Cluster Observatory; UN: World Urbanization Prospects)	**2010 or 2011**	NUTS1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 0	NUTS 0	NUTS 0	NUTS 1	NUTS 2	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 2
		ACCESSIBILITY	Switzerland included P(A) (k=2). Calculated using GDP and area data of Eurostat Regional Database	**2010**	NUTS1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 2	NUTS 0	NUTS 0	NUTS 0	NUTS 2	NUTS 2	NUTS 0	NUTS 2
II. START-UP SKILLS PILLAR	*QUALITY OF EDUCATION*	**PISA**	*Low achievers in reading*	*2006*	*NUTS0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*
			Low achievers in math	*2006*	*NUTS0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*
			Low achievers in science	*2006*	*NUTS0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 0*
			Average value of (1) low achievers in reading (2) low achievers in math (3) low achievers in science variables	**2006**	NUTS0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0*	NUTS 0	NUTS 0	NUTS 0
		CREATIVE CLASS	Annual employment in creative class / economically active pop (ESPON)	**2008**	NUTS1 *	NUTS 1*	NUTS 1*	NUTS 1*	NUTS 2	NUTS 2	NUTS 1*	NUTS 1*	NUTS 1*	NUTS 1*	NUTS 2	NUTS 2	NUTS 1*	NUTS 1*	NUTS 2	NUTS 2	NUTS 2*	NUTS 0	NUTS 0	NUTS 0	NUTS 2*	NUTS 2	NUTS 0	NUTS 2
			Number of jobs in the creative workforce per active population (ESPON)	**2008**	NUTS1 *	NUTS 1*	NUTS 1*	NUTS 1*	NUTS 2	NUTS 2	NUTS 1*	NUTS 1*	NUTS 1*	NUTS 1*	NUTS 2	NUTS 2	NUTS 1*	NUTS 1*	NUTS 2	NUTS 2	NUTS 2*	NUTS 0	NUTS 0	NUTS 0	NUTS 2*	NUTS 2	NUTS 0	NUTS 2
III. RISK ACCEPTANCE PILLAR	*BUSINESS RISK*	**BUSINESS DISCLOSURE**	World Development Indicators	**2012**	NUTS0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0
IV. NETWORKING PILLAR	*SOCIAL CAPITAL*	**SOCIAL CAPITAL**	Legatum Prosperity Index, Social Capital Sub-index	**2011**	NUTS0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0
		TECHNOLOGICAL READINESS	*INTERNET1: Households with broadband access by NUTS 2 regions (EUROSTAT)*	**2011**	*NUTS1*	*NUTS 1*	*NUTS 1*	*NUTS 1*	*NUTS 2*	*NUTS 2*	*NUTS 1*	*NUTS 1*	*NUTS 1*	*NUTS 1*	*NUTS 2*	*NUTS 2*	*NUTS 1*	*NUTS 1*	*NUTS 2*	*NUTS 2*	*NUTS 2**	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 2**	*NUTS 2*	*NUTS 0*	*NUTS 2*
			INTERNET2: Households with access to the Internet at home by NUTS 2 regions (EUROSTAT)	**2011**	*NUTS1*	*NUTS 1*	*NUTS 1*	*NUTS 1*	*NUTS 2*	*NUTS 2*	*NUTS 1*	*NUTS 1*	*NUTS 1*	*NUTS 1*	*NUTS 2*	*NUTS 2*	*NUTS 1*	*NUTS 1*	*NUTS 2*	*NUTS 2*	*NUTS 2**	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 2**	*NUTS 2*	*NUTS 0*	*NUTS 2*
			INTERNET3: Individuals who ordered goods or services over the Internet for private use by NUTS 2 regions (EUROSTAT)	**2011**	*NUTS1*	*NUTS 1*	*NUTS 1*	*NUTS 1*	*NUTS 2*	*NUTS 2*	*NUTS 1*	*NUTS 1*	*NUTS 1*	*NUTS 1*	*NUTS 2*	*NUTS 2*	*NUTS 1*	*NUTS 1*	*NUTS 2*	*NUTS 2*	*NUTS 2**	*NUTS 0*	*NUTS 0*	*NUTS 0*	*NUTS 2**	*NUTS 2*	*NUTS 0*	*NUTS 2*
			Average of INTERNET1, INTERNET2 and INTERNET3 variables	**2011**	NUTS1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 2*	NUTS 0	NUTS 0	NUTS 0	NUTS 2*	NUTS 2	NUTS 0	NUTS 2
V. CULTURAL SUPPORT PILLAR	*OPEN SOCIETY*	**CORRUPTION**	CHARRON ET AL. (2011) EU QoG Corruption Index (EQI)	**2009-2010**	NUTS1	NUTS 1	NUTS 1	NUTS 1*	NUTS 2	NUTS 1	NUTS 1*	NUTS 1*	NUTS 1*	NUTS 1	NUTS 2	NUTS 1	NUTS 1*	NUTS 1	NUTS 2	NUTS 0	NUTS 2*	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 2
		PERSONAL FREEDOM	Legatum Prosperity Index, Personal Freedom Sub-inex	**2011**	NUTS0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0

PILLARS	*INSTITUTIONAL VARIABLES*	VARIABLES OF INSTITUTIONAL VARIABLES	SOURCE OF VARIABLES	TIME	EL = GR	NL	BE	FR	ES	HU	IT	RO	AT	UK	DK	SE	PL	DE	PT	IE	FI	LT	LV	EE	HR	SI	CZ	SK
VI. OPPORTUNITY STARTUP PILLAR	*BUSINESS ENVIRONMENT*	BUSINESS FREEDOM	Heritage Foundation	2013	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0
		EU QoG INDEX	Data shows quality of government. Data based on A Study on Regional Variation in Quality of Government within the EU. Charron et al. 2011.	2009-2010	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 2*	NUTS 0	NUTS 0	NUTS 0	NUTS 2	NUTS 2	NUTS 0	NUTS 2
VII. TECHNOLOGY SECTOR PILLAR	*ABSORPTIVE CAPACITY*	FIRM-LEVEL TECHNOLOGY ABSORPTION	The Global Competitiveness Index 2012-2013, World Economic Forum	2011–12 weighted average	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0
		EMPLOYMENT IN KNOWLEDGE-INTENSIVE AND HIGH-TECHNOLOGY ADOPTIONS	Employment in high-Technology Adoptions (high-tech manufacturing and high-tech knowledge-intensive services) by NUTS 2 level	2008	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1*	NUTS 2*	NUTS 2	NUTS 2	NUTS 0	NUTS 0	NUTS 0	NUTS 2	NUTS 2	NUTS 0	NUTS 2
			Employment in technology and knowledge-intensive sectors by NUTS 2 regions and sex	2011	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 2*	NUTS 2	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1*	NUTS 2*	NUTS 2	NUTS 2	NUTS 0	NUTS 0	NUTS 0	NUTS 2	NUTS 2	NUTS 0	NUTS 2
			Researchers, all sectors by NUTS 2 regions % of total employment	2009		NUTS 1	NUTS 1		NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 2	NUTS 0	NUTS 0	NUTS 0	NUTS 2	NUTS 2	NUTS 0	NUTS 2
			Annual data on HRST and sub-groups by NUTS 2 regions	2011	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 2	NUTS 0	NUTS 0	NUTS 0	NUTS 2	NUTS 2	NUTS 0	NUTS 2
VIII. HUMAN CAPITAL PILLAR	*EDUCATION & TRAINING*	HIGHER EDUCATION TRAINING AND LIFE LONG LEARNING	*Share of population 25-64 with higher educational attainment (EUROSTAT)*	2011	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 2	NUTS 0	NUTS 0	NUTS 0	NUTS 2	NUTS 2	NUTS 0	NUTS 2
			Share of population 25-64 involved in education and training (EUROSTAT)	2011	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 2	NUTS 0	NUTS 0	NUTS 0	NUTS 2	NUTS 2	NUTS 0	NUTS 2
IX. COMPETITION PILLAR	*BUSINESS STRATEGY*	NATURE OF COMPETITIVE ADVANTAGE	The Global Competitiveness Index 2012-2013, World Economic Forum	2011–12 weighted average	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0	NUTS 0
		BUSINESS SOPHISTICATION	Employment JK sectors, Eurostat Regional Database	2011	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 1	NUTS 1	NUTS 2	NUTS 2	NUTS 2	NUTS 0	NUTS 0	NUTS 0	NUTS 2	NUTS 2	NUTS 0*	NUTS 2
			GVA in JK sectors, EU Regional Competitiveness Index	2007	NUTS 1*	NUTS 1*	NUTS 1*	NUTS 1*	NUTS 2	NUTS 2	NUTS 1*	NUTS 1*	NUTS 1*	NUTS 1*	NUTS 2	NUTS 2	NUTS 1*	NUTS 1*	NUTS 2	NUTS 2	NUTS 2	NUTS 0	NUTS 0	NUTS 0	NUTS 2*	NUTS 2	NUTS 0*	NUTS 2
			FDI intensity, EU Regional Competitiveness Index	2005-2007	NUTS 1*	NUTS 1*	NUTS 1*	NUTS 1*	NUTS 2	NUTS 2	NUTS 1*	NUTS 1*	NUTS 1*	NUTS 1*	NUTS 2	NUTS 2	NUTS 1*	NUTS 1*	NUTS 2	NUTS 2	NUTS 2	NUTS 0	NUTS 0	NUTS 0	NUTS 2*	NUTS 2	NUTS 0*	NUTS 2

PILLARS	*INSTITUTIONAL VARIABLES*	VARIABLES OF INSTITUTIONAL VARIABLES	SOURCE OF VARIABLES	TIME	EL = GR	NL	BE	FR	ES	HU	IT	RO	AT	UK	DK	SE	PL	DE	PT	IE	FI	LT	LV	EE	HR	SI	CZ	SK
X. PRODUCT INNOVATION PILLAR	*TECHNOLOGY TRANSFER*	PATENT APPLICATIONS	Patent applications to the EPO by priority year by NUTS2 regions (number of applications per million of inhabitants)	2008-2009	NUTS1	NUTS1	NUTS1	NUTS1	NUTS2	NUTS2	NUTS1	NUTS1	NUTS1	NUTS1	NUTS2	NUTS2	NUTS1	NUTS1	NUTS2	NUTS2	NUTS2	NUTS0	NUTS0	NUTS0		NUTS2	NUTS0	NUTS2
		SCIENTIFIC PUBLICATIONS	Publications per million inhabitants (Thomson Reuters Web of Science and CWTS database, average)	2005-2006	NUTS1*	NUTS1	NUTS1	NUTS1	NUTS2	NUTS2	NUTS1	NUTS1	NUTS1	NUTS1	NUTS2	NUTS2	NUTS1	NUTS1	NUTS2	NUTS2	NUTS2	NUTS0	NUTS0	NUTS0		NUTS2	NUTS0	NUTS2
		HIGH-TECH INVENTORS	High-tech patent applications to the EPO by priority year by NUTS 2 regions 8number of applications per million of inhabitnats)	2008-2009	NUTS1	NUTS1	NUTS1	NUTS1	NUTS2*	NUTS2	NUTS1	NUTS1	NUTS1	NUTS1	NUTS2	NUTS2	NUTS1	NUTS1	NUTS2*	NUTS2	NUTS2	NUTS0	NUTS0	NUTS0		NUTS2	NUTS0	NUTS2*
		ICT INVENTORS	PCT patent applications in ICT	2010	NUTS1	NUTS1	NUTS1	NUTS1*	NUTS2	NUTS2	NUTS1*		NUTS1*	NUTS1	NUTS2	NUTS2	NUTS1*	NUTS1	NUTS2	NUTS2	NUTS2			NUTS0		NUTS2	NUTS0	NUTS2
		BIOTECH INVENTORS	PCT patent applications in biotech	2010	NUTS1	NUTS1	NUTS1	NUTS1*	NUTS2	NUTS2	NUTS1*		NUTS1*	NUTS1	NUTS2	NUTS2	NUTS1*	NUTS1	NUTS2	NUTS2	NUTS2			NUTS0		NUTS2	NUTS0	NUTS2
XI. PROCESS INNOVATION PILLAR	*TECHNOLOGY DEVELOPMENT*	GERD	Eurostat Regional Database	2009	NUTS1	NUTS1	NUTS1	NUTS1	NUTS2	NUTS2	NUTS1	NUTS1	NUTS1	NUTS1	NUTS2	NUTS2	NUTS1	NUTS1	NUTS2	NUTS2	NUTS2*	NUTS0	NUTS0	NUTS0	NUTS2*	NUTS2	NUTS0	NUTS2
XII. HIGH GROWTH PILLAR	*CLUSTERING*	CLUSTERS	Cluster Mix Index (DGRegion individual data)		NUTS1*	NUTS1*	NUTS1*	NUTS1*	NUTS2	NUTS2	NUTS1*	NUTS1*	NUTS1*	NUTS1*	NUTS0	NUTS2	NUTS1*	NUTS1*	NUTS2	NUTS2	NUTS2*	NUTS0	NUTS0	NUTS0	NUTS0	NUTS2*	NUTS0	NUTS2
XIII. GLOBALIZATION PILLAR	*CONNECTIVITY*	INFRASTRUCTURE SUB-INDEX	*ROAD: Motorway density, motorway, combined index (average pop/area), EU27=100 EU Regional Comp. Index, 2010*	2006	NUTS1*	NUTS1*	NUTS1*	NUTS1*	NUTS2	NUTS2	NUTS1*	NUTS1*	NUTS1*	NUTS1*	NUTS2	NUTS2	NUTS1*	NUTS1*	NUTS2	NUTS2	NUTS2*	NUTS0	NUTS0	NUTS0	NUTS2*	NUTS2	NUTS0*	NUTS2
			RAILWAY: Railway density,railway combined index (average pop/area), EU27=100, EU Regional Comp. Index, 2010	2007	NUTS1*	NUTS1*	NUTS1*	NUTS1*	NUTS2	NUTS2	NUTS1*	NUTS1*	NUTS1*	NUTS1*	NUTS2	NUTS2	NUTS1*	NUTS1*	NUTS2	NUTS2	NUTS2	NUTS0	NUTS0	NUTS0	NUTS2*	NUTS2	NUTS0*	NUTS2
			AIR: Number of passenger flights, daily number of passenger flights (accessible within 90'drive), EU Regional Comp. Index, 2010	2007	NUTS1*	NUTS1*	NUTS1*	NUTS1*	NUTS2	NUTS2	NUTS1*	NUTS1*	NUTS1*	NUTS1*	NUTS2	NUTS2	NUTS1*	NUTS1*	NUTS2	NUTS2	NUTS2	NUTS0	NUTS0	NUTS0	NUTS2*	NUTS2	NUTS0*	NUTS2
XIV. FINANCING PILLAR	*FINANCIAL INSTITUTIONS*	DCM	Groh, A et al. (2012) The Global Venture Capital and Private Equity Country Attractiveness Index 2012 Annual,	2013	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0	NUTS0
		CONCENTRATION OF FINANCIAL SERVICES	Cluster Observatory Database / EU Regional Database	2005-2011	NUTS1	NUTS1	NUTS1	NUTS1	NUTS2	NUTS2	NUTS1	NUTS1	NUTS1	NUTS1	NUTS2	NUTS2	NUTS1	NUTS1	NUTS2	NUTS2	NUTS2*	NUTS0	NUTS0	NUTS0	NUTS2*	NUTS0	NUTS0	NUTS2

