

ICT SECTORAL SPECIALIZATION AND CONCENTRATION IN V4+ COUNTRIES ON REGIONAL LEVEL (NUTS2)

Kamila TUREČKOVÁ

Silesian University in Opava

Univerzitni namesti 1934/3, 733 40 Karvina, Czech Republic

tureckova@opf.slu.cz

Abstract. *This article focuses on economic specialization in context of regional competitiveness of the regions of Visegrad group countries plus defined on regional level by NUTS2, and on spatial concentration of the selected economic activity, which is Information and communication technology characterized by NACE, Rev. 2 through section J. The presented research tries to define the position of Information and communication technology sector and its development in Poland, the Czech Republic, Slovakia, Slovenia, Austria, and Hungary in the period 2005 – 2012 using Gross Value Added data. The analysis of ICT sectoral specialization and concentration in V4+ countries will be made on a regional level based on empirical data from the European statistical office, Eurostat. Standard economic-geographical methods and statistical measures of specialization and concentration are applied and combined. Specialization and concentration are calculated using Herfindahl index for concentration, the Herfindahl index for specialization, Krugman dissimilarity index for concentration and specialization, Specialization index and Localisation index. The text after Introduction is organized subsequently: the second part explains the theoretical approach and methodology. There are introduced generally used methods for calculating sectoral specialization and concentration. The third part contains the conceptual framework of empirical analysis and results of ICT sector in V4+ regions in the context of concentration and specialization and the Conclusion highlights some major conclusions of detailed analysis made in the previous chapter. It was discovered through the selected types of methods that in all six analyzed countries ICT activities were concentrated in the same region in which the capital city of the given country is situated. Slovakia had the most balanced representation of the ICT sector from all regions V4+ countries.*

Keywords: *ICT sector; specialization; concentration; index; region; regional competitiveness; comparison.*

Introduction

Sectoral regional specialization and geographical concentration of sectors are two closely interrelated phenomena since they reflect the similar reality base on the identical production structures. It is two sides of the same coin (Aiginger & Rossi-Hansberg, 2006). Regional specialization in the context of economic sector expresses the share of regionally selected sector in the sector of the overall economy while the geographical concentration of the specific economic sector reflects the distribution of its regional shares.

The high level of specialization in the sector is reflected in sector's competitiveness what is defined as the ability of the particular economic sector to defend and/or gain

market share in open international markets, relying on price and/or quality of their products (European Commission, 2004). If we add the concept of external competitiveness of the economic sectors to the concept of internal aggregate competitiveness, the “strong” sector is reflected in a positive trajectory of the main macroeconomic indicators with an emphasis on productivity, which sustained growth. This growth is a prerequisite for achieving positive results at the macroeconomic level. There is no doubt that the geographical specialization in any economic sector brings, either directly or indirectly, significant economic and social benefits for the particular economy and society (Turečková, 2016).

The aim of this article is to evaluate the Visegrad group countries plus (V4+) regions in the context of their regional sectoral specialization and geographical concentration concerning the economic branch of Information and communication technology (ICT) characterized by NACE Rev. 2. To define the regional disparities in the relevant sectors an empirical result was used. This analysis was performed for the period 2005 through 2012 based on the Gross Value Added data of the economic sector and the NUTS2 region provided by Eurostat. The selected methods including the traditional economic-geographical methods were used, such as the Herfindahl index for concentration, the Herfindahl index for specialization, Krugman dissimilarity index for concentration and specialization, Specialization index or Localisation index) to express territorial specialization and geographical concentration. These methods are supplemented by ordinary statistical methods such as the standard deviation method and others.

The article is organized as follows. Section 2 describes the theoretical approach towards the regional specialization and geographical concentration with an emphasis on the main theoretical contributions to this problem and methodology that measures its sectoral level, specifically in the ICT sector, in NUTS2 regions of Poland, the Czech Republic, Slovakia, Slovenia, Austria, and Hungary. The Section 3, Empirical analysis of ICT sector in V4+ regions in the context of concentration and specialization, presents concrete basic empirical results on economic specialization and geographical concentration of ICT in particular regions of the selected countries in years 2005 to 2012. It also provides us with a comparison between analyzing the regions and determining the order of the regions in its specialization in ICT sector. The Section 4, the conclusion, provides us with concluding comments, and it highlights some of the major conclusions from the analysis provided.

Theoretical approach and methodology

Regarding the methodological perspective, the current research is based on economic-geographical methods that are part of Economic geography. The discipline (New) Economic Geography was strengthened in the 1990s as a synthesis of the new theory of trade, Myrdal, respectively Hirschman theory of cumulative causes and neoclassical location theory (Baldwin, Forslid, Martin, Ottaviano & Robert-Nicoud, 2005; Šimanová & Trešl, 2011).

The possibility to define and measure geographical specialization and sectoral concentration allows us to focus on regional specialization and industrial concentration in the context of relevant microeconomic and macroeconomic analysis of the economy in particular region. Krugman and Venables (1995) consider

transaction costs as the key role in the geographical advantage of localities, when the first step leads to a greater economