Measuring the knowledge base of regional innovation systems in Sweden

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ABSTRACT

Within the literature on innovation systems, there are a growing number of scholars emphasizing the importance of differentiated knowledge bases underlying innovation activities. The existing work on knowledge bases is largely grounded on in-depth case studies; while surprisingly little effort has been done so far to operationalize the concept in a more systematic manner. In this paper, an attempt is made to develop a scheme of analysis to identify the knowledge base of a regional economy. We suggest using occupation data in association with a location quotient analysis, to assess whether a regional economy has a particular strength in one (or more) knowledge bases. To bring the analytical scheme into practice and assess it, we apply it on the county level in Sweden. The results are explained and contrasted with insights on the regional economies taken from secondary sources. We conclude that the proposed scheme of analysis leads to fairly reliable results, and could stimulate further empirical research on differentiated knowledge bases.

Key words: differentiated knowledge base, regional innovation system, Sweden

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Title:
Measuring the knowledge base of regional innovation systems in Sweden

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Abstract: Within the literature on innovation systems, there are a growing number of scholars emphasizing the importance of differentiated knowledge bases underlying innovation activities. The existing work on knowledge bases is largely grounded on in-depth case studies; while surprisingly little effort has been done so far to operationalize the concept in a more systematic manner. In this paper, an attempt is made to develop a scheme of analysis to identify the knowledge base of a regional economy. We suggest using occupation data in association with a location quotient analysis, to assess whether a regional economy has a particular strength in one (or more) knowledge bases. To bring the analytical scheme into practice and assess it, we apply it on the county level in Sweden. The results are explained and contrasted with insights on the regional economies taken from secondary sources. We conclude that the proposed scheme of analysis leads to fairly reliable results, and could stimulate further empirical research on differentiated knowledge bases.

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1. Introduction

The geography of innovation and knowledge creation is a vital and extensive research field in contemporary economic geography. In the last decades, a large literature has emerged studying the relation between geography and knowledge creation, building on a long research tradition ranging from Marshall's early work on innovation in industrial districts (Marshall, 1920) to the more recent work on the creative class (Florida, 2002; Pratt, 2008; Peck, 2005), learning regions (Boekema et al., 2000; Morgan, 1997; Asheim, 1996) and regional innovation systems (Cooke et al., 1997; Asheim and Gertler, 2005). Many studies dealing with the role of proximity for interactive learning and knowledge generation emphasize that knowledge generation is dependent on unique and exclusive regional framework conditions (Boschma, 2005). With the aim to formulate fine-tuned recommendations for regional innovation policy, it is essential to strive for a differentiated and nuanced understanding of the conditions and processes underlying knowledge creation, by taking a systemic perspective on innovation (Edquist, 1997). Following such a systemic view, innovation is largely seen as emanating through interactive learning between various actors in industry, government and academia, which is often, however not always, a highly localized phenomenon. A systemic approach on innovation and knowledge creation has been followed by a number of scholars explaining spatial patterns of innovation (Cooke et al., 1997; Asheim and Isaksen, 1997; Bathelt et al., 2004). Stemming from this line of research, different knowledge taxonomies have emerged that can be applied as heuristic models for the analysis of innovation systems. Only recently, the knowledge base concept has been brought forward by Asheim and Gertler (2005), who differentiate between different types of knowledge underlying innovation activities. The knowledge base concept has been developed further and proven to be a useful heuristic for the analysis of regional innovation systems. It has been applied and advanced by
a number of scholars, whose work is mainly based on in-depth case studies analysing a variety of regions and industries within those regions (Asheim and Coenen, 2005; Asheim and Coenen, 2006; Coenen and Moodysson, 2009; Moodysson et al., 2008). Case studies are seen as the appropriate framework for the study of regional innovation systems, since knowledge generation and innovation are complex and unique processes that can hardly be captured by a set of quantitative measures. However, we suggest that a quantitative and more formalized research design can provide additional insights into the empirics of knowledge bases, facilitate interregional comparisons and help to identify the knowledge specialisation of companies, industries and territorial entities such as regions.

In this paper, an attempt is made to develop a comprehensive scheme of analysis that allows detecting the knowledge specialization of a regional economy. The main idea is identify the knowledge specialization of a region by means of quantitative measures\(^1\). We propose an empirical approach to assess whether a regional economy has a particular strength in one (or more) knowledge bases. The main research questions dealt with in this paper are the following:

- How can we operationalize the knowledge bases concept by means of quantitative measures?
- What are the dominant knowledge bases on a regional level in Sweden?

The paper is organized as follows. First, we review the theoretical background of the differenced knowledge base concept. Related knowledge taxonomies such as the tacit versus codified dichotomy (Nelson and Winter, 1982; Polanyi, 1967; Gertler, 2003) are discussed briefly, before explaining more detailed the differentiated knowledge base concept promoted

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\(^1\) As far as we are aware, the first and only attempt to quantitatively assess the knowledge base of territorial entities has been made by Asheim and Hansen (2009).
by Asheim and Gertler (2005). Second, a method for an operationalization of the knowledge base concept is developed. We suggest using occupation data reflecting the tasks and duties undertaken by the local workforce, in association with a location quotient analysis. To bring the analytical scheme into practice and assess its usability, we apply it on the county level in Sweden. The results are explained and contrasted with insights on the according regional economies taken from secondary sources. Finally, we conclude the paper and give ideas for further research on the topic.

2. Theoretical concept of differentiated knowledge bases

At least three prominent knowledge taxonomies can be found in innovation system literature. Most frequently applied is the distinction between “codified knowledge” that is easily transferrable over time and distance and “tacit knowledge” that is embedded in people and organizations. This classification originates from Polanyi’s (1967) work, has been brought forward by Nelson and Winter (1982) and has received much attention within the literature on innovation. The basic notion behind this concept is that tacit knowledge is by definition difficult to write down and strongly context-specific. Therefore, it is not easy to share over distance and most effectively transmitted through direct fact-to-face interaction. Consequently, innovating economic actors who are largely dependent on tacit knowledge will tend to locate close to each other in order to facilitate frequent and frictionless interaction. Geographic proximity will be less important if innovation activities depend more on codified forms of knowledge, since those are relatively easy to share and to understand over distance (Gertler, 2008). The tacit-codified dichotomy can be criticized for a restrictively narrow understanding of knowledge, learning and innovation (Johnson et al., 2002). Many forms of tacit knowledge do not remain embodied into people, since people articulate their thoughts, experiences and viewpoints in form of mimic, gesture and language. Nor is codified
knowledge objective, since codification and interpretation is always dependent on the individual and subjective understanding. Most forms of economically relevant knowledge are mixed in these respects, and while knowledge creation and innovation always involves both kinds, the two forms should be seen as complements rather than substitutes to each other (Nonaka et al., 2000; Johnson et al., 2002; Nonaka and von Krogh, 2009).

A further classification has been brought forward by Lundvall and Johnson (1994), who distinguish between “know-what”, referring to knowledge about facts, “know-why” referring to knowledge about principles and laws in nature and society, “know-how” referring to skills and “know-who” referring to knowledge about possible partners for cooperation and knowledge exchange. The notion of know-what is closely related to what one would term information, i.e. knowledge about mere facts. Technological progress has made access to information easier and know-what almost ubiquitous, so that other types of knowledge have become increasingly relevant. Know-why is usually associated with science-based industries, where the application of scientific laws and principles reduces the need for expensive trial and error procedures and accelerates innovation. At the same time, the use and creation of know-why requires intuition and skills, and even the application of very basic mathematical skills is reliant on experience-based learning (Lundvall and Johnson, 1994). Consequently, scientific activities always involve a combination of know-why and know-how (Polanyi, 1967). As products and processes are becoming increasingly complex, there is a growing need for companies to share and exchange elements of know-how (Johnson et al., 2002). As a result, knowledge about possible cooperation partners is becoming more relevant. Know-who involves information about “who knows what and who knows what to do” (Johnson et al., 2002:251), but also the ability to communicate with partners from different professional and socio-cultural background, and is therefore both very contexts depended and difficult to codify.
Only recently and referring to Laestadius (2000), Asheim and Gertler (2005) have introduced an alternative conceptualization that takes more explicitly into account the content of the actual interactions taking place in networks of innovators. To explain the geography of innovation in different industrial sectors, a distinction is made between three types of knowledge base: (1) analytical, (2) synthetic, and (3) symbolic. These knowledge bases differ in various respects such as the rational for knowledge creation, the development and use of knowledge, the actors and types of knowledge involved and the meaning of geographical proximity in the innovation process (see Table 1).

**Table 1: Differentiated knowledge bases. A typology.**

<table>
<thead>
<tr>
<th></th>
<th>Analytical (science based)</th>
<th>Synthetic (engineering based)</th>
<th>Symbolic (arts based)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rationale for knowledge creation</strong></td>
<td>Developing new knowledge about natural systems by applying scientific laws; <em>know why</em></td>
<td>Applying or combining existing knowledge in new ways; <em>know how</em></td>
<td>Creating meaning, desire, aesthetic qualities, affect, intangibles, symbols, images; <em>know who</em></td>
</tr>
<tr>
<td><strong>Development and use of knowledge</strong></td>
<td>Scientific knowledge, models, deductive</td>
<td>Problem solving, custom production, inductive</td>
<td>Creative process</td>
</tr>
<tr>
<td><strong>Actors involved</strong></td>
<td>Collaboration within and between research units</td>
<td>Interactive learning with customers and suppliers</td>
<td>Experimentation in studios, project teams</td>
</tr>
<tr>
<td><strong>Knowledge types</strong></td>
<td>Strong codified knowledge content, highly abstract, universal</td>
<td>Partially codified knowledge, strong tacit component, more context specific</td>
<td>Importance of interpretation, creativity, cultural knowledge, sign values; implies strong context specificity</td>
</tr>
<tr>
<td><strong>Importance of spatial proximity</strong></td>
<td>Meaning relatively constant between places</td>
<td>Meaning varies substantially between places</td>
<td>Meaning highly variable between place, class and gender</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td>Drug development</td>
<td>Mechanical engineering</td>
<td>Cultural production, design, brands</td>
</tr>
</tbody>
</table>

Source: Asheim and Gertler (2005); Asheim et al. (2007); Gertler (2008)

An analytical knowledge base is dominant in economic activities where scientific knowledge is important, and where knowledge creation is mainly based on formal models, codified science and rational processes (Asheim and Gertler, 2005). Examples mentioned in
the literature are genetics, biotechnology and information technology. For these industries, basic research and applied research as well as systematic development of products and processes are relevant activities. Companies usually have their own R&D departments, but at the same time they greatly rely on knowledge generated at universities and other research organisations as an input to their innovation activities. For that reason, linkages and networks between university and industry are highly important and take place more often than if other knowledge bases are dominant. Since these industries deal with scientific knowledge stemming from universities and other research organisations, they rely to a large extend on codified forms of knowledge. Knowledge exchange is only little constraint by geographical distance and often takes place in globally configured networks (Martin and Moodysson, 2011; Plum and Hassink, 2011).

A synthetic knowledge base prevails in industries that create innovation through use and new combination of existing knowledge (Asheim and Gertler, 2005). This is often the case when specific problems that appear in the interaction with clients and suppliers need to be solved. Examples mentioned in the literature are plant engineering, specialized advanced industrial machinery and shipbuilding, where products are often created in small series. Formal R&D activities are of minor importance; they take the form of applied research or more often of incremental product and process development. Linkages between university and industry are relevant, however they occur more in the field of applied R&D than in basic research. Knowledge generation is conducted partly through deduction or abstraction, but primarily through induction, encompassing the process of testing, experimentation or practical work. Knowledge embodied in the respective technical solution or engineering work is at least partially codified. However, tacit knowledge seems to be more important, especially due to the fact that knowledge often results from experience gained by learning by doing, using and interacting. Compared to others, industries that rely on a synthetic
knowledge base require more know-how, craft and practical skills for their product and process development. Those skills are often provided by professional and polytechnics schools or by on-the-job training (Asheim and Coenen, 2006; Broekel and Boschma, 2011).

The symbolic knowledge base is a third category that has been introduced recently to account for the growing importance of cultural production. It is strongly present within a set of cultural industries such as film, television, publishing, music, fashion, and design, in which innovation is devoted to the generation of aesthetic value and images and less to a physical production process (Asheim et al., 2007). Symbolic knowledge can be embedded in material goods such as clothing or furniture, while its impact on consumers and its commercial value arises from its intangible character and artistic quality. Symbolic knowledge also includes forms of knowledge applied and created in service industries such as advertising (Gertler, 2008). Since these industries often produce through short-term projects in flexible constellations, knowledge about possible partners for cooperation and knowledge exchange (know-who) is of considerable importance. Symbolic knowledge is highly context-specific, as the interpretation of symbols, images, designs, stories and cultural artefacts “is strongly tied to a deep understanding of the habits and norms and ‘everyday culture’ of specific social groupings” (Asheim et al., 2007)p. 664). The meaning and the value associated with symbolic knowledge can vary considerably between places, and therefore exchange of knowledge typically takes place in localised networks with partners that share a similar socio-economic background (Martin and Moodysson, 2011).

The distinction between the three knowledge bases is intended as ideal-types, a mode of conceptual abstraction, while in practice, most activities comprise of more than one knowledge base, and the degree to which a certain knowledge base prevails can varies between industries, firms and different types of activities (Asheim and Hansen, 2009; Asheim
et al., 2011). Figure 1 visualizes how different knowledge specializations can intersect and be combined in concrete reality.

Figure 1: Possible intersection of knowledge specializations. Source: own draft

3. Methodology for measuring knowledge bases

1.1. Indicators

Prior to developing a methodological approach, it is important to decide on a set of indicators that suits best for the purpose of the analysis. We consider the knowledge characteristic of the local labour force as key variable for measuring the knowledge base of a region. The scientific discourse on the role of human capital for regional development is rooted for instance in the endogenous growth theory, with Romer (1986) who argues that increasing returns to scale can be accomplished by investments into the production of knowledge. Moreover, the literature on tacit knowledge implies that particular attention must
be paid to knowledge that is embodied in individuals as personal skills and experience, and thus cannot easily be transferred from one person to another (Maskell and Malmberg, 1999; Polanyi, 1967).

To measure the knowledge characteristics of the local labour force, one can draw on three core statistics: occupation data, reflecting the tasks and duties undertaken by the local workforce, industry sector data, reflecting the industry sectors in which the local workforce is active, or education data, reflecting the type and level of education acquired by the workforce. We argue that occupation statistics are most suitable for capturing the knowledge base of an economic system. Occupation data reflect the set of activities or tasks that employees are paid to perform, and thereby the type of knowledge they actually apply at their place of work. Employees who perform the same tasks are classified to the same occupation, whether or not they are active in the same industry sector. If an individual has more than one occupation, it is classified in the occupation that requires the highest level of skills and expertise. If there is no clear difference in skill requirements, workers are included in the occupation in which they spend most of their time (OECD, 2007). We argue that occupation data provides a measure that is more appropriate than industry sector data when it comes to capturing actual skills applied at the workplace. Furthermore, we argue that educational data is not sufficient to capture the knowledge base of a person, since continuous learning and on the job training allows people to develop their careers and carry out tasks that go beyond their certified level of education, while increasing labour mobility will lead people to work with activities that may have little to do with their formal area of education.

We claim that each type of knowledge base can be attributed to a set of different occupations. For example, a region with a high share of persons working as physicists, mathematicians or in other scientific fields are considered as analytical based, a region with a
high share of engineers and related professions is considered as synthetic based, and a region with a high share of workforce with artistic occupation such as design and cultural activities is considered as symbolic based.

The usefulness of such an approach is also dependent on the availability of data, where we use data on employees and their field of occupation provided by the Swedish statistical office (SCB). They follow a national classification system (SSYK) which is to a large extent matching the International Standard Classification of Occupation (ISCO).

Table 2: Occupation groups within the synthetic, analytical and symbolic knowledge bases

<table>
<thead>
<tr>
<th>Analytical knowledge base</th>
<th>Synthetic knowledge base</th>
<th>Symbolic knowledge base</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Physicists, chemists and related professionals</td>
<td>• Architects, engineers and related professionals</td>
<td>• Writers and creative or performing artists</td>
</tr>
<tr>
<td>• Mathematicians and statisticians</td>
<td>• Physical and engineering science technicians</td>
<td>• Archivists, librarians and related information professionals</td>
</tr>
<tr>
<td>• Computing professionals</td>
<td>• Computer associate professionals</td>
<td>• Artistic, entertainment and sports associate professionals</td>
</tr>
<tr>
<td>• Life science professionals</td>
<td>• Optical and electronic equipment operators</td>
<td></td>
</tr>
<tr>
<td>• College, university and higher education teaching professionals</td>
<td>• Ship and aircraft controllers and technicians</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Safety and quality inspectors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Life Science technicians</td>
<td></td>
</tr>
</tbody>
</table>

Note: SSYK nomenclature based on ISCO. Source: modified after Asheim and Hansen (2009), p. 10)

To run the analysis, we use regionally aggregated occupation data and apply a classification brought forward by Asheim and Hansen (2009), who attribute different occupations to the three knowledge bases. They identify a number of job functions that are

\[2\] The International Standard Classification of Occupations (ISCO) is one of the main international occupation classifications. It is a tool for organizing all jobs in an establishment, an industry or a country into a defined set of groups according to the tasks and duties undertaken in the job.
clearly dominated by one of the three knowledge bases and classify them into synthetic, analytical and symbolic knowledge base\(^3\) (see Table 2). It is worth to mention that only few occupations will depend merely on one knowledge base, but on a mix of two or more knowledge bases.

1.2. Location quotient analysis

To assess which region specializes on which knowledge base, we apply a location quotient (LQ) analysis, a classical technique in economic geography. It compares the local economy to a reference economy, in the process attempting to identify specializations in the local economy. Commonly, this technique is used to see whether certain industries have a smaller or larger presence in a local economy compared to the corresponding national economy, measured by employment active in industry sectors (MacLean and Voytek, 1992). In this paper, our intention is to identify knowledge specializations rather than industry specializations. Therefore, we use data on employment in their field of occupation to find out whether particular occupations (which we have attributed to the three knowledge bases) have a relatively smaller or larger presence in the regional compared to the national economy\(^4\). A LQ equal to 1 indicates that the share of employment with a specific occupation is equally high in the local and the reference economy. If the LQ is greater than 1, the percentage of employment in the local economy exceeds the percentage of employment in the reference economy.

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\(^3\) We follow Asheim and Hansen’s classification with minor modifications: Instead of using only writers and creative or performing artists to describe the symbolic knowledge base, we include also archivists, librarians and related information professionals as well as artistic, entertainment and sports associate professionals, following Eurostat’s cultural statistics (Eurostat 2007) Eurostat. (2007) Cultural Statistics. Eurostat Pocketbooks. Luxembourg: Office for Official Publications of the European Communities.

\(^4\) After adapting the formula for location quotients, it can be written as \(LQ = \frac{e_i}{E} \times \frac{e}{E_i} \); where:
- \(e_i\) = local employment with occupation attributed to knowledge base i;
- \(e\) = total local employment;
- \(E_i\) = Reference area employment with occupation attributed to knowledge base i;
- \(E\) = total reference area employment.
If it is smaller than 1, the share of employment in the local economy is smaller than in the reference economy. We consider a LQ of more than 1.25 as a sign for a strong regional specialization on the respective knowledge base, and a LQ of less than 0.75 as a sign for weak presence of the knowledge base under consideration (MacLean and Voytek, 1992).

4. Empirical analysis and results for Swedish regions

To test the practicality of this scheme of analysis, we apply it on a regional level in Sweden. The territorial focus is the county, or län, which is the first level administrative and political subdivision in Sweden. We perform the analysis for all 21 counties based on occupation data provided by the Swedish statistical office. The results are presented in the following.

4.1. Analytical knowledge base

![Analytical Knowledge Base](source: own draft)

Figure 2 displays the location quotients for occupations attributed to the analytical knowledge base. A strong specialisation on economic activities where scientific knowledge is
important can be found in Uppsala county (LQ=1.43) and Västerbotten county (LQ=1.33). The reason why Uppsala is present in this category is without doubt its well established higher education sector in the capital city of the region, but also a substantial industrial focus on medical research and biotechnology. Uppsala has a number of the country’s largest biotech tools, medical technology and in-vitro diagnostics companies, and is part of the larger Stockholm-Uppsala life science cluster (Sandström et al., 2011; Waluszewski, 2004). Västerbotten appears in the same category; its capital city Umeå has the fifth largest university in Sweden with particular focus on technical and medical research, which collaborates with a number of small, research intensive companies in the region (Sandström et al., 2011; Högskoleverket, 2011). A significant analytical knowledge base can also be identified in Stockholm county (LQ=1.19) and Skåne county (LQ=1.08). Stockholm is characterized by a large service sector and a number of high-tech companies that cooperate with universities and other research organisations in the region. Organizations of higher education in Stockholm include Stockholm University, Stockholm School of Economics and The Karolinska Institute, one of Europe's largest medical universities. The life science industry in Sweden is mainly clustered around Stockholm and Uppsala, followed by Skåne region in southern Sweden. Skåne hosts Sweden’s largest university in Lund and possesses a live science cluster with a strong and dedicated R&D infrastructure employing approximately 6,000 life scientists (Cooke, 2005; Moodysson et al., 2008; Moodysson, 2008). Typical science based business segments in the region are drug development, biotech and in-vitro diagnostics, with the large multinational companies Gambro, AstraZeneca and McNeil. Furthermore, the region has a tradition in agricultural biotechnology, with a number of companies in food, agricultural and environmental biotech (Sandström et al., 2011; Nilsson, 2008). For these industries, the absorption of scientific knowledge through industry-
university collaborations is a precondition for economic success, and knowledge-creation is more formalized and scientifically grounded than in activities based on synthetic knowledge.

4.2. Synthetic knowledge base

Figure 3 visualizes the location quotients for occupations attributed to the synthetic knowledge base. Their distribution across Swedish regions is more balanced than for other types of knowledge base, none of the regions stands out with a particular high location quotient. However, there are some regions that rely more on synthetic knowledge creation than others, for instance Blekinge county (LQ=1.22), Västmanland county (LQ=1.19) and Dalarna county (LQ=1.18). Blekinge possesses an academic environment with Blekinge Institute of Technology conducting both basic education and research in the fields of engineering, humanities, healthcare and social science (Högskoleverket, 2011). Nevertheless the analytical knowledge base does not outweigh the importance of synthetic knowledge creating, in which existing knowledge is combined in a new way involving practical skills.
and know-how. Västmanland, even though possessing a university in the regional capital city Västerås, is strongly shaped by its manufacturing sector; especially by the large engineering company ABB, operating in the power technology and industrial automation sector. Dalarna county possesses a small university college; however it’s regional economy relies heavily on the manufacturing sector with large companies like SSAB and Avesta Sheffield, active in iron and steel production, and STORA Enso, fabricating paper, packing and wood products (Invest in Dalarna, 2011). In these areas, knowledge creation is mainly engineering based and aims at solving concrete, technical problems.

**4.3. Symbolic knowledge base**

Figure 4 visualizes the location quotients for occupations attributed to the symbolic knowledge base. The generation of artistic value in a course of cultural production is highly present in Gotland county (LQ=1.60) and Stockholm county (LQ=1.34).
Gotland is a small island region and a prominent holiday destination in Sweden, with a regional economy mainly reliant on tourism. Its cultural and natural heritage does attract not only tourists, but also writers and painters who live and pursue their profession on the island. Apart from tourism, there is a number of small manufacturing businesses focusing on quality and design, especially in design oriented furniture-making (Gotland, 2009). For that reason, a symbolic knowledge base is highly present in Gotland.

Stockholm as capital city of Sweden is the country’s centre of cultural production per se. An remarkable case of symbolic knowledge creation in Stockholm is the national music industry which has been studied by Power and Hallencreutz (2002). In the recent years, Swedish pop, rock and dance music has enjoyed considerable commercial success. By singing in English and following the main stream music genres, Swedish artistes have created products that are easy to sell to a large international audience. Although most of the well-known Swedish groups originate from other cities than Stockholm, the capital region is the centre of the music industry and the place where most artistes pursue their professional careers. Stockholm hosts a large number of local and international music companies, with around 200 record companies and approximately 70 music-publishing companies, which is roughly one half of the national total (Power and Hallencreutz, 2002). Music is of course not the only form of symbolic knowledge generation in Stockholm, where various kinds of media businesses are located: four nation-wide daily newspapers, the publicly-funded radio (SR) and television (SVT) and all other major television channels have their headquarters in the capital city.

The regional economies of Gotland and Stockholm benefit from their strong symbolic knowledge base. Although the productive output of symbolic industries is often not clearly tangible, since they often occur in form of images, sounds or symbols, they still generate
value consumers are willing to pay for. As a result, symbolic industries can generate high revenues and constitute an important driver for regional economic growth.

5. Conclusion

In this paper, an attempt is made to develop an analytical scheme to empirically identify the knowledge base of a region. First, a review was given on the theoretical concept of differentiated knowledge bases which was brought forward by Asheim and Gertler (2005). Second, the applied indicators and method for assessing knowledge bases were discussed. We used occupation data reflecting the tasks and duties undertaken by the local workforce, in association with a location quotient analysis comparing the knowledge specialisation of the regional economy to the national economy. To bring the scheme into practice, we applied it on the county level in Sweden. The results show an analytical knowledge base that is particularly strong in Uppsala and Västerbotten county, a rather balanced specialization in synthetic knowledge across Swedish counties and a strong specialization on symbolic knowledge especially in Gotland and Stockholm county. The obtained results consist well with the characteristics of the regional industries identified by reviewing the literature. We conclude that the proposed scheme of analysis leads to fairly reliable results.

Therefore, we suggest bringing the method forward and extending the research agenda towards more advanced empirical work on differentiated knowledge bases. Building on the approach developed in this paper, one could address further research questions. For instance, one could study whether a particular combination of knowledge specializations is favourable for innovation and economic growth. Are regions with strong analytical knowledge base more competitive than regions with a strong synthetic knowledge base, or is symbolic knowledge the essential driver for growth? Could it be a combination of different types of knowledge base that leads to the best performance in terms of innovation? Furthermore, one
could analyse if particular knowledge specializations are associated with different types of growth, e.g. income versus employment growth, or different types of innovation, e.g. process versus product innovation. And finally, one could extend the analysis from a static to a more dynamic and evolutionary perspective, by observing different points in time and thereby exploring how knowledge bases transform with the evolution of a region.

It is important to stress that innovation and knowledge dynamics in a regional economy can be very complex and diversified, and can hardly be captured adequately by a set of quantitative measures. The approach promoted in this paper aims to provide a first overview of the knowledge specialisation of a region. Taking this aim into consideration, the developed scheme of analysis has shown to be fairly reliable and applicable for further empirically informed research on differenced knowledge bases.
References


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