Notes: EL=GR=Greece; NL=Netherland; BE=Belgium; FR=France; ES=Spain; HU=Hungary; IT=Italy; RO=Romania; AT=Austria; UK=United Kingdom; DK=Denmark; SE=Sweden; PL=Poland; PT=Portugal; IE=Ireland, FI=Finland, LT=Lithuania, LV=Latvia; EE=Estonia; HR=Croatia; CZ=Czech Republic; SK=Slovakia; SI=Slovenia.

Notes:	*	*POPULATION GROWTH:*	Italy: only 2011 and 2012 data are available for the ITH (Nord-Est) region, at NUTS1 level
MISSING DATA is substituted with other available NUTS level data		*URBANIZATION:*	Denmark, Sweden, Poland, Ireland, Finland, Croatia and Slovenia: only country level data are available (World Urbanization Prospect database, 2011)
		OECD-PISA:	Croatia NUTS2 level regions: Croatia's overall reading scale (476) is close to the value of Czech Rep. (478) and Slovak Rep.(477): the value is calculated as the *average of the 2 countries (26.3)*; Croatia's overall math scale(460) is close to the value of Greece (466): the value is the *same as for Greece (32.3)*; Croatia's overall science scale (486) is close to the value of Slovak Rep.(490), Spain (488) and Italy (489): calculated as the *average of these 3 countries (21.7).* *Source*: http://www.oecd.org/pisa/pisaproducts/46619703.pdf (page 8; downloaded: 16/5/2013)
		SCIENTIFIC TALENT:	EL, NL, BE, FR, IT, RO, AT, UK, PL, DE, CZ: NUT1 (in the case o CZ NUTS0) level data are calculated as the population weighted average of NUTS2 level data In the case of both NUTS2 level Croatian regions: "To what extent are scientists and engineers available in your country?" [1 = not at all; 7 = widely available] (2011–12 weighted average). Croatia's value (3,8) is close to the value of Slovenia (3,8), Romania (3,8) and Slovak Rep. (3,9): the value for Croatia is *estimated as the average of the values of these three countries.* Annual employment in creative class / economically active pop (ESPON): HR = 3,365+7,245+4,025 =4,878 Number of jobs in the creative workforce per active population (ESPON): HR = 33,243+64,73+43,44 = 47,14 Source: The Global Competitiveness Index 2012-2013, WEF, http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf Finland: FI1B data = FI 1C data Germany, Sachsen-Anhalt NUTS1 level region (DEE): Number of jobs in the creative workforce per active population: calculated as simple average of the NUTS1 level regions of Mecklenburg-Vorpommern, Brandenburg,Thüringen and Sachsen
		TECHNOLOGY READINESS	Finland, Helsinki-Uusimaa (FI1B) and Etelä-Suomi (FI1C) are the same as Manner-Suomi NUTS1 data, and FI1B = FI1C. Croatia, Kontinentalna Hrvatska (Continental Croatia) HR04 regions: in the case of INTERNET1, INTERNET2 and INTERNET3 variables: HR04 regions is the average of HR01 Sjeverozapadna Hrvatska and HR02 Sredisnja i Istocna (Panonska) Hrvatska regions *Source*: http://hr.zero.wikipedia.org/wiki/Sredi%C5%A1nja_i_Isto%C4%8Dna_Hrvatska; http://hr.wikipedia.org/wiki/Sjeverozapadna_Hrvatska; http://en.wikipedia.org/wiki/NUTS_of_Croatia (downloaded: 16/05/2013)
		CORRUPTION:	HU and SE are available only NUTS1 level. FR, AT, IT, RO, PL: NUT1 level data are calculated as the population weighted average of NUTS2 level data EE, FI, LV, LT, SI, CZ, IE: only country level data are available, CPI, 2012 http://cpi.transparency.org/cpi2012/results/ (available: 9/10/2013) Finland FI19 (Länsi-Suomi) region is calculated as the average value of NL and SE regional corruption data, FI1B = FI1C
		PERSONAL FREEDOM:	Data are available only at NUTS0 level.
		BUSINESS FREEDOM:	Data are available only at NUTS0 level.

		EU QoG INDEX:	HU and SE are available only NUTS1 level. FR, AT, IT, RO, PL: NUT1 level data are calculated as the population weighted average of NUTS2 level data IE, FI, SI: only country level data are available HR: estimated, the average of the values of SP, CZ, SL, HU, RO, EL, IT. For the estimation, the following WEF data were used: *Burden of government regulation*: How burdensome is it for businesses in your country to comply with governmental administrative requirements (e.g., permits, regulations, reporting)? [1 = extremely; 7 = extremely easy] | 2011–12 weighted average *Transparency of government policymaking*: Transparency of government policymaking: How easy is it for businesses in your country to obtain information about changes in government policies and regulations affecting their activities? [1 = impossible; 7 = extremely easy] | 2011–12 weighted average *Government provision of services for improved business performance*: To what extent does the government in your country continuously improve its provision of services to help businesses in your country boost their economic performance? [1 = impossible; 7 = extremely easy] | 2011–12 weighted average Source: The Global Competitiveness Index 2012-2013, WEF, http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf
		FIRM-LEVEL TECHNOLOGY ABSORPTION	Data are available only at NUTS0 level.
		EMPLOYMENT IN KNOWLEDGE-INTENSIVE AND HIGH-TECHNOLOGY ADOPTIONS:	Employment in High-Technology Adoptions: DE5= average of DE2 and DE6; PT15= average of PT17 and PT18; Employment in knowledge intensive sectors: DE5= average of DE2 and DE6; DEC= same as DE3; PT15= average of PT17 and PT18; PT18= average of PT16 and PT17; ES23= same as ES24; Researchers: missing data: GR, FR
		NATURE OF COMPETITIVE ADVANTAGE	Data are available only at NUTS0 level.
		BUSINESS SOPHISTICATION:	In the case of GVA in JK sectors and FDI intensity: EL, NL, BE, FR, IT, RO, AT, UK, PL, DE, CZ: NUT1 (in the case o CZ NUTS0) level data are calculated as the population weighted average of NUTS2 level data HR: estimated, the average of the values of SI01 and SI02
		TECHNOLOGY TRANSFER:	High-tech patents: ES23= same as ES24; ES43= same as ES13; PT18= average of PT16 and PT17; SK03= average of SK02 and SK04 PCT patent indicator and PCT patent for biotechnology indicator: no data are available for LV, LT, RO. FR, AT, IT, PL : NUT1 level data are calculated as the population weighted average of NUTS2 level data HR: estimated as the average of HU, CZ, EL, LT, SK, PL. For the estimation, the following WEF data were used: *PCT patent application*: Number of applications filed under the Patent Cooperation Treaty (PCT) per million population | 2008–09 average Source: The Global Competitiveness Index 2012-2013, WEF, http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf
		GERD:	HR, Kontinentalna Hrvatska (Continental Croatia) HR04 regions:HR04 regions is the average of HR01 Sjeverozapadna Hrvatska and HR02 Sredisnja i Istocna (Panonska) Hrvatska regions Finland: FI1B data = FI 1C data; FI1D = average of Pohjois-Suomi and Itä-Suomi
		CLUSTERING:	SI, DK: Clusters variable are available only for country level (NUTS0 level). CZ, BE, DE, EL, FR, IT, NL, AT, PL, RO, UK : NUT1 (in the case o CZ NUTS0) level data are calculated as the population weighted average of NUTS2 level data

			Finland: FI1B data = FI 1C data HR = average of the values of HU, PL, LV. For the estimation, the following WEF data were used: *State of cluster development: In your country's economy, how prevalent are well-developed and deep clusters? [1 = nonexistent; 7 = widespread in many fields] | 2011–12 weighted average* Source: The Global Competitiveness Index 2012-2013, WEF, http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf
		CONNECTIVIY: *DCM:*	EL, NL, BE, FR, IT, RO, AT, UK, PL, DE: NUT1 level data are calculated as the population weighted average of NUTS2 level data HR: ROAD = average of LT, IE, EE, SI; RAILROAD = average of SI, HU, EE; AIR = average of EE, HU, LT. For the estimation, the following WEF data were used: CZ= ROAD = average of SK, EL, HU, RAILROAD = average of SK, LT, DK; AIR = average of UK, AT, IE, DK, SE, BE. For the estimation, the following WEF data were used: ROAD: Croatia two regions: *Quality of road infrastructure: How would you assess the road system in your country? [1 = extremely underdeveloped; 7 = extensive and efficient by international standards] | 2011–12 weighted, average of the ROAD variables of Lithuania, Ireland, Estonia and Slovenia.* RAILROAD: Croatia two regions: Quality of railroad infrastructure: How would you assess the railroad system in your country? [1 = extremely underdeveloped; 7 = extensive and efficient by international standards] | 2011–12 weighted, *average of the railroad variables of Slovenia, Estonia, Hungary* AIR: Croatia two regions: *Quality of air transport infrastructure*: How would you assess passenger air transport infrastructure in your country? [1 = extremely underdeveloped; 7 = extensive and efficient by international standards] |2011–12 weighted average, *average of the AIR variables of Estonia, Lithuania and Hungary* Source: The Global Competitiveness Index 2012-2013, WEF, http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf Data are available only at NUTS0 level.
		CONCENTRATION OF FINANCIAL SERVICES:	HR: average of SI, EL, IE, LT. For the estimation, the following WEF data were used: *Availability of financial services*: Does the financial sector in your country provide a wide variety of financial products and services to businesses? [1 = not at all; 7 = provides a wide variety] | 2011–12 Source: The Global Competitiveness Index 2012-2013, WEF, http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf Finland, FI1B = FI1C SI: only NUTS0 level data are available.
		No data	
		Share of Product Innovation (used as individual variable)	DE: Brandenburg: Share of knowledge workers, calculated as simple average of the Mecklenburg-Vorpommern, Sachsen-Anhalt,Thüringen and Sachsen HR: average of PL, LV, LT, RO, SK. or the estimation, the following WEF data were used: *Capacity for innovation*: In your country, how do companies obtain technology? [1 = exclusively from licensing or imitating foreign companies; 7 = by conducting formal research and pioneering Source: The Global Competitiveness Index 2012-2013, WEF, http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf
		Share of Process Innovation (used as individual variable)	DE: Brandenburg: Share of knowledge workers, calculated as simple average of the Mecklenburg-Vorpommern, Sachsen-Anhalt,Thüringen and Sachsen HR: average of PL, LV, LT, RO, SK. or the estimation, the following WEF data were used: *Capacity for innovation*: In your country, how do companies obtain technology? [1 = exclusively from licensing or imitating foreign companies; 7 = by conducting formal research and pioneering Source: The Global Competitiveness Index 2012-2013, WEF, http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf

7.5 Appendix E: The applied individual and institutional variables and indicators in the REDI

Individual variables	Individual indicators	Institutional variables	Institutional indicators	Institutional Sub-indicators
Opportunity recognition	Opportunity recognition	Market agglomeration	Market agglomeration	3
Skill perception	Skill perception	Quality of education	PISA	3
			Creative Class	2
Business acceptance	Risk acceptance	Business risk	Business disclosure	3
Know entrepreneurs	Know entrepreneurs	Social capital	Social capital	7
			Technological readiness	3
Carrier status	Carrier	Open Society	Corruption	5
	Status		Personal Freedom	5
Opportunity motivation	Opportunity motivation	Business Environment	Business Freedom	10
			EU Quality of Government Index	4
Technology level	Technology level	Absorptive Capacity	Firm-level technology	1
			Employment in High-tech/knowledge intensive	4
Educational level	Educational level	Education and Training	Higher education/ training	2
Competitors	Competitors	Business strategy	Nature of competitive advantage	1
			Business sophistication	3
New product	New prod	Technology transfer	Innovation sub index	5
	Prod innovation			
New technology	New tech	Technology Development	GERD	1
	Tech Innovation			
Gazelle	Gazelle	Clustering	Clusters	3
Export	Export	Connectivity	Accessibility	3
Informal investment	Informal Investment Mean	Financial institutions	Depth of Capital Markets	7
	Business Angel		Concentration of financial services	1
14	**18**	**14**	**22**	**76**
			Country level indicators= 9	
			Regional level indicators = 13	

7.6 Appendix F: The characteristics of the penalty function

In the previous version of the PFB, we have used the natural logarithm penalty function (, Acs et al., 2013). Tarabusi and Palazzi (2004) and Tarabusi and Guarini (2012) have also developed a family of penalization methodology. We can define the penalty as the difference between the original and the after penalty pillar values. Following Tarabusi and Palazzi (2004) Tarabusi and Guarini (2012) and *Szerb et al*. (2011) we can define the required characteristics of the penalty functions. Most importantly, the penalty function should reflect to the magnitude of the penalty, lower difference implies lower penalty while higher unbalance implies higher penalty. The penalty function should also reflect to the compensation of the loss of one pillar for a gain in another pillar.

The Marginal Rate of Compensation (MRC) is defined as:

$$MRC_{i,j} = \frac{dy_i}{dy_j} \qquad \text{(E1)}$$

Full compensability means that a loss in one pillar can be compensated by the same increase in another pillar. However, this is not realistic. The MRC is the same concept as the Marginal Rate of Substitution for goods and to the Marginal Rate of Technical Substitution of inputs (Tarabusi and Guinari 2012), that are reflected to the law of diminishing return. Therefore, the effect of the change of the penalty should not be proportional reflecting to the increasing rate of (MRC). It means that we require higher compensation for the loss in one pillar if the difference between another pillar value and the particular pillar is higher as compared to the situation when the difference between the pillars is lower. The required positive value of the second derivative means that the pillars just only partially and not fully compensable with each other. So the penalty should increase in an increasing rate:

$$\frac{dMRC_{i,j}}{dy_j} > 0 \qquad \text{(E2)}$$

Tarabusi and Palazzi (2004) suggested a correction form of an exponential function of ae^{-bx}. In a recent article Tarabusi and Guarini (2012) used another adjustment function that refers to the deviation from the mean pillar value. For our purposes the mean adjustment is not really suitable so it is better to use the exponential form. Modifying Tarabusi and Palazzi (2004) original function for our purposes, we can define a penalty function family as

$$h_i = y_{min} - a(1 - e^{-b(y_i - y_{min})}) \qquad \text{(E3)}$$

where $h_{i,j}$ is the modified, post-penalty value of index component *j* in region *i*
$y_{i,j}$ is the normalized value of index component *j* in region *i*
y_{min} is the lowest value of $y_{i,j}$ for region *i*.
i = 1, 2,……n = the number of regions
j= 1, 2,…….m= the number of index components
a, and b are parameters are calibrated to be between 0 and 1 to provide the penalty from 0 to 1.
$0 \leq a, b \leq 1$

With the combination of the two parameters different kinds of penalty functions can be created. Figures E1 and E2 show the effect of parameters “a” and “b”.

Figure 19. The effect of changing parameter a in the penalty function (y_{min} =0, and b=1)

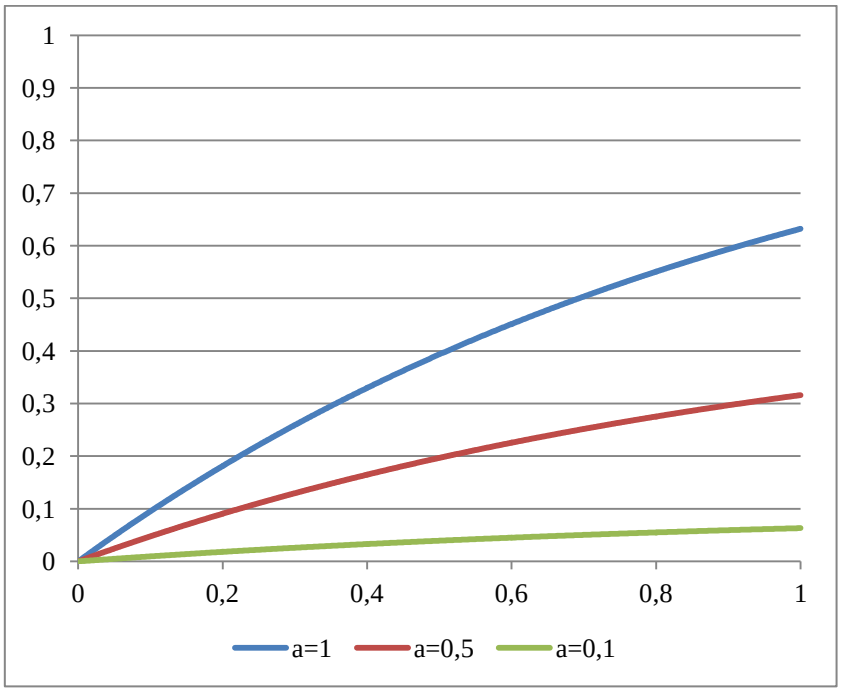
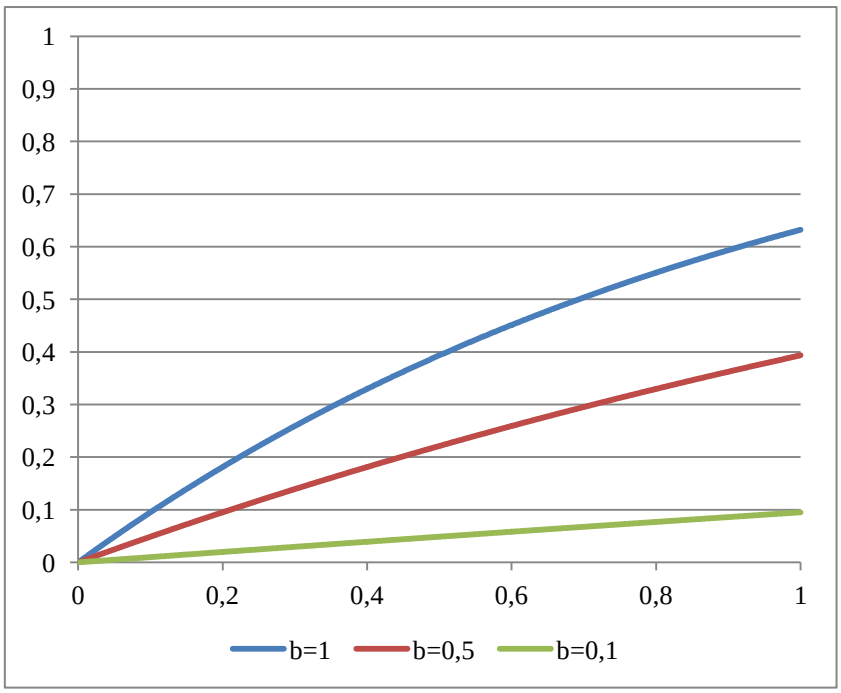


Figure 20. The effect of changing parameter b in the penalty function (y_{min} =0, and a=1)



When parameter a =1 then the penalty is minimal: After the penalty, the 0.2 original pillar value is going to be 0.18, so the penalty is 0.02. At higher pillar values the penalty is higher. If the original pillar value is 1, then the penalized pillar value is 0.63, so the maximum penalty is 0.37. The decrease of the parameter "a" has an effect of increasing penalty. For example, if parameter a=0.5 then the maximum penalty is 0.68, at a=0.1 the maximum penalty is 0.94. At a=0, the maximum penalty is 1. It means that the performance of the system is solely depending on the minimum pillar value. Since the

minimum pillar value here is 0, all the other penalized pillar values are also restricted to be 0 from the system perspective.

7.7 Appendix G: The calculation of the REDI scores

1. Pillar values were capped at the 95 percent value. By the application of this technique we got a proper benchmarking for each of the pillars. In this case not a potential outlier serves as a reference, but at least the best six regions have the same maximum value.
2. Capped pillar values were normalized by using the distance method. While this method transforms variables to be in the [0,1] range, does not restrict the worse region to have a zero value as in the case of the min-max normalization.

$$x_{i,j} = \frac{z_{i,j}}{\max z_{i,j}} \qquad \text{(F1)}$$

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

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

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

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

3. Original normalized pillar value averages range from 0,38 (*Opportunity Perception* and *Financing*) to 0,63 (*Product Innovation*). We believed that these values reflect to the difficulty to reach good performance; i.e. it is more difficult to attain good performance in *Product Innovation* as compared to *Finance*. For proper public policy application we equated the fourteen pillar averages to have the same marginal effect. While this technique does not handle the cost differences over size and countries it definitely reduces potential biases.
The arithmetic average of pillar j for number *n* regions is:

$$\bar{x}_j = \frac{\sum_{i=1}^{n} x_{i,j}}{n} \text{ for all } j \qquad \text{(F2)}$$

We want to transform the $x_{i,j}$ values such that the potential values to be in the [0,1] range.

$$y_{i,j} = x_{i,j}^{k} \qquad \text{(F3)}$$

where k is the "strength of adjustment", the k-th moment of X_j is exactly the needed average, $\bar{y}_j$. We have to find the root of the following equation for k:

$$\sum_{i=1}^{n} x_{i,j}^{k} - n\bar{y}_j = 0 \qquad \text{(F4)}$$

It is easy to see based on previous conditions and derivatives that the function is decreasing and convex which means it can be quickly solved using the well-known Newton-Raphson method with an initial guess of 0. After obtaining k, the computations are straightforward. Note that if

$$\begin{aligned} \bar{x}_j < \bar{y}_j \quad & k < 1 \\ \bar{x}_j = \bar{y}_j \quad & k = 1 \\ \bar{x}_j > \bar{y}_j \quad & k > 1 \end{aligned}$$

that is k be thought of as the strength (and direction) of adjustment.

4. We have defined entrepreneurship as the dynamic interaction of entrepreneurial attitudes, abilities, and aspiration across different levels of development. One issue this definition raises is how to bring the system perspective of dynamic interaction into the model. Following the Theory of Weakest Link and the Theory of Constraints we developed the Penalty for Bottleneck method to determine the optimum configuration. We hold that all the fourteen pillars constituting the system of entrepreneurship should be equal for optimalizing the use of the available resources. The performance of a particular region depends on its worst performing pillar, called the bottleneck. With respect to entrepreneurship, bottleneck means a shortage or the lowest level of a particular entrepreneurial pillar, relative to other pillars. This notion of a bottleneck is important for policy purposes. Our model suggests that pillars interact; if they are out of balance, entrepreneurship is inhibited. The pillar values should be adjusted in a way that takes into account this notion of balance. After normalizing the scores of all the pillars, and equalizing the averages of the pillars the value of each pillar of a region is penalized by linking it to the score of the pillar with the weakest performance in that region.

   We defined our penalty function following as:

$$h_{(i),j} = min\, y_{(i),j} + 1 - e^{-\left(y_{(i)j} - min\, y_{(i),j}\right)} \qquad \text{(F5)}$$

   where $h_{i,j}$ is the modified, post-penalty value of pillar j in region i
   $y_{i,j}$ is the normalized value of index component j in region i
   y_{min} is the lowest value of $y_{i,j}$ for region i.
   i = 1, 2,……n = the number of regions
   j= 1, 2,…….m= the number of pillars

5. The pillars are the basic building blocks of the sub-index: 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 a 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.

$$ATT_i = 100 \sum_{j=1}^{5} h_j \qquad (F6a)$$

$$ABT_i = 100 \sum_{j=6}^{10} h_j \qquad (F6b)$$

$$ASP_i = 100 \sum_{j=11}^{14} h_j \qquad (F6c)$$

   where $h_{i,j}$ is the modified, post-penalty value of pillar j in region i
   i = 1, 2,……n = the number of regions
   j= 1, 2,…….14= the number of pillars

6. The super-index, the Regional Entrepreneurship and Development Index, is simply the average of the three sub-indices.

$$REDI_i = \frac{1}{3}(ATT_i + ABT_i + ASP_i) \qquad (F7)$$

where i = 1, 2,……n = the number of regions

7. The Average Bottleneck Efficiency (ABE) is defined as how close a region's pillars to a region's best performing pillar score, on average. ABE is expressed in terms of percentages. Higher ABE values imply more balanced performance and therefore more efficient use of the available resources while lower ABE values mean substantial imbalances over the fourteen pillars of the GEDI. An equal alternative indicator of efficiency is to calculate the Average Bottleneck Gap (ABG). ABG also shows how much additional resource, on average, is necessary to raise all thirteen pillar values to their maximum pillar value. ABG is just the opposite to ABE, higher ABG values mean less balanced and low ABG values mean more balanced performance of the fourteen pillars.

7.8 Appendix H: Robustness test for the five cluster categorization

It is important to see if the indicated development stages perform real differences at the lower levels of the REDI as well. One way analysis of variance was implemented to see if the groups of regions indeed show differences in the average value of the sub-indices, the original and the penalty weighted pillars.

First let us see the results of the different groups from the point of view of the sub-indices. The following table (*Table 16*) summarizes the ANOVA results.

Table 17. Results of ANOVA for the sub-indices

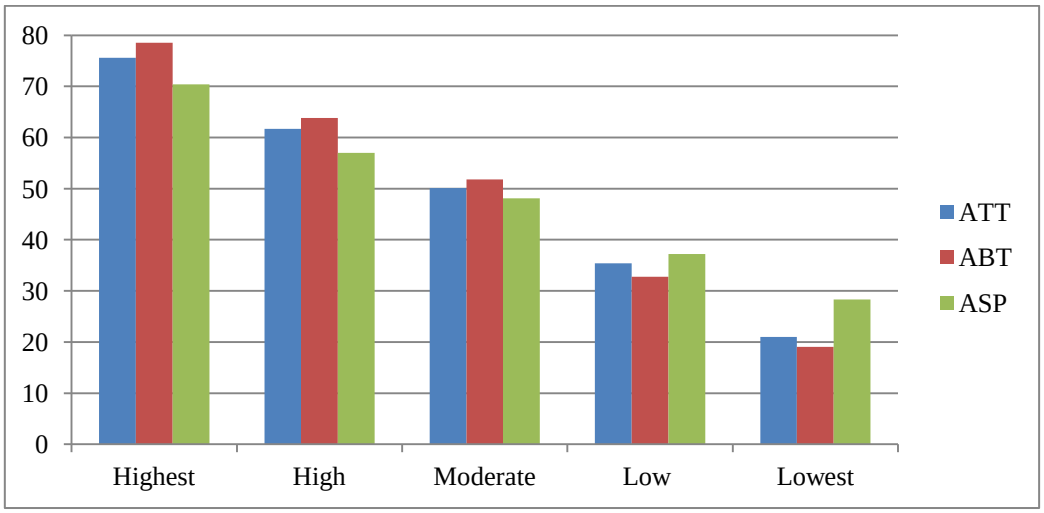
Sub-indices	F	p value	Deviation ratio
ATT	220.1	0.000	0.94
ABT	188.3	0.000	0.93
ASP	68.9	0.000	0.84

Each sub-index justifies the created clusters, as the means of the regions of the groups are significantly different in all three cases. (The Independent-Samples Kruskal-Wallis test presents the same conclusions.) The deviation ratio[12] indicates the strength of the relationship between the sub-index and the cluster membership. As its value is above 0.7 in every case, we can conclude that the clusters and the sub-indices are in a strong stochastic relationship.

Tukey HSD post-hoc tests indicate that there are significant differences (p value is 0.000 in every case) between every group pairwise. The mean values of the sub-indices are presented in *Figure 21*. by the clusters.

[12] Deviation ratio = $\sqrt{SS_{BG}/SS_T}$, where SS_{BG} is the sum of squares between the groups, and SS_T is the total sum of squares.

Figure 21. The comparison of the mean of the sub-indices by cluster membership



Moving on with the analysis, we examine the situation of the penalty adjusted pillars. The results of the one-way analysis of variance seem to support our classification (*Table 17*).

Table 18. Results of ANOVA for the penalty weighted pillar values

Penalty weighted pillars	F	p value	Deviation ratio
Opportunity perception	64.2	0.000	0.83
Startup skills	50.3	0.000	0.79
Risk Acceptance	28.8	0.000	0.70
Networking	88.4	0.000	0.86
Cultural support	68.0	0.000	0.83
Opportunity startup	78.2	0.000	0.85
Technology adoption	75.1	0.000	0.85
Human capital	41.0	0.000	0.76
Competition	96.8	0.000	0.87
Product innovation	34.5	0.000	0.73
Process innovation	12.6	0.000	0.54
High growth	22.1	0.000	0.65
Globalization	10.2	0.000	0.50
Financing	26.4	0.000	0.68

According to the p values ($p = 0.000$), the pillars and the clusters are not independent meaning that the mean values are different among the five groups. (The Independent-Samples Kruskal-Wallis test presents the same conclusions.) The strength of the stochastic relationships between the pillars and the cluster membership are still strong in most of the cases. There are only four pillars, where the strength of the relationship is moderate (*Process innovation*, *High growth*, *Globalisation* and *Financing*). However, even the lowest value is above 0.5. Pairwise comparison was carried out to see the underlying structure of the different pillars. *Table 18* summarizes the p values of the Tukey HSD post-hoc tests.

Table 19. Significance values of the Tukey HSD post hoc tests of the penalty adjusted pillars

Penalty weighted pillars	1 - 2	1 - 3	1 - 4	1 - 5	2 - 3	2 - 4	2 - 5	3 - 4	3 - 5	4 - 5
Opportunity perception	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Strat-up skills	0.089	0.000	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.001
Risk Acceptance	0.146	0.000	0.000	0.000	0.006	0.000	0.000	0.005	0.000	0.553
Networking	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
Cultural support	0.147	0.000	0.000	0.000	0.011	0.000	0.000	0.000	0.000	0.000
Opportunity startup	0.116	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000
Technology adoption	0.006	0.000	0.000	0.000	0.009	0.000	0.000	0.000	0.000	0.008
Human capital	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.052	0.000	0.000
Competition	0.115	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005
Product innovation	0.117	0.000	0.000	0.000	0.010	0.000	0.000	0.041	0.000	0.000
Process innovation	0.092	0.000	0.000	0.000	0.080	0.002	0.000	0.859	0.080	0.355
High growth	0.158	0.000	0.000	0.000	0.004	0.000	0.000	0.034	0.081	1.000
Globalization	0.699	0.601	0.002	0.000	0.999	0.002	0.000	0.007	0.001	0.695
Financing	0.018	0.001	0.000	0.000	0.675	0.000	0.000	0.001	0.000	0.033

Most of the cases, the p values in *Table 18* are rather low. However, in the case of group one and two the difference is not significant. This means that the top regions' pillars are similar in the best two development stages. So the overall position of group one and two can be determined only in the "macro" level of the sub-indices or of the REDI indicator itself. *Globalisation*, *Process innovation* and *High growth* are the least heterogeneous pillars, based on the post hoc test results. They indicate differences just among the other pillars at the lower performing regions.

Following, we examine the original pillar values (*Table 19*).

Table 20. Results of ANOVA for the original pillar values

Original pillars	F	p value	Deviation ratio
Opportunity perception	29.91	0.000	0.71
Strat-up skills	22.61	0.000	0.66
Risk Acceptance	18.32	0.000	0.62
Networking	44.03	0.000	0.77
Cultural support	46.98	0.000	0.78
Opportunity startup	55.54	0.000	0.81
Technology adoption	51.04	0.000	0.79
Human capital	26.21	0.000	0.68
Competition	53.40	0.000	0.80
Product innovation	23.79	0.000	0.67
Process innovation	6.54	0.000	0.42
High growth	11.49	0.000	0.53
Globalization	4.69	0.002	0.37
Financing	9.74	0.000	0.50

The p values are below 0.01 in every case, reinforcing the proper selection of such categorization (*Table 19*). (The Independent-Samples Kruskal-Wallis test presents the same conclusions.) However, the strength of the relationships is not so convincing. Six pillars still indicate strong stochastic relationship (*Opportunity perception, Networking, Cultural support, Opportunity startup, Technology adoption* and *Competition*). All the other pillars show medium-strong relationship. Pairwise comparison is necessary again to see the significance of the differences between the five clusters. *Table 20* summarizes the p values of the Tukey HSD post-hoc tests. The red cells include those p values that are above 0.05. So in these cases the pairwise comparisons show that the five clusters are independent from each other. The differences between clusters 1 and 2, 2 and 3, and 4 and 5 indicate the least significant differences. Similarly to the earlier results, *Globalisation* is found to be the most homogeneous original pillar. *Process innovation* and *High growth* are also less heterogeneous as compared to the other pillars.

Table 21. Significance values of the Turkey HSD post-hoc tests of the original pillar values

Original pillars	1 - 2	1 - 3	1 - 4	1 - 5	2 - 3	2 - 4	2 - 5	3 - 4	3 - 5	4 - 5
Opportunity perception	0.012	0.000	0.000	0.000	0.035	0.000	0.000	0.005	0.000	0.293
Strat-up skills	0.639	0.031	0.000	0.000	0.137	0.000	0.000	0.005	0.000	0.116
Risk Acceptance	0.648	0.014	0.000	0.000	0.050	0.000	0.000	0.012	0.006	0.947
Networking	0.026	0.000	0.000	0.000	0.035	0.000	0.000	0.000	0.000	0.159
Cultural support	0.614	0.017	0.000	0.000	0.077	0.000	0.000	0.002	0.000	0.000
Opportunity startup	0.516	0.008	0.000	0.000	0.056	0.000	0.000	0.000	0.000	0.001
Technology adoption	0.003	0.000	0.000	0.000	0.156	0.000	0.000	0.000	0.000	0.083
Human capital	0.000	0.000	0.000	0.000	0.158	0.000	0.000	0.314	0.000	0.006
Competition	0.146	0.001	0.000	0.000	0.095	0.000	0.000	0.000	0.000	0.107
Product innovation	0.208	0.003	0.000	0.000	0.123	0.000	0.000	0.177	0.000	0.001
Process innovation	0.263	0.008	0.003	0.000	0.233	0.074	0.009	0.996	0.580	0.733
High growth	0.076	0.001	0.000	0.000	0.150	0.000	0.003	0.320	0.530	1.000
Globalization	0.966	0.999	0.206	0.058	0.983	0.154	0.031	0.050	0.010	0.828
Financing	0.040	0.060	0.000	0.000	1.000	0.019	0.011	0.016	0.009	0.950

The penalty adjusted pillars and the sub-indices clearly justify the results of the cluster analysis. The five different groups (development stages) present significantly different mean values at the level of the sub-indices and of the penalty weighted pillars. **The level of the performance of the regions seems to be captured correctly by the penalized pillars and the sub-indices. These facts underline the results of the REDI index calculation methodology.**

7.9 Appendix I: The examination of the Institutional REDI and the REDI 28 index versions

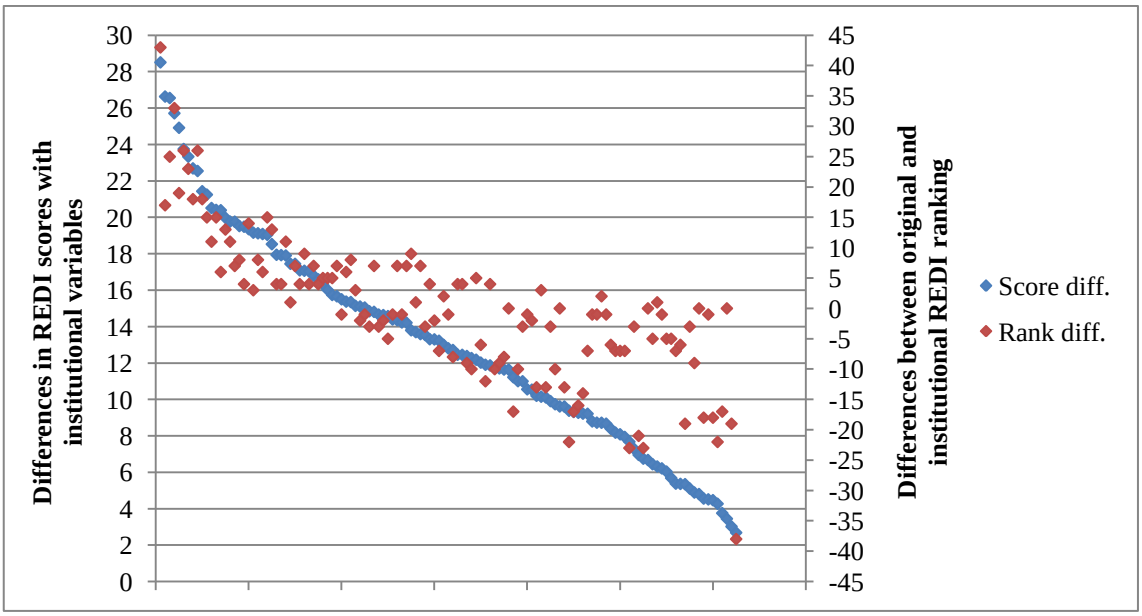
If we compare the descriptive statistics of the original REDI and institutional REDI scores, we can see that the institutional scores are higher than the original ones, but the ranges and the interquartile ranges are similar (*Table 21*).

Table 22. Descriptive statistics of REDI and Institutional REDI

	REDI scores	Institutional REDI scores
Average	46.03	59.18
Median	48.21	62.50
Minimum	18.42	21.87
Maximum	82.16	92.91
Range	63.74	71.04
Interquartile range	25.51	27.71

The average difference between the original and institutional scores was 13.15 points, the minimum difference was 2.69 and the maximum difference was 28.51. As we have already shown by the descriptive statistics, the institutional REDI scores are higher than the original ones meaning that all of the regions got higher scores than in the original case. The correlation between the score and the ranking differences is high and significant (correlation value: 0.80, p=0,01). *Figure 22* demonstrates that there were some regions with the highest differences got better ranking. However it is not a general rule as there were some regions that had had high score differences, but no better position in the ranking. Viewing regions with smaller score differences we can see that the score differences just slightly determinate the changes in the ranking.

Figure 22. The differences between original and institutional REDI scores and ranking



We could observe German, British, Finnish and Swedish regions in the group of those regions which had the highest score and positive ranking difference. The two Slovenian, the two Irish regions and some South-European regions suffered the highest lost in the ranking. If we observe those regions

which were at the end in the original REDI ranking, we can see that their positions remained about the same and they were not able to reach better positions. It can be seen on the right side of *Figure 22* that they react relatively inflexible on the institutional REDI scores.

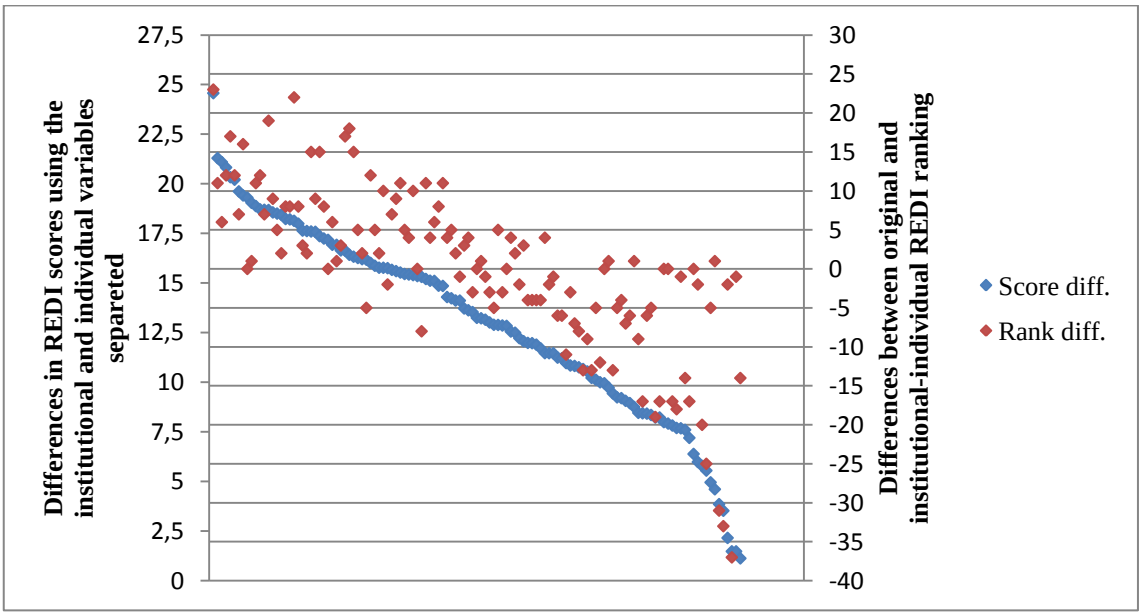
The differences in the ranking are the lowest if we compare REDI with the 28 variable REDI versions. The maximum drop was in the case of the Belgian Région Wallone that lost 37 places while the German Mecklenburg-Vorpommern gained 23 places. We can see on *Table 22* that if we use the individual and institutional variables separately to compute the REDI scores, the average and median values of the new scores are significantly higher. The minimum and maximum value have risen only few points but the interquartile range declined which could show us that the medium 50% of scores are in a narrower range as in the original case.

Table 23. Descriptive statistics of REDI and Institutional REDI

	REDI scores	28 variables REDI scores
Average	46.03	59.18
Median	48.21	62.50
Minimum	18.42	24.81
Maximum	82.16	84.53
Range	63.74	59,09
Interquartile range	25.51	16,10

If we check the differences between the original and the 28 variables REDI in scores and ranking, we can see that all of the 28 variables REDI scores are higher than in the original case. It can be seen on *Figure 23* that the minimum value of score difference is above 0. Viewing the ranking differences and the right Y axis, we can see that there are many regions (about the half of the regions) which got higher scores however their ranking positions did not change or changed only slightly, between 0 to 5 positions in positive or negative direction.

Figure 23. The differences between original and the 28 variables REDI scores and ranking



The REDI points and the ranking of all the 125 regions with all four versions can be found in *Table 23*.

Table 24. The scores and the ranking of the countries with the four different REDI versions

Code	Region	REDI scores	REDI Rank	REDI Individual Score	REDI Individual Rank	REDI Institutional Score	REDI Institutional Rank	REDI 28 Variables Score	REDI 28 Variables Ranking
AT1	Ostösterreich	60.7	25	68	31	72.4	34	68.9	44
AT2	Südösterreich	52	48	71.3	15	58.9	69	62.2	61
AT3	Westösterreich	50.3	55	69.6	18	59.9	68	63.1	58
BE1	Région de Bruxelles-Capitale	64.9	13	63.8	56	75.9	23	68.4	46
BE2	Vlaams Gewest	62.1	21	63.1	66	74.5	30	66	52
BE3	Région wallonne	60.1	26	62.3	70	69.5	48	61.6	63
CZ	Czech Republic	37	80	53.8	114	46.8	90	47.7	93
DE1	Baden-Württemberg	58.1	34	62.9	68	76.6	21	73	23
DE2	Bayern	57.3	37	64.8	47	73.0	32	73.7	19
DE3	Berlin	67.2	11	65.3	41	82.3	8	78.7	7
DE4	Brandenburg	48.5	61	57.6	106	65.5	57	59.3	68
DE5	Bremen	48.4	62	53.8	115	77	19	64.1	55
DE6	Hamburg	54.3	47	60.4	87	80	14	69.9	38
DE7	Hessen	63.3	19	68.7	22	77	18	75.9	15
DE8	Mecklenburg-Vorpommern	35.6	89	48.5	124	62.1	64	60.1	66
DE9	Niedersachsen	51.6	50	61.7	78	66.1	55	66.9	50
DEA	Nordrhein-Westfalen	55	43	66.6	34	71.5	39	73.1	21
DEB	Rheinland-Pfalz	56.2	41	68.1	30	70.8	43	72.8	24
DEC	Saarland	54.9	44	63.4	60	69.7	47	68.4	47
DED	Sachsen	50	56	59.9	92	70.5	45	68.2	48
DEE	Sachsen-Anhalt	41.3	72	52.8	119	60.4	66	58.9	70
DEF	Schleswig-Holstein	43.6	69	55.6	111	68.5	50	63.8	57
DEG	Thüringen	37.2	78	46.4	125	63.8	61	58.3	72
DK01	Hovedstaden	82.2	1	78.3	5	90.8	2	83.6	2
DK02	Sjalland	60.7	23	64.8	48	75.4	26	70.7	35
DK03	Syddanmark	65.1	12	74.1	8	71.9	35	72.7	26
DK04	Midtjylland	64.3	16	71.7	14	74.5	29	71.5	33
DK05	Nordjylland	72	8	73.7	10	75	27	73.1	22
EE	Estonia	45.9	64	69.3	20	50.4	82	53.8	81
EL2	Kentriki Ellada	19.5	123	59	98	25.9	122	29.3	122
EL3	Attiki	31.3	100	63.1	65	41.2	103	44.1	100
EL4	Nisia Aigaiou. Kriti	21.4	120	59.4	95	28.1	120	31.4	120
ES11	Galicia	36.9	82	59.5	94	52.9	77	55.4	77
ES12	Principado de Asturias	42.3	70	63.1	67	57.4	71	60	67
ES13	Cantabria	36.5	85	58.3	99	56.5	72	57.8	74
ES21	País Vasco	45.6	65	62.2	73	65.4	58	64.5	54

Code	Region	REDI scores	REDI Rank	REDI Individual Score	REDI Individual Rank	REDI Institutional Score	REDI Institutional Rank	REDI 28 Variables Score	REDI 28 Variables Ranking
ES22	Comunidad Foral de Navarra	39	74	59.2	96	58.5	70	58	73
ES23	La Rioja	37.6	77	61.6	80	52	78	53.7	82
ES24	Aragón	32.6	95	58.1	102	48	89	51.3	88
ES30	Comunidad de Madrid	54.7	46	67.4	33	71	41	72.3	31
ES41	Castilla y León	36.8	83	59.9	91	54.2	76	56.4	76
ES42	Castilla-la Mancha	32.1	97	58.3	100	45.4	93	49	91
ES43	Extremadura	30.3	102	58	103	43.9	95	47.6	94
ES51	Cataluna	42.3	71	63.5	59	60.2	67	63.1	59
ES52	Comunidad Valenciana	38.1	75	61.4	83	55.6	74	57.4	75
ES53	Illes Balears	37.7	76	62	75	49.4	86	53	84
ES61	Andalucía	37.1	79	62.2	71	51.3	80	54.3	79
ES62	Región de Murcia	36.7	84	63.2	63	49.5	85	52.4	86
ES70	Canarias (ES)	35.5	90	63.7	57	48.5	88	52.2	87
FI19	Länsi-Suomi	58.7	32	68.7	23	71	42	72.4	29
FI1B	Helsinki-Uusimaa	62.2	20	66.1	37	81.9	9	78.2	8
FI1C	Etelä-Suomi	58.9	30	67.5	32	80.4	12	77.6	11
FI1D	Pohjois- ja Ita-Suomi	51.2	52	61.7	79	71.6	37	70.6	36
FR1	Île de France	79.2	3	76	6	85.5	4	81.4	5
FR2	Bassin Parisien	50.9	54	65.1	43	62.5	62	61.6	62
FR3	Nord - Pas-de-Calais	48.8	60	62.1	74	68	52	64	56
FR4	Est (FR)	49.7	58	61	84	65.2	59	65.2	53
FR5	Ouest (FR)	51.8	49	64.8	46	61.1	65	62.8	60
FR6	Sud-Ouest (FR)	58.9	31	73.8	9	66.6	54	69.4	40
FR7	Centre-Est (FR)	64.2	17	71.2	16	73.5	31	70	37
FR8	Méditerranée	59.4	27	72.3	13	70.6	44	72.4	30
HR03	Jadranska Hrvatska (Adriatic Croatia)	32	98	68.3	27	36.8	107	40.4	107
HR04	Kontinentalna Hrvatska (Continental Croatia)	29.9	103	63.9	54	37.2	106	40.8	106
HU10	Közép-Magyarország	31.4	99	57.8	105	46.7	91	50	90
HU21	Közép-Dunántúl	22	117	55.9	109	33.8	113	37.4	113
HU22	Nyugat-Dunántúl	21.5	118	55.1	112	35.7	111	39.5	110
HU23	Dél-Dunántúl	23.8	113	57.9	104	36.3	109	40.1	108
HU31	Észak-Magyarország	22.4	115	57	107	32	115	35.7	115
HU32	Észak-Alföld	21.4	119	56	108	33.6	114	37.3	114
HU33	Dél-Alföld	21	121	52.6	120	34.8	112	38.6	112
IE01	Border. Midland and Western	63.4	18	80.3	2	66.1	56	69	43
IE02	Southern and Eastern	72	7	79.3	4	75.7	24	78	9
ITC	Nord-Ovest	40.4	73	64.3	51	55.5	75	58.8	71
ITF	Sud	27.3	109	63.2	64	36	110	38.7	111
ITG	Isole	27.6	108	65.5	39	37.8	105	41.3	104
ITH	Nord-Est	36.1	86	62.2	72	51.8	79	54.4	78

