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Identification of Smart Regions with Resilience, Specialisation and Labour Intensity in a Globally Competitive Sector – Examination of LAU-1 Regions in Finland

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Abstract

The purpose of the study was to construct smart specialisation indicators for LAU-1 regions in Finland. Established indices are based on indicators of the regions' revealed comparative advantage and the degree of diversification in the sub-regional industrial structure. Furthermore, we introduce an indicator that can be used to assess the socio-economic importance (employment) of diversification and specialisation for a region. The indices data is based on Statistics Finland (2015) data for the 70 Local Administrative Unit level 1 (LAU1) sub-regions in Finland. The potential S3 indices measured here reveal the position of each sub-region's smart specialisation among the 70 sub-regions in 2015. It is common economic knowledge that manufacturing industries are the most export-oriented, highly productive and thus can approximate a region's success in international trade and competitive advantages. The study is based on three smart specialisation indices: the Herfindahl-Hirschman Index for regional resilience (HHI), the regional relative specialisation index (RRSI) based on the Balassa-Hoover Index (B-H), and the relative employment volume index in the manufacturing sector (LIMI). Through index examination, we can obtain knowledge about a region's smart specialisation status and potential. The results reveal that each sub-region has its own smart specialisation characteristics with a different risk profile. Sub-regions like Helsinki and Tampere have a similar industrial structure to Finland as a whole and are resilient: they will benefit from nationwide economic and industrial policy, and they have a good capability of resisting economic shocks. Our study reveals that there are some other similar smaller (LAU-1) sub-regions in Finland – for example Rauma. As such, it is critical that this kind of research-based basic information be taken into account when constructing sustainable strategies for regional development. Similar calculations could be performed for all regions in Europe.

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KEYWORDS: Finland, Herfindahl-Hirschman Index, Balassa-Hoover Index, industrial diversification, European Union, regional development, revealed comparative advantage, smart specialisation.

Introduction

A smart region must be able to specialise enough to succeed in international competition and at the same time be sufficiently diverse in its industrial (i.e. competitive) structure to adapt to external shocks. This study concerns the specialisation and diversification of the competitive/industrial sector in LAU-1 sub-regions in Finland concerning their position in terms of smart specialisation.

Smart specialisation has been a strategic (S3) challenge in European regional development and policy for several years. Despite intensive research and numerous financed projects, the actual content of S3 remains somewhat obscure. On the one hand, the goal is that each European region finds its own competitive advantages and fields of economic specialisation (Foray et al. 2009, Foray 2011, 2012, 2014, 2015, Capello 2014, Gule 2015, European Commission 2014, European Commission 2017). The ultimate goals are economic growth, investments and jobs (see e.g. McCann & Ortega-Argilés 2015, Kaivo-oja, Haukioja & Karppinen 2017). On the other hand, any given region should be resilient to external shocks. In practice, this means that the industrial structure of the region should be diverse enough to maintain its ability to recover from setbacks. There is a strong foothold in S3 thinking according to which European regions are supposed to find their local strengths by adopting Entrepreneurial Discovery Processes (EDP) and renewing their co-operation practices with stakeholders in the spirit of the Quadruple Helix Approach. The aim of most S3 projects is to emphasise the importance of micro-based qualitative indicators, because they can produce unique local knowledge. However, interest is also shifting towards quantitative macro indicators and statistics, because only they can reveal a region's relative potential and economic success in relation to other regions. Both kinds of information are important in order to produce sustainable Smart Specialisation Strategies (see OECD 2013, Borsekova et al. 2017).

The construction of 'smart' indicators for Europe's Smart Specialisation Strategies (S3) is a current but challenging topic both for academic research and for the people involved in the practice of regional development. The need for S3 indicators has been recognized but the common ground for implementing a systematic set of indicators is still lacking. There is an obvious reason for this: it is hard to create an integrated indicator system that is based on a bottom-up approach and a subjective process where local stakeholders are supposed to create a common comprehension of relevant objects of measurement and the right indicators for that purpose. Unavoidably, many such subjective-based indicators must be qualitative in nature. If this is a challenging task for one region, it is almost a 'mission impossible' for the whole of the European Union. In Europe there are numerous regions whose cultural and socio-economic features may be highly distinctive; what fits well for one region may be totally inadequate for another. Despite these difficulties, in its handbook 'Implementing Smart Specialisation' (Gianelle et al. 2016, Paliokaite, Martinaitis & Reimeris 2015, Santonen, Kaivo-oja & Suomala 2014, Virkkala et al. 2014), the European Commission presents a framework and the desirable properties that are expected from smart specialisation indicators.

A bottom-up approach makes local tailoring possible, because understanding can be increased about the specific characteristics of a given region. The problem, however, is that this micro-based information cannot be used effectively to understand other regions. Consequently, comparisons between regions must also be rather arbitrary. Some Smart Specialisation scholars have even taken quite a critical attitude to macro-based indicators, almost denying their usefulness in Smart Specialisation considerations (OECD 2013, 77). However, quantifiable macro-indicators may at their best present a quantitative and 'objective' measuring tool for some phenomenon of interest, which makes a region's relative differences and features visible, and can provide important comparative knowledge about a region's relative position among a group of 'smart' regions. In contrast to such indoctrination, we see that there is no convincing research-based evidence to justify neglecting the macro aspects in academic S3 research and in the practice of regional development projects. On the contrary, we see that such omissions may even be harmful for viable and sustainable regional strategies. We propose that both approaches are needed, and the omission of one may give an incomplete, inaccurate and biased picture about what is going on in a region. Thus, all aspects of micro, macro, qualitative and quantitative approaches should be exploited, because they are not exclusionary, but complementary. In order to commit to a high quality strategy building process, a comprehensive 'both-and' mindset needs to be adopted. As a conclusion, by using an index approach we can obtain regional profiles of smart specialisation that are revealed by general statistics, instead of local or individual qualitative assessments that are incomparable with each other.

The knowledge creation in this study is based on the idea that regions in Europe need relevant and as objective data as possible to recognize their true competitive advantages. Competitive advantages are not isolated from other regions; rather they are related to other regions. Thus, sustainable and successful Smart Specialisation strategies for individual regions must be compatible with this knowledge. The index approach can reveal a region's present economic structure in industrial production. It can also support relevant background information, which enables realistic discoveries about potential new business models that originate in regions' strengths (see e.g. Johnson 2015, Gheorghiu et al. 2016, Jucevicius & Galbuogiene 2014, Paliokaite, Martinaitis & Sarpong 2016). This provides the foundation for knowledge-based management and strategy building, supporting bold openings for experiments and the regional strengthening of the Entrepreneurial Discovery Processes.

Theoretical framework

The S3 approach aims to support the building blocks of regional competitiveness. Typical sources of competitiveness are (1) innovation and creativity, (2) agglomeration economics, (3) foreign direct investment (FDI), (4) clusters, specialisation and concentration, (5) networks and transportation costs, (6) education and research, (7) size and available resources, (8) economic structure and (9) interregional structure. Regions have many ways to improve their competitiveness (Thissen et al. 2013, S3 Platform 2015).

Clear indications of competitiveness are (1) research and technological development, (2) institutions and social capital, (3) foreign direct investment and (4) infrastructure and human capital. These fundamental factors lead regions towards revealed comparative advantage with improved labour productivity and employment rate. Finally, these two key factors guide regions to improvement of regional performance (gross regional product). In the final stage, the target outcome is welfare and quality of life (see Thissen et al. 2013, p. 50). Regional development strategies can be based on clustering, openness, diversification and specialisation. These four domains give rise to our regional strategic options: (1) cluster strategy, where a region combines specialisation and openness, (2) cluster strategy, where a region combines specialisation and clustering, (3) self-sufficiency strategy, where a region combines clustering and diversification, and finally (4) trade-dependent diversification strategy, where a region combines diversification and openness (Thissen et al. 2013, p. 89).

Method and data

For a Smart Specialisation Strategy to work in regions, it is of great importance to find the best indicators that show the status of a region as plainly as possible among the comparison group. We have applied the index approach to the LAU-1 regions of Finland. Industrial production is emphasised, which can be characterised as an export-oriented high productivity sector. Three statistical Smart Specialisation indicators are examined:

Equation 1 is based on the Herfindahl-Hirschman Index (HHI). Originally, the HHI was used to measure market concentration, i.e. the market shares of the firms in an industry. It also can be used to describe a region's economic resilience. This index can be used to identify ex ante the region's ability to cope with external shocks, such as a financial crisis, the closure of large mills or industrial accidents.

The calculation of the HHI index takes into account the extent to which the individual industries in the sub-sector employ the population in relation to the entire industrial sector's labour force in the region. The smaller the value of HHI becomes, the more versatile industrial structure the region has. A versatile industry structure reflects the economic resilience of the region: "all the eggs" are not put "into the same basket". Resilience calculation enables better risk management in regional policy and regional economics (see also Lahari et al. 2008, Karppinen, & Vähäsanta-nen 2015, Maliranta 2005, Kakko, Kaivo-oja & Mikkelä 2016). Information on economic resilience in the region is useful for both public and private sector decision-makers, who should be aware of the instability of the global economy when they are developing and implementing regional strategies. The data for this study comes from Statistics Finland (2017, 2018).

Herfindahl-Hirschman Index (HHI)

We have applied the Herfindahl-Hirchman Index (HHI) to describe the *ex ante* resilience properties of the Finnish sub-regions against asymmetric external economic shocks (Herfindahl 1950, Hirch-man 1964). Our data includes 70 sub-regions and 24 industrial sectors. The HHI measures the in-dustry-wide diversification of a competitive sector in the sub-region. The HHI formula is as follows:

$$HHI_s = \sum_{i=1}^{n} \left(\frac{x_i}{x}\right)_s^2 \qquad (1)$$

where x_i is the number of people employed in the industrial sector (i), x is the total number of people employed in all industrial sectors in the region (s) and (n) is the number of industrial sec-tors. The HHI index is calculated as the sum of squared industry shares for each sub-region. The HHI uses values between [0,1]. The smaller the value, the more diversified the region, and vice versa (see e.g. Kaivo-oja et al. 2017).

Region's Relative Specialisation Index (RRSI)

As the HHI reflects a region's ability to resist external shocks in an *ex ante* sense, we have ap-plied RRSI as an indicator of the *revealed* comparative specialisation of sub-regions in an *ex post* sense. The RRSI measures the observable amount of the relative deviation of the region's industrial structure compared to that of the whole country.

The aim of the RRSI is to identify whether the region has succeeded in specialising to a sufficient degree to survive in global competitive markets. In the terminology of economics, the relative comparative advantage is revealed. The RRSI measures the relative disparity of the industri-al structure of the region with respect to the broad industrial structure of the whole country. The higher the value RRSI index becomes, the more specialised the region's industrial produc-tion base is in relation to the entire national economy. For industrial activities, this means high productivity and economic success in good times, but on the reverse side, there is a possibly of weaker economic resilience in the event of a recession or other economic downturn. This approach is in line with the terminology of intelligent specialisation. It can be calculated in the following way (see e.g. Balassa & Noland 1989):

$$RRSI_s = \left[\sqrt{\textstyle\sum_{i=1}^{n}(1-BHI_i)^2}\right]_s \qquad (2)$$

where BHI_i is the Balassa-Hoover Index (BHI) for industry (i). The formula for the BHIsi is as follows:

$$BHI_{si} = \frac{x_{si}}{X_s} \Big/ \frac{x_i}{X} \qquad (3)$$

where x_{si}/X_s is the share of employed in the region (s) in industry (i), and (x_i/X) is the corresponding share for the country as a whole. If $BHI_{si} \geq 1$, there is a revealed comparative advantage for that industry in a sub-region (s) compared to the sum of all the regions. We have used the BHI with industrial labour data.

The higher the RRS index, the more specialised the structure of manufacturing industry is revealed to be in the region. If the structure of a region is similar to that of the country as a whole, the RRSI obtains a value of zero. If the RRSI ≠ 0, the industrial structure of a region differs from the country's average.

Equation 4 is a simple indicator of employment in industrial production in a given region. We call this indicator the 'Labour Intensity of Manufacturing Index' (LIMIs) for region (s):

$$LIMI_s = \left[{}^{E_{man}}/_{TE}\right]_S \qquad (4)$$

where E_{man} measures employment in manufacturing and TE is total employment.

As a third dimension, the significance of employability with the features revealed by the two previous indicators in the region still needs to be considered. The Labour Intensity of Manufacturing Index (LIMI) measures the region's industrial workforce's share of the entire workforce in the region. The empirical material is based on the employment statistics of industry (TOL2) produced by Statistics Finland (LAU1, statistical definition, which is used by the European Statistical Office in Eurostat Finland). The data sets are for 2015.

Results

In Fig. 1 we have reported the Herfindahl-Hirschman Index analysis of the regional economy in Finland (70 LAU1 regions) in 2015.

In Fig. 2 we have reported the regions' Relative Specialisation Index (RRSI) in Finland in 2015.

In Fig. 3 we have reported the regions' labour intensity in Finland in 2015.

Fig. 4 is based on the indices (HHI) and (LIMI) presented in Figs. 1 and 3 and equations (1) and (3). We have classified both the resilience and labour intensity of the manufacturing properties of smart sub-regions into four sub-areas (I-IV) based on their median. If a sub-region is in sub-area I or II, its S3 properties are strong resilience in the sub-region's economy and high/weak labour intensity of manufacturing, respectively. Correspondingly, sub-areas III and IV consist of weak resilience and weak/strong labour intensity properties, respectively. For more detailed classification purposes, the upper and lower quartiles are also shown in the figure. The coloures indicate the location of the sub-region with respect to the LIMI index median/quartiles classification. The names of some smart sub-regions – the ten most diversified and the five least diversified – are expressed according to the LIMI classification. Each of the sub-regions can find a distinctive position for their smart specialisation in 2015. For example, the smart specialisation properties for the economy of the Jakobstad sub-region can be characterised by a very strong labour intensity and quite high resilience in manufacturing. In Tables 1 and 2 these sub-regions are explored in more detail.

Fig. 5 is based on the indices (RRSI) and (LIMI) presented in Figs. 2 and 3 and equations (2) and (3). In order to achieve convenient comparisons with respect to sub-regional smart specialisation properties (i.e. HHI and RRSI with respect to LIMI), we have also classified here two smart specialisation features. In the case of Fig. 5, the relative sub-regional specialisation and labour intensity of manufacturing properties of the smart sub-regions are classified into four sub-areas (I-IV) based on their median. If a sub-region is in sub-area I or II, its S3 properties are a significant

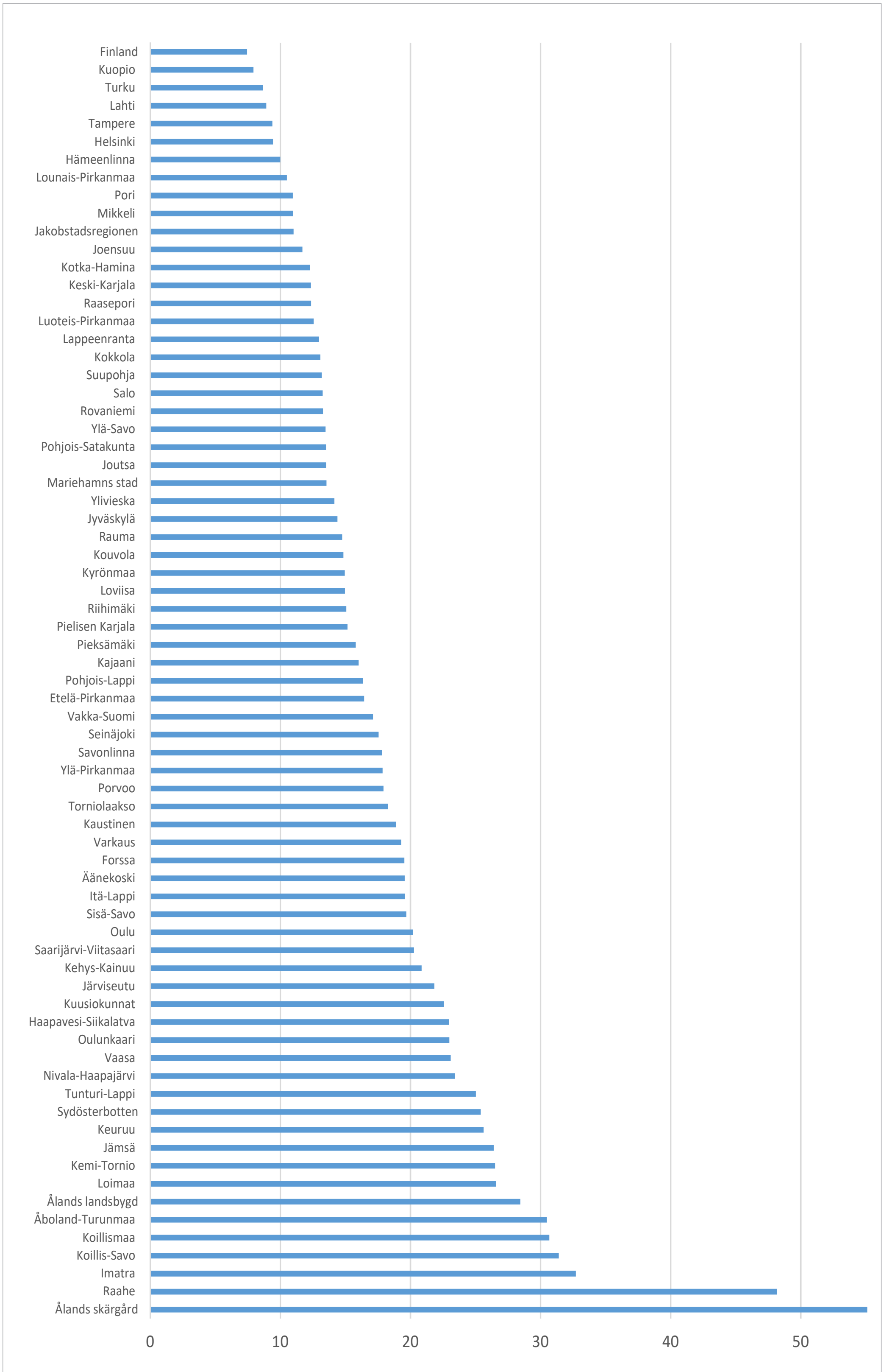
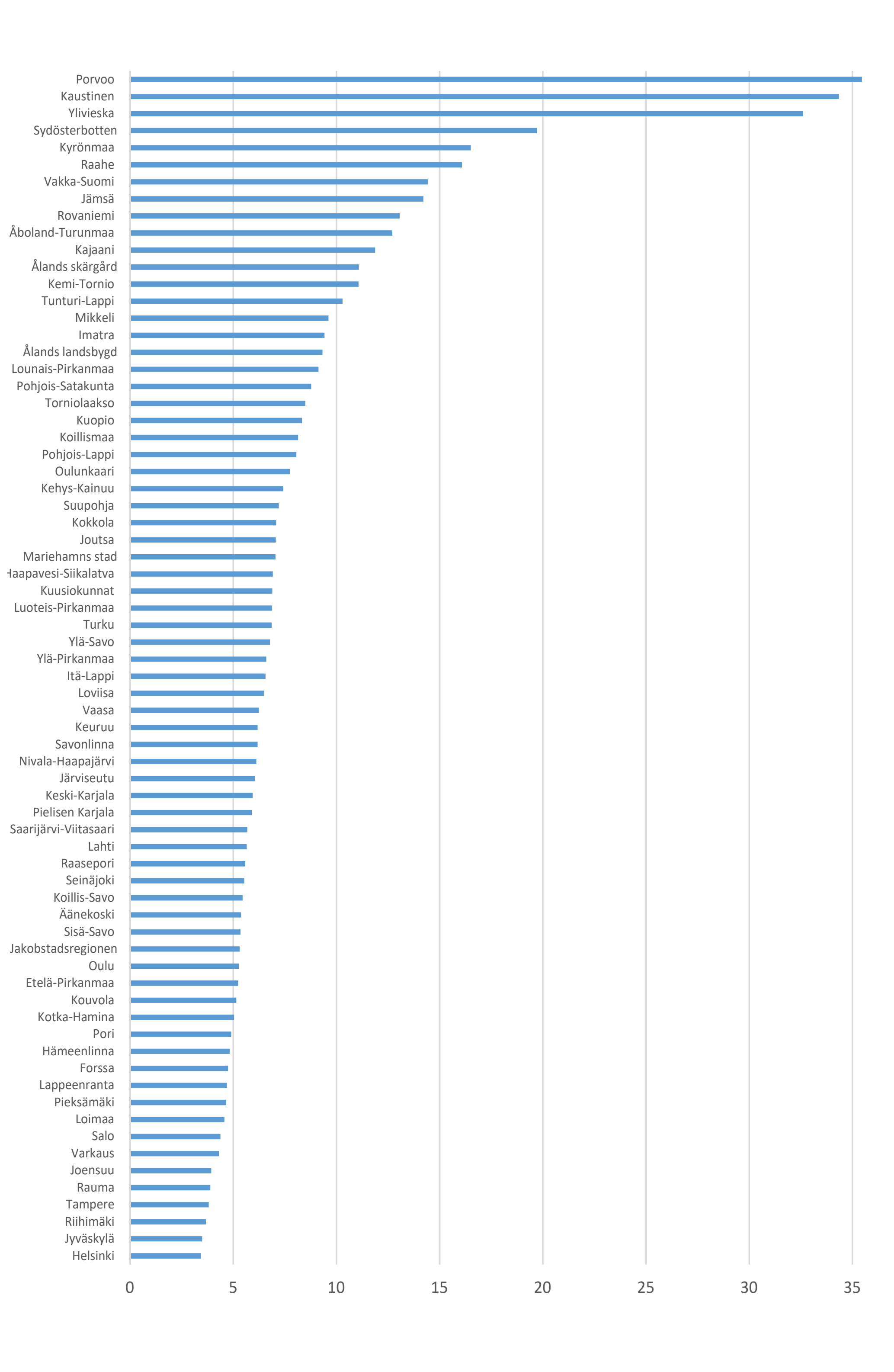


Figure 1

Herfindahl-Hirschman Index Analysis of the Regional Economy in Finland (70 LAU1 regions) in 2015

Figure 2

Regions' Relative Specialisation Index (RRSI) in Finland in 2015



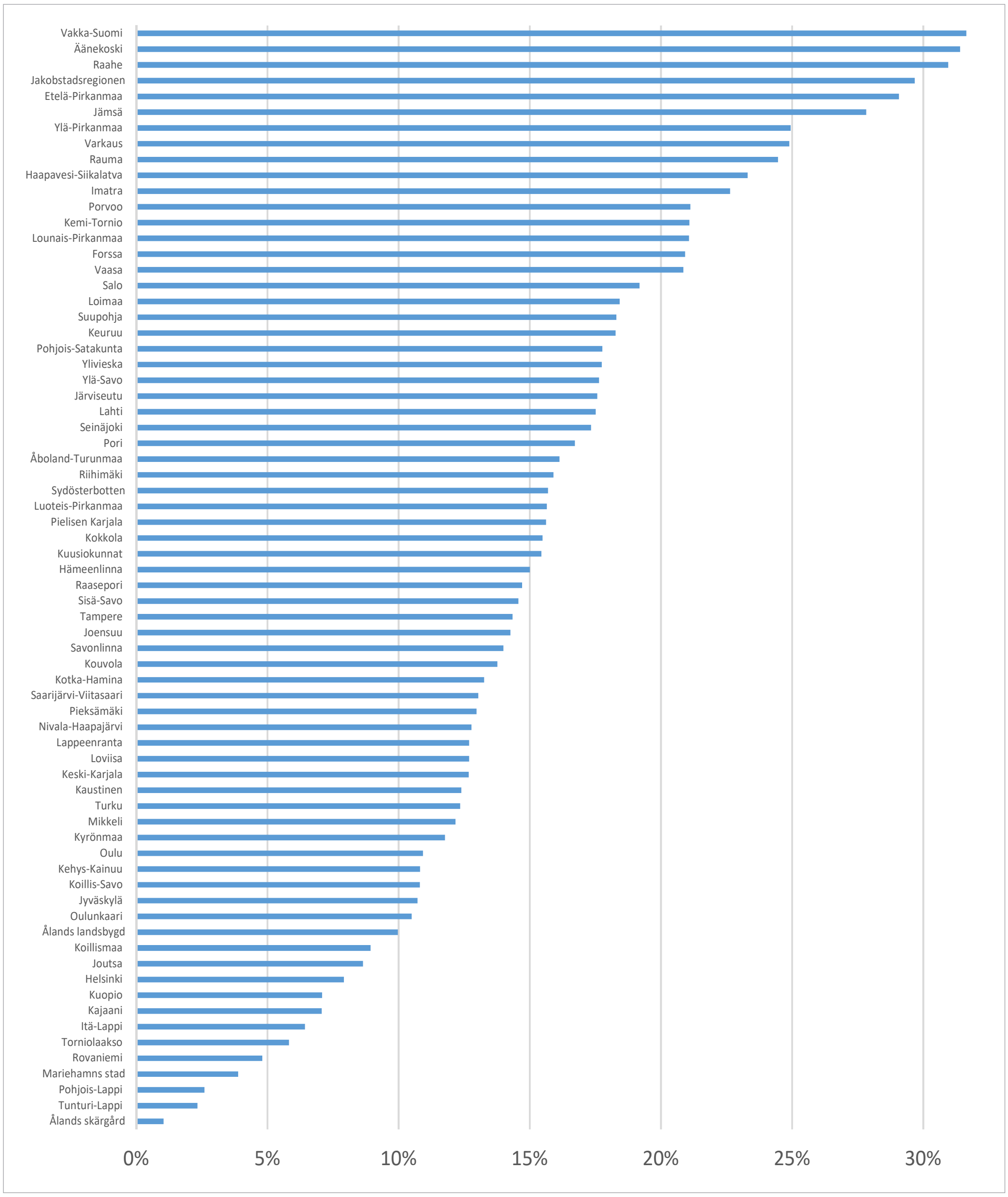


Figure 3
Labour intensity in the sub-regions of Finland

relative specialisation in the sub-region's economy and high/weak labour intensity of manufacturing, respectively. Correspondingly, sub-areas III and IV consist of minor relative deviation in the sub-region's industrial structure and weak/strong labour intensity properties, respectively. For more detailed classification purposes, the upper and lower quartiles are also shown in the figure. The colours indicate the location of the sub-region with respect to the LIMI index median/quartiles classification. The names of some smart sub-regions – the ten most relatively specialised and the five least specialised – are expressed according to the LIMI classification. Also in this case, each of the sub-regions can find a distinctive position for their smart specialisation in 2015. For example, the smart specialisation properties for the economy of the Porvoo sub-region can be characterised by a very high relative specialisation compared to Finland as a whole and the quite high importance of industry for its sub-regional economy.

Figure 4

Classification of smart sub-regions (1) by resilience (HHI) and labour intensity of manufacturing (LIMI)

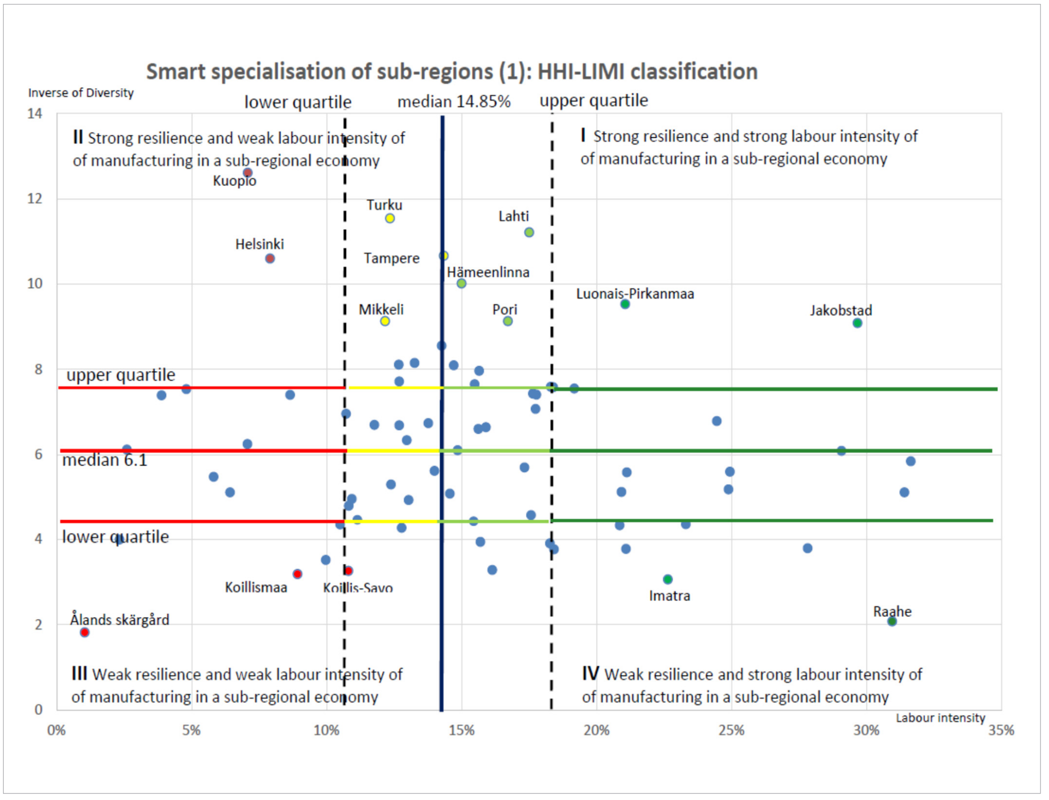
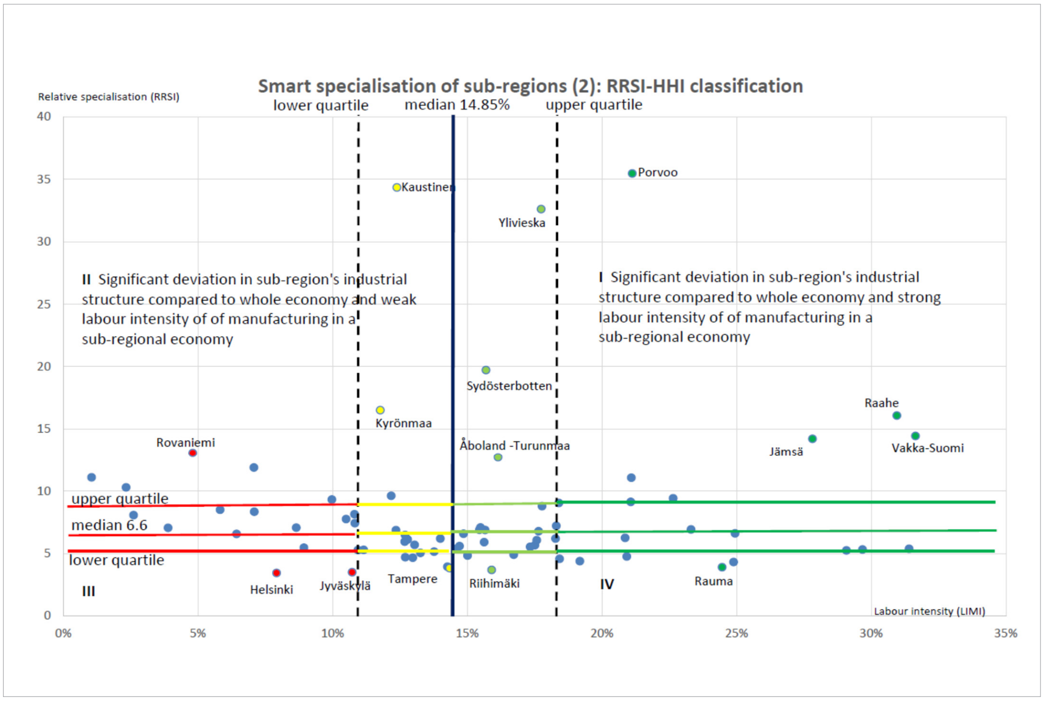


Figure 5

Classification of smart sub-regions (2) by revealed comparative advantage (i.e. sub-regional specialisation, RRSI) and labour intensity of manufacturing (LIMI)



Notes: III Quite similar industrial structure compared to the whole economy and weak labour intensity of manufacturing in a sub-regional economy. IV Quite similar industrial structure compared to the whole economy and strong labour intensity of manufacturing in a sub-regional economy.

Comparing the sub-regions' smart specialisation properties using HHI and RRSI (i.e. resilience and specialisation) with the labour intensity of manufacturing in the sub-regions' economy it can be observed, firstly, that the RRSI index for sub-regions – as a description of smart specialisation – produces a distribution whose kurtosis is much higher with a remarkably higher specialisation tail. Concretely, this means that the industrial structure of many Finnish sub-regions is quite similar in terms of the industrial structure in Finland as whole but some specific LAU-1 regions differ significantly from the average structure. Potentially, these sub-regions have great potential to succeed in international competition because of their relative specialisation, but simultaneously they may be vulnerable. They have the potential to emerge as an area of sudden structural change. Secondly, if the distribution of smart sub-regions with respect to specialisation is very peaked, it can be assumed that nationwide industrial and economic policy also supports the economic growth of many such sub-regions. These sub-regions are explored more specifically in Tables 1 and 2.