Code	Region	REDI scores	REDI Rank	REDI Individual Score	REDI Individual Rank	REDI Institutional Score	REDI Institutional Rank	REDI 28 Variables Score	REDI 28 Variables Ranking
ITI	Centro (IT)	36.9	81	64.3	52	50.2	83	53.9	80
LT	Lithuania	35.2	91	61.8	77	43.3	98	46.9	95
LV	Latvia	33.8	93	68.3	28	42	100	45.7	97
NL1	Noord-Nederland	51.1	53	64.2	53	64.3	60	66.9	51
NL2	Oost-Nederland	56.5	39	65.9	38	68.4	51	70.8	34
NL3	West-Nederland	64.4	15	73.5	11	74.5	28	76.9	13
NL4	Zuid-Nederland	57	38	68.4	25	69.8	46	72.4	28
PL1	Region Centralny	36.1	88	51.9	121	50.9	81	50.2	89
PL2	Region Poludniowy	34.1	92	52.9	118	45.8	92	46.1	96
PL3	Region Wschodni	29.2	105	53.6	116	41.7	101	43.5	101
PL4	Region Pólnocno-Zachodni	32.3	96	51.5	122	43.3	99	43.5	102
PL5	Region Poludniowo-Zachodni	36.1	87	61.6	81	45.3	94	49	92
PL6	Region Pólnocny	33.2	94	55.1	113	43.7	96	45.2	98
PT11	Norte	29.2	106	59.5	93	37.9	104	41.3	103
PT15	Algarve	30.9	101	61.5	82	41.5	102	45	99
PT16	Centro (PT)	27.6	107	55.6	110	36.4	108	39.9	109
PT17	Lisboa	44.6	67	61.8	76	62.5	63	60.8	65
PT18	Alentejo	29.4	104	49.8	123	43.7	97	40.8	105
RO1	Macroregiunea unu	19.4	124	60.1	88	24.2	124	27.3	124
RO2	Macroregiunea doi	18.4	125	59.9	90	21.9	125	24.8	125
RO3	Macroregiunea trei	22.1	116	60.7	85	27.8	121	30.5	121
RO4	Macroregiunea patru	19.7	122	53.2	117	24.2	123	27.4	123
SE11	Stockholm	73.8	4	68.8	21	92.9	1	82.5	3
SE12	Östra Mellansverige	72.7	5	70.5	17	81.1	11	77.6	10
SE21	Smaland med öarna	49.9	57	63.2	62	69.4	49	68.6	45
SE22	Sydsverige	67.3	10	66.4	35	84.4	6	76.5	14
SE23	Vastsverige	72.2	6	72.5	12	80.1	13	80.1	6
SE31	Norra Mellansverige	57.7	36	68.6	24	67	53	67.1	49
SE32	Mellersta Norrland	48.2	63	58.2	101	71.5	40	61.4	64
SE33	Övre Norrland	64.7	14	68.4	26	76.7	20	73.1	20
SI01	Vzhodna Slovenija	45.3	66	81	1	49.9	84	53.5	83
SI02	Zahodna Slovenija	51.3	51	79.8	3	55.6	73	59	69
SK01	Bratislavsky kraj	44	68	69.5	19	49.3	87	52.4	85
SK02	Západné Slovensko	25.8	110	63.2	61	31.1	116	34.7	116
SK03	Stredné Slovensko	24.9	111	63.9	55	30.3	118	33.9	118
SK04	Vychodné Slovensko	24.5	112	59	97	30.9	117	34.6	117
UKC	North East (UK)	48.9	59	60.5	86	72.7	33	69.2	42
UKD	North West (UK)	59	28	63.7	58	81.7	10	74.6	17
UKE	Yorkshire and The Humber	56.4	40	65.5	40	75.4	25	72.7	25
UKF	East Midlands (UK)	55.3	42	62.8	69	77.9	16	72.7	27

Code	Region	REDI scores	REDI Rank	REDI Individual Score	REDI Individual Rank	REDI Institutional Score	REDI Institutional Rank	REDI 28 Variables Score	REDI 28 Variables Ranking
UKG	West Midlands (UK)	58.6	33	64.7	49	76.5	22	71.8	32
UKH	East of England	61.5	22	64.4	50	82.7	7	77.3	12
UKI	London	79.9	2	74.8	7	85	5	84.5	1
UKJ	South East (UK)	69.5	9	68.1	29	89.9	3	82.4	4
UKK	South West (UK)	60.7	24	65	45	77.5	17	75.6	16
UKL	Wales	54.7	45	65.1	44	71.7	36	69.8	39
UKM	Scotland	59	29	65.2	42	78.3	15	74.2	18
UKN	Northern Ireland (UK)	58	35	66.3	36	71.6	38	69.3	41

7.10 Appendix J: The effect of changing variables

During the creation of the REDI scores we have conducted hundreds of index versions. We also recognized that the change of the variables or pillars had minimal influence on the ranking. Here, we report the result of changing two variables. First, we replaced the original Clustering variable with the "cluster observatory star rating" and with the "cluster employment" variable. Second, we calculated the REDI scores with "Corruption" and "Personal freedom" instead of "Cultural support" variable. *Table 24* shows the Pearson's correlation coefficient (between the original and new scores) and Spearman's rank correlation coefficient (between the original and new rankings).

Table 25. Correlation values between the original and new versions of REDI

	Pearson's coefficient	**1**	**2**	**3**	**4**	**5**
1	REDI	1	0.990	0.985	0.999	0.997
2	REDI Star rating		1	0.993	0.990	0.987
3	REDI Employment			1	0.985	0.982
4	REDI Corruption				1	0.996
5	REDI Personal Freedom					1
	Spearman's rho (new rankings to the original one)	1	0.988	0.987	0.996	0.996

According to *Table 24*, all the changed versions of REDI scores correlate significantly on a very high level with the original REDI scores and there are only very small differences between the new versions. The Spearman's rhos also prevail high rank correlation between any two of the reported versions.

The Star rating, known as "Observatory star rating" is reported by the European Cluster Observatory. Observatory star rating (or Star indicator) is the amount and quality of knowledge circulating and spilling over between firms located in a given cluster. It depends upon the cluster size, the degree to which it is specialized and the extent to which the locality (the region) is geared towards and focused upon production in the relevant industries comprising the cluster. These three factors -- size, specialization and focus –reflect whether the cluster has reached 'specialized critical mass' to develop positive spillovers and linkages. The European Cluster Observatory assigns one, two or three stars to a region depending on the extent to which clusters have achieved a specialized critical mass of the following three factors:

1. *Size*: if employment reaches a sufficient share of total European employment, it is more likely that meaningful economic effects of clusters will be present. The 'size' measure shows whether a cluster is in the top 10% of all clusters in Europe within the same cluster category in terms of the number of employees. Those in the top 10% will receive one star.
2. *Specialisation*: if a region is more specialized in a specific cluster category than the overall economy across all regions, this is likely to be an indication that the economic effects of the regional cluster have been strong enough to attract related economic activity from other regions to this location, and these spillovers and linkages will be stronger. The 'specialisation' measure compares the proportion of employment in a cluster category in a region over the total employment in the same region, to the proportion of total European employment in that cluster category over total European employment (see equation). If a cluster category in a region has a specialization quotient of 2 or more it receives a star.

3. *Focus*: if a cluster accounts for a larger share of a region's overall employment, it is more likely that spill-over effects and linkages will actually occur instead of being drowned in the economic interaction of other parts of the regional economy. The 'focus' measure shows the extent to which the regional economy is focused upon the industries comprising the cluster category. This measure relates employment in the cluster to total employment in the region. The top 10% of clusters which account for the largest proportion of their region's total employment receive a star.

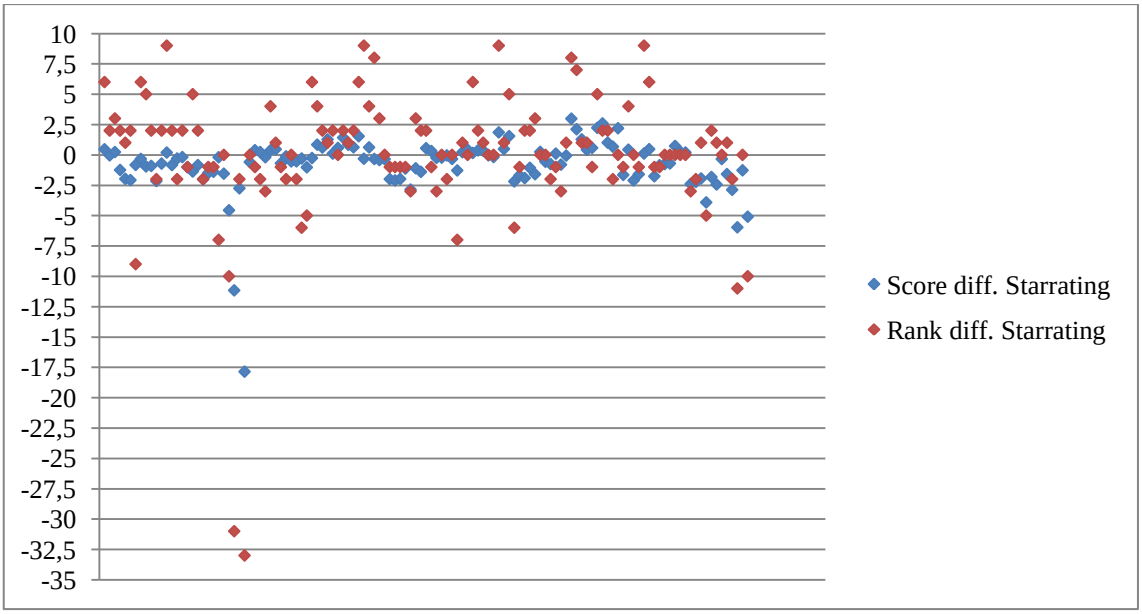
For practical use, we re-scaled the original 0-3 range variable to a scale of 0-10. *Table 25* present the basic statistics for the original REDI and the REDI Star rating versions. The differences are minimal.

Table 26. The descriptive statistics of the original and "Star rating" REDI versions

	REDI	REDI Star rating
Average	46.03	45.26
Median	48.21	46.33
Minimum	18.42	19.76
Maximum	82.16	80.61
Range	63.74	60.85
Interquartile range	25.51	23.34

The highest score difference was in the case of the Portugal Norte region (+3 points) and the lowest score difference was noticed in the Danish Nordjylland region (-17.9 points). However, most of the score differences were inside -3 points to +3 points a range. This differences for all the 125 regions can be seen in *Figure 24*. Because of the small differences we did not need to apply a secondary (right) Y axis.

Figure 24. Differences between REDI and "Star rating" REDI scores and ranking



Comparing the rankings, there are four regions that were the "winner" of the new ranking and gained 9 places: the Italian Nord-Est (from 86th to 77th), the German Hamburg (from 47th to 38th), the Swedish Norra Mellansverige (from 36th to 27th) and the Finnish Länsi-Suomi (from 32nd to 23rd). The main losers in the new ranking were two Danish regions that lost relatively high scores. Nordjylland lost 33 places (from 8th to 41st) and Syddanmark's position declined by 31 places (from 12th to 43rd).

In the following, we changed the cluster mix index for the "Cluster Employment" data. Cluster employment data are based on the location quotients (LQ) showing the specialization of a region with respect to the number of employees. Strong clusters must have a LQ>1. There were missing data for Croatia and average of the data for Poland, Latvia and Hungary[13]. According to the correlation coefficients, this version had the "lowest" correlation (which is fundamentally very strong). The data were re-scaled to a scale the 0-10 range, similar to the "Star rating" version.