Rank	Subregion	TOP10 HHI	LIMI	Rank	Subregion	TOP10 RRSI	LIMI
1	Kuopio	7.93	7.1%	1	Porvoo	35.46	21.1 %
2	Turku	8.67	12.3%	2	Kaustinen	34.35	12.4 %
3	Lahti	8.92	17.5%	3	Ylivieska	32.61	17.7 %
4	Tampere	9.38	14.3%	4	Sydösterbotten	19.72	15.7 %
5	Helsinki	9.44	7.9%	5	Kyrönmaa	16.51	11.8 %
6	Hämeenlinna	9.99	15.0%	6	Raahe	16.08	31.0 %
7	Lounais-Pirkanmaa	10.50	21.1%	7	Vakka-Suomi	14.44	31.6 %
8	Pori	10.96	16.7%	8	Jämsä	14.21	27.8 %
9	Mikkeli	10.96	12.2%	9	Rovaniemi	13.06	4.8 %
10	Jakobstadsregionen	11.01	29.7%	10	Åboland-Turunmaa	12.71	16.1 %

Table 1

TOP 10 ´Traffic lights´ regional development. TOP 10 regions of HHI and RRSI in Finland in 2015

Rank	Subregion	HHI	LIMI	Rank	Subregion	RRSI	LIMI
66	Koillismaa	30.67	8.9%	66	Rauma	3.89	24.5%
67	Koillis-Savo	31.40	10.8%	67	Tampere	3.82	14.3%
66	Imatra	32.71	22.6%	66	Riihimäki	3.68	15.9%
69	Raahe	48.15	31.0%	69	Jyväskylä	3.49	10.7%
70	Ålands skärgård	55.10	1.04%	70	Helsinki	3.43	7.9%

Table 2

RANKING 66-70 ´Traffic lights´ regional development. The bottom five sub-regions of HHI and RRSI in Finland in 2015

In Table 1 the TOP 10 ´Traffic lights´ of regional development of HHI and RRSI in Finland in 2015 are listed.

According to Table 1, the Kuopio sub-region is the most diversified (of the 70 sub-regions) but the economic significance of the industrial sector is minimal in its regional economy. The Lahti sub-region, on the other hand, is diversified and at the same time its labour intensity is significant. In other words, this kind of sub-region is resilient to external shocks according to its industrial structure, and at the same time this structure has major significance for its regional development. The same goes for the Lounais-Pirkanmaa and Jakobstad regions.

In Table 2 the bottom five ranked sub-regions of Finland are listed. Both HHI and RRSI indicators are used as reference points.

In Table 2 there are some interesting results when we compare them with Table 1. Firstly, as we can easily see, some sub-regions are represented in both the Top 10 of HHI analysis and also at the bottom of the RRSI analysis list. Such sub-regions are Helsinki and Tampere. Helsinki and Tampere are in the Top Ten group of resilience (HHI), but at the same time in the RRSI these regions are on the list of the bottom five sub-regions. This result is intuitive: the sub-regions are diversified and their industrial structure complies with the industrial structure of the whole country. These areas, Helsinki and Tampere, strongly determine the industrial structure of the whole country, as they are large economies on a Finnish scale. Regions like this benefit from the overall industrial and economic policy of Finland.

In the left column, attention is drawn to the sub-regions of Raahe and Imatra. These sub-regions have problems with resilience strategy because the value of the HHI index is high and at the same time the LIMI index has a high value. In Finland, the sub-region of Salo with its earlier large industrial Nokia production had a similar economic position to the Imatra and Raahe sub-regions.

This spatial analysis covers Finnish sub-regions. The same type of analysis could be presented for all EU member states.

Conclusions

- In this study, we conducted an S3 analysis with three different indicators, HHI, RRSI and LIMI, which measure the industry-wide diversification of a competitive sector in the sub-region, the relative disparity of the industrial structure of the region with respect to the industrial structure of the whole country and labour intensity of manufacturing, respectively.
- Regions considering their smart specialisation strategies can benefit from this kind of knowledge, because it reveals what are their relative strengths and positions as compared to other regions. These analyses can be made for all regions in Europe.
- The competitiveness aspects of a smart specialisation strategy have not yet been adequately studied.
- For future regional smart specialisation strategy in the European Union, further development of integrated employment and competitiveness indicators would be useful.
- Building of a smart specialisation indicators system across the EU will be needed in the future, but now this project is in its early stages of development. The need for further empirical S3 research is clear.

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