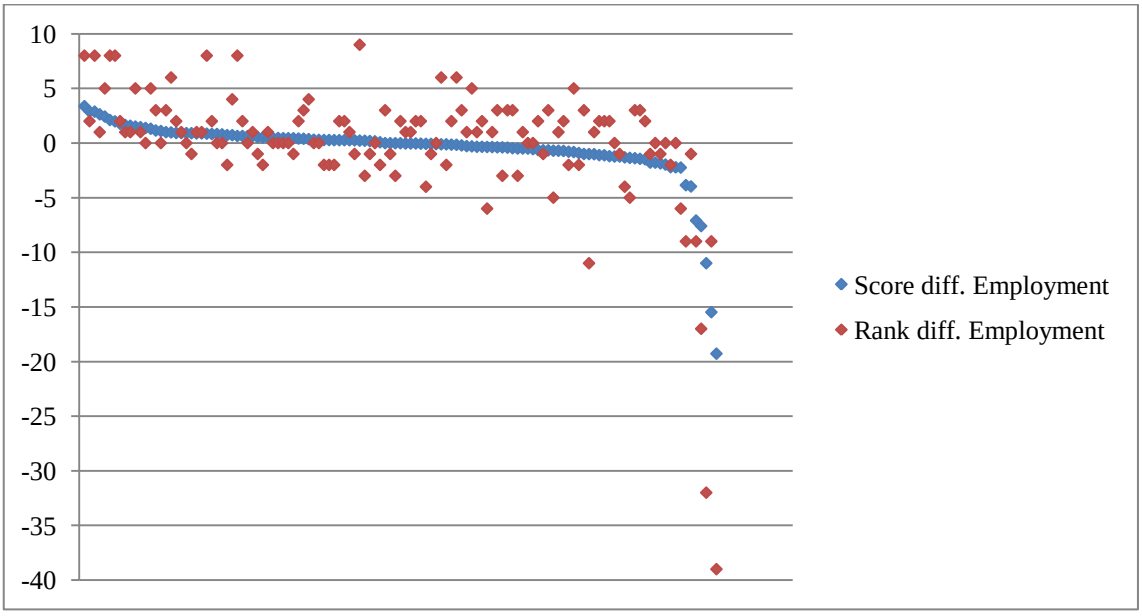
Comparing the descriptive statistics of the original and the "Employment" REDI versions we can see that the results are similar to the previous case: The range and the interquartile range are narrower than in the original case and the maximum value is below 80 points (*Table 26*).

Table 27. The descriptive statistics of the original and "Employment" REDI versions

	REDI	REDI Employment
Average	46.03	45.57
Median	48.21	47.40
Minimum	18.42	20.04
Maximum	82.16	79.88
Range	63.74	59.84
Interquartile range	25.51	23.13

Examining the score and ranking differences, there are noticeable similarities as compared to the former case: The Portugal Norte region had the most positive score difference (+3.4 points) and the Danish Nordjylland had the most negative difference (-19.3 points). Here we note that almost all of the Danish regions' scores were declined significantly (*Figure 25*).

Figure 25. Differences between REDI and "Employment" REDI scores and ranking



[13] For the estimation data, the following WEF data were used: State of cluster development "In your country's economy, how prevalent are well-developed and deep clusters?" [1 = nonexistent; 7 = widespread in many fields] | 2011–12 weighted average (WEF Global Competitiveness Index 2012-2013, 504. p)

The Swedish Norra Mellansverige gained the most by 9 places (from 36th to 27th) the Danish Nordjylland fell by 39 places (from 8th to 47th) in the ranking. As a consequence, London and French Ile de France occupy the first two places in the "Employment" REDI ranking. The Danish Hovedstaden, the former leader in most of the REDI rankings slipped down to the 10th place.

The next examined variable is "Cultural Support". We investigated the effect of the modification of two variables. First, we changed the original variable to "Corruption". The Corruption data were based on a standardized variable combining education (*EdCor*: region's aggregated score from survey question on the extent to which corruption persists in the education system in the region/area), health (*HelCor*: region's aggregated score from survey question on the extent to which corruption persists in the health care system in the region/area), general public corruption (*OtherCor*: region's aggregated score from survey question on the extent to which respondents felt other citizens in the region/area use bribery to obtain public services), law enforcement (*LawCor*: region's aggregated score from survey question on the extent to which corruption persists in the law enforcement in the region/area) and the payment of bribes (*HelBribe*: region's aggregated score from survey question asking whether the respondents were forced to pay a bribe in the last 12 months to obtain any health care in the region/area)[14]. Data are from 2009-2010 and they were re-scaled to a scale of 0 to 10.

We compared the main descriptive statistics values and we can see minimal differences (*Table 27*). Out of the four examined versions the "Corruption" version shows the highest correlation with the original version. However, it does not necessary mean that the ranking is also the same.

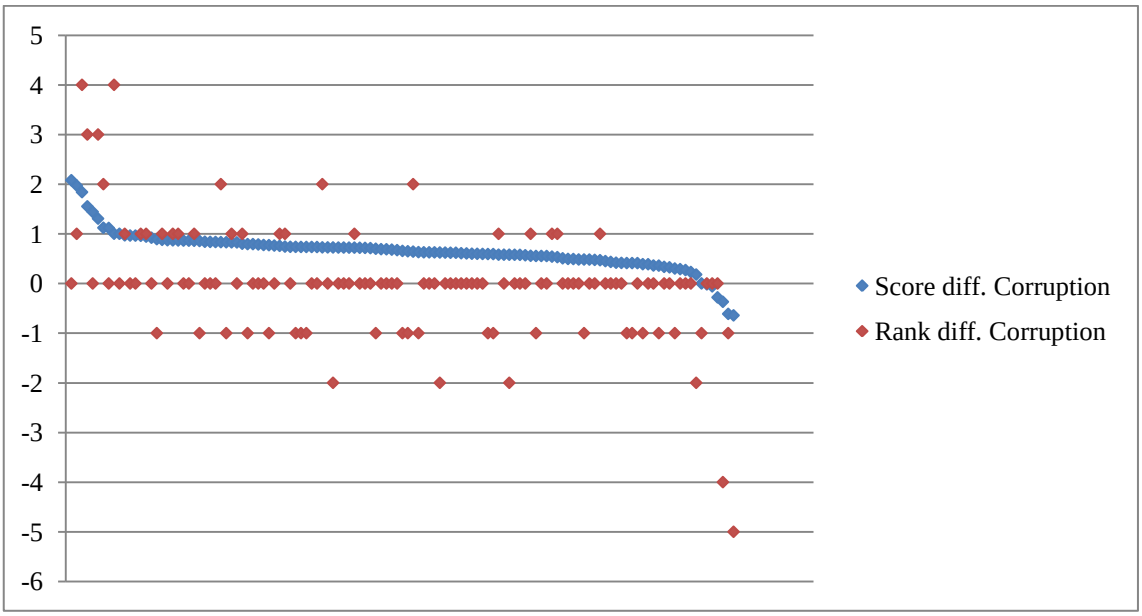
Table 28. The descriptive statistics of the original and "Corruption" REDI versions

	REDI	REDI Corruption
Average	46.03	46.69
Median	48.21	48.44
Minimum	18.42	18.66
Maximum	82.16	82.57
Range	63.74	63.72
Interquartile range	25.51	25.29

Based on *Table 27*, the Baltic states had the highest score difference: Estonia gained +2.1 points, Latvia did +2 points and Lithuania did +1.8 points. The Belgian Région Wallone had the lowest score difference with -0.6 points. Only five regions had their score difference below 0 meaning that score differences disperse in a very narrow range (*Figure 26*).

[14] *Source*: Nicholas Charron, Lewis Dijkstra & Victor Lapuente (2013): Regional Governance Matters: Quality of Government within European Union Member States, Regional Studies, DOI:10.1080/00343404.2013.770141. To link to this article: http://www.qog.pol.gu.se/digitalAssets/1446/1446579_regional-studies-article.pdf (9 August 2013).
Detailed description of the variable is available at: http://www.qog.pol.gu.se/digitalAssets/1362/1362471_eqi---correlates-codebook.pdf (9 August 2013)

Figure 26. Differences between REDI and "Corruption" REDI scores and ranking



Although, the ranking of the regions did not changed or changed only two places in a positive or negative direction, the ranking differences disperse is more substantial. Lithuania and the Finnish Etelä-Suomi (+4 places) stepped ahead the most and Région wallone suffered the biggest lost (-5 places).

In the following, we show the consequences of the replacement of the "Cultural Support" variable with "Personal freedom". The Personal Freedom, as a sub-index of the Heritage Foundation's Index of Economic Freedom, measures countries' performance in two areas: individual freedom and social tolerance. The Personal Freedom sub-index captures the effects of freedom of choice, expression, movement, and belief, on a country's per capita GDP and the subjective wellbeing of its citizens. It also assesses how levels of tolerance of ethnic minorities and immigrants impact countries' economic growth and citizens' life satisfaction. Societies that foster strong civil rights and freedoms have been shown to enjoy increases in levels of satisfaction among their citizens. When citizens' personal liberties are protected, a country benefits from higher levels of national income (for year 2011). The Personal Freedom sub-index contains 5 sub-indicators: (1) Civil Liberties, (2) Civil Liberty and Free Choice, (3) Satisfaction with Freedom of Choice, (4) Tolerance of Immigrants and (5) Tolerance of Minorities.[15]

Comparing the descriptive statistics of the original and "Personal Freedom" REDI versions we can see little differences. According to *Table 28*, the range and interquartile range is almost the same with the original version (similar to the "Corruption" REDI versions).

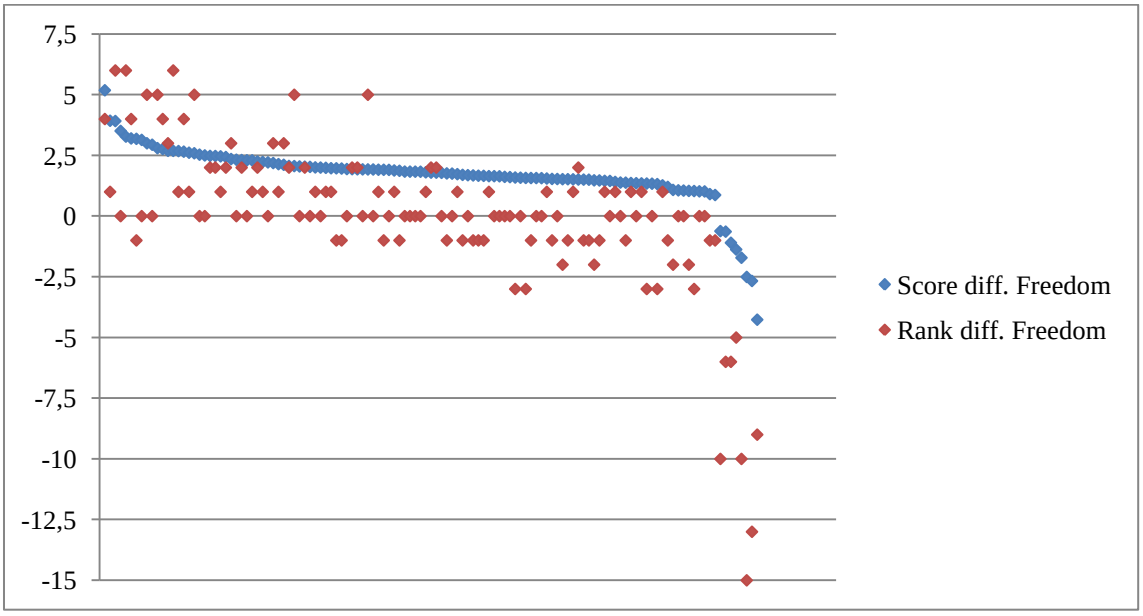
[15] Detailed description of the variable is available at:
http://webapi.prosperity.com/download/pdf/PI2012_MethodologyV4.pdf (5 August 2013)

Table 29. The descriptive statistics of the original and "Personal Freedom" REDI versions

	REDI	REDI Personal Freedom
Average	46.03	47.74
Median	48.21	49.23
Minimum	18.42	20.17
Maximum	82.16	83.22
Range	63.74	63.05
Interquartile range	25.51	25.68

The highest difference of the scores between the old and the new version was +5.2 points (the Slovakian Bratislavsky kraj) and the lowest (or highest negative) difference was noticed in the case of Estonia with -4.3 points. Most of the score differences are above 0. There are only eight regions that had a negative score difference. According the new version, the "winner" of the ranking was the French Sud-Ouest, the Portugal Norte and the Hungarian Közép-Magyarország. Each region gained 6 places. The Belgian Région wallone suffered the biggest lost in ranking by 15 places. We note that all of the Belgian regions slipped down significantly (*Figure 27*).

Figure 27. Differences between REDI and "Personal Freedom" REDI scores and ranking



The REDI points and the ranking of all the 125 regions with the original and four examined versions can be found in *Table 29*.

Table 30. The scores and the ranking of the countries with the use of different variables

CODE	REGION	REDI	REDI rank	Star rating	Star rating rank	Employment	Employment rank	Corruption	Corruption rank	Personal Freedom	Personal Freedom rank
AT1	Ostösterreich	60.7	25	61.1	19	60.6	19	61.4	23	60	31
AT2	Südösterreich	52	48	51.9	46	51.9	48	52.9	48	53.6	51
AT3	Westösterreich	50.3	55	50.5	52	50.7	52	51.1	55	51.8	57
BE1	Région de Bruxelles-Capitale	64.9	13	63.6	11	64.6	12	64.5	17	63.8	19
BE2	Vlaams Gewest	62.1	21	60.1	20	61.5	18	62.7	21	59.4	34
BE3	Région wallonne	60.1	26	58	24	58.7	23	59.5	31	57.6	41
CZ	Czech Republic	37	80	36.2	89	36.7	86	37.9	79	36.4	90
DE1	Baden-Württemberg	58.1	34	57.8	28	57.3	29	58.9	34	60	32
DE2	Bayern	57.3	37	56.3	32	56.3	34	58.1	36	59.2	35
DE3	Berlin	67.2	11	66.3	9	67.2	8	67.7	11	68.5	10
DE4	Brandenburg	48.5	61	46.3	63	41.4	70	48.9	62	49.9	62
DE5	Bremen	48.4	62	47.7	60	49.2	58	49	61	50	61
DE6	Hamburg	54.3	47	54.5	38	55	39	54.8	47	55.7	47
DE7	Hessen	63.3	19	62.5	17	63	17	63.9	19	65.8	18
DE8	Mecklenburg-Vorpommern	35.6	89	35.3	91	35.6	91	36.3	90	38.2	85
DE9	Niedersachsen	51.6	50	51.4	48	50.2	55	52.3	50	53.9	49
DEA	Nordrhein-Westfalen	55	43	53.9	44	54	45	55.8	43	56.9	43
DEB	Rheinland-Pfalz	56.2	41	54.8	36	54.4	42	56.8	41	58.7	39
DEC	Saarland	54.9	44	54	42	54.5	41	55.5	44	56.5	44
DED	Sachsen	50	56	48	58	47.7	62	50.7	56	52.3	56
DEE	Sachsen-Anhalt	41.3	72	39.8	73	39.4	73	42	72	43.3	71
DEF	Schleswig-Holstein	43.6	69	42.2	70	43	68	44.4	68	45.5	68
DEG	Thüringen	37.2	78	37	85	36.2	89	37.8	80	38.8	81
DK01	Hovedstaden	82.2	1	80.6	1	66.7	10	82.6	1	83.2	1
DK02	Sjalland	60.7	23	56.2	33	56.9	32	61.3	25	61.6	24
DK03	Syddanmark	65.1	12	54	43	54.1	44	65.7	12	66.6	13
DK04	Midtjylland	64.3	16	61.6	18	56.7	33	64.9	15	65.9	17
DK05	Nordjylland	72	8	54.1	41	52.7	47	72.5	7	73.4	7
EE	Estonia	45.9	64	45.4	64	47.4	63	48	64	41.7	73
EL1	Voreia Ellada	22.7	114	23.1	115	23.4	114	23.2	114	25	114
EL2	Kentriki Ellada	19.5	123	19.8	125	20	125	20.2	123	21.4	122
EL3	Attiki	31.3	100	31.1	103	31.1	102	31.8	99	33.3	98
EL4	Nisia Aigaiou. Kriti	21.4	120	21.8	116	22.2	118	21.9	121	23.6	117
ES11	Galicia	36.9	82	37.4	81	37.5	81	37.7	82	38.6	83
ES12	Principado de Asturias	42.3	70	41.6	71	42.8	69	43.1	70	44.2	70
ES13	Cantabria	36.5	85	36.4	87	36.9	85	37.1	86	38.4	84
ES21	País Vasco	45.6	65	45.1	65	43.4	67	46.4	65	47.5	66
ES22	Comunidad Foral de Navarra	39	74	38.5	76	39.2	75	39.7	74	41.5	74
ES23	La Rioja	37.6	77	37.3	83	38.4	77	38.3	77	39.5	78
ES24	Aragón	32.6	95	31.6	100	32.6	99	33.3	95	34.4	94

CODE	REGION	REDI	REDI rank	Star rating	Star rating rank	Employment	Employment rank	Corruption	Corruption rank	Personal Freedom	Personal Freedom rank
ES30	Comunidad de Madrid	54.7	46	54.4	40	54.2	43	55.4	45	56.3	46
ES41	Castilla y León	36.8	83	37.6	79	37.9	80	37.4	84	39.2	80
ES42	Castilla-la Mancha	32.1	97	32.7	95	33	96	32.9	98	34.2	95
ES43	Extremadura	30.3	102	31.6	101	31.9	101	31	102	32.2	102
ES51	Cataluna	42.3	71	42.4	69	40.3	71	43	71	44.7	69
ES52	Comunidad Valenciana	38.1	75	38.7	75	39	76	38.8	75	40.6	75
ES53	Illes Balears	37.7	76	39.1	74	39.4	74	38.3	76	39.7	76
ES61	Andalucía	37.1	79	37.9	78	38	78	37.8	81	39.6	77
ES62	Región de Murcia	36.7	84	37.3	82	38	79	37.4	85	39.5	79
ES70	Canarias (ES)	35.5	90	37.1	84	37.5	82	36.3	91	37.6	87
FI19	Länsi-Suomi	58.7	32	58.4	23	58.5	26	59.5	30	59.6	33
FI1B	Helsinki-Uusimaa	62.2	20	62.8	16	63.7	15	63.2	20	63.5	20
FI1C	Etelä-Suomi	58.9	30	58.6	22	59.8	22	59.9	26	60.3	29
FI1D	Pohjois- ja Ita-Suomi	51.2	52	50.8	49	51.1	50	52.2	51	52.5	55
FR1	Île de France	79.2	3	78.9	3	79.2	2	79	3	80.9	3
FR2	Bassin Parisien	50.9	54	48.9	55	50.1	56	51.4	54	53.6	50
FR3	Nord - Pas-de-Calais	48.8	60	46.7	61	48.3	60	49.4	60	51.5	59
FR4	Est (FR)	49.7	58	47.8	59	49.4	57	50.3	58	52.9	54
FR5	Ouest (FR)	51.8	49	50.7	50	50.5	53	52.4	49	54.5	48
FR6	Sud-Ouest (FR)	58.9	31	56	34	57.1	31	59.4	32	61.6	25
FR7	Centre-Est (FR)	64.2	17	63.1	14	63.2	16	64.7	16	66.8	12
FR8	Méditerranée	59.4	27	58	25	58.7	25	59.7	27	62.4	22
HR03	Jadranska Hrvatska (Adriatic Croatia)	32	98	32.5	96	32.2	100	33.1	96	33	101
HR04	Kontinentalna Hrvatska (Continental Croatia)	29.9	103	30.2	104	30.2	105	31	103	30.9	105
HU10	Közép-Magyarország	31.4	99	31.1	102	30.7	104	31.6	101	34.7	93
HU21	Közép-Dunántúl	22	117	21.7	117	22.3	117	22.9	116	23.5	118
HU22	Nyugat-Dunántúl	21.5	118	21.5	120	21.8	120	22.4	118	23	120
HU23	Dél-Dunántúl	23.8	113	23.5	113	24	113	24.8	112	25.5	113
HU31	Észak-Magyarország	22.4	115	21.1	122	22.4	116	23.2	115	24	115
HU32	Észak-Alföld	21.4	119	21.6	118	21.4	122	22.3	119	23.3	119
HU33	Dél-Alföld	21	121	21.5	121	21.5	121	21.9	120	22.9	121
IE01	Border. Midland and Western	63.4	18	63.6	12	63.8	14	63.9	18	66.1	15
IE02	Southern and Eastern	72	7	72.3	5	72.4	5	72.3	8	74.3	5
ITC	Nord-Ovest	40.4	73	40.7	72	39.7	72	41.8	73	41.9	72
ITF	Sud	27.3	109	27.2	109	27.7	109	27.8	109	29.3	109
ITG	Isole	27.6	108	27.4	108	28.1	108	28.5	107	29.8	108
ITH	Nord-Est	36.1	86	38	77	36.4	87	37.7	83	37.5	89
ITI	Centro (IT)	36.9	81	37.4	80	37.1	84	38.2	78	38.6	82
LT	Lithuania	35.2	91	36.8	86	37.3	83	37.1	87	33.8	96
LV	Latvia	33.8	93	31.6	99	33.7	94	35.8	92	32.1	103

CODE	REGION	REDI	REDI rank	Star rating	Star rating rank	Employment	Employment rank	Corruption	Corruption rank	Personal Freedom	Personal Freedom rank
NL1	Noord-Nederland	51.1	53	49.4	54	50.4	54	51.8	53	53	53
NL2	Oost-Nederland	56.5	39	54.6	37	55.3	37	57.3	39	58.7	38
NL3	West-Nederland	64.4	15	63.4	13	64.4	13	65.1	13	66.1	16
NL4	Zuid-Nederland	57	38	55.5	35	55.6	36	57.8	38	59.1	37
PL1	Region Centralny	36.1	88	36.4	88	36.4	88	37	89	37.6	88
PL2	Region Poludniowy	34.1	92	33.5	92	33.6	95	34.8	93	35.9	91
PL3	Region Wschodni	29.2	105	28.5	107	29.8	106	30.2	104	30.9	106
PL4	Region Pólnocno-Zachodni	32.3	96	32.4	97	32.7	97	33	97	33.8	97
PL5	Region Poludniowo-Zachodni	36.1	87	35.3	90	35.7	90	37	88	37.8	86
PL6	Region Pólnocny	33.2	94	33.1	93	33.8	92	34.1	94	35	92
PT11	Norte	29.2	106	32.2	98	32.6	98	29.6	106	33.1	100
PT15	Algarve	30.9	101	33	94	33.8	93	31.6	100	33.2	99
PT16	Centro (PT)	27.6	107	28.9	106	29	107	28	108	30.8	107
PT17	Lisboa	44.6	67	45	66	45.5	65	45.1	67	47.5	67
PT18	Alentejo	29.4	104	29.9	105	31	103	29.9	105	31.3	104
RO1	Macroregiunea unu	19.4	124	21.6	119	21.8	119	20.1	124	20.7	124
RO2	Macroregiunea doi	18.4	125	21	123	21.3	123	18.9	125	20.2	125
RO3	Macroregiunea trei	22.1	116	23.1	114	23	115	22.5	117	24	116
RO4	Macroregiunea patru	19.7	122	20.4	124	20.4	124	20.2	122	21.3	123
SE11	Stockholm	73.8	4	75.9	4	76.4	3	74	4	74.8	4
SE12	Östra Mellansverige	72.7	5	71	6	72.9	4	73	5	74.2	6
SE21	Smaland med öarna	49.9	57	50.3	53	50.9	51	50.5	57	51.8	58
SE22	Sydsverige	67.3	10	65.2	10	67	9	67.7	10	68.5	11
SE23	Vastsverige	72.2	6	70.6	7	68.2	7	72.5	6	73.3	8
SE31	Norra Mellansverige	57.7	36	57.8	27	57.9	27	58	37	59.1	36
SE32	Mellersta Norrland	48.2	63	48.7	57	48.2	61	48.4	63	49.2	63
SE33	Övre Norrland	64.7	14	62.9	15	65.7	11	65.1	14	66.5	14
SI01	Vzhodna Slovenija	45.3	66	44.5	67	45.6	64	46.3	66	47.6	65
SI02	Zahodna Slovenija	51.3	51	50.5	51	51.6	49	52.1	52	53.1	52
SK01	Bratislavsky kraj	44	68	43.3	68	44	66	43.4	69	49.2	64
SK02	Západné Slovensko	25.8	110	26.5	110	26.9	110	25.7	110	29.3	110
SK03	Stredné Slovensko	24.9	111	25.1	111	25.8	111	24.9	111	28.1	112
SK04	Vychodné Slovensko	24.5	112	24.7	112	25.3	112	24.5	113	28.4	111
UKC	North East (UK)	48.9	59	46.5	62	48.3	59	49.5	59	50.8	60
UKD	North West (UK)	59	28	56.8	30	57.8	28	59.6	29	60.8	26
UKE	Yorkshire and The Humber	56.4	40	54.5	39	55.3	38	57	40	58.4	40
UKF	East Midlands (UK)	55.3	42	51.4	47	54.7	40	56.1	42	56.9	42
UKG	West Midlands (UK)	58.6	33	56.7	31	57.1	30	59.2	33	60.5	28
UKH	East of England	61.5	22	59.1	21	60.4	20	62	22	63	21
UKI	London	79.9	2	79.6	2	79.9	1	80.2	2	81.5	2
UKJ	South East (UK)	69.5	9	67.9	8	69.3	6	70.1	9	70.5	9
UKK	South West (UK)	60.7	24	57.8	26	60.3	21	61.4	24	62	23

CODE	REGION	REDI	REDI rank	Star rating	Star rating rank	Employment	Employment rank	Corruption	Corruption rank	Personal Freedom	Personal Freedom rank
UKL	Wales	54.7	45	48.7	56	53.4	46	55.3	46	56.3	45
UKM	Scotland	59	29	57.7	29	58.7	24	59.7	28	60.5	27
UKN	Northern Ireland (UK)	58	35	52.9	45	55.8	35	58.8	35	60.1	30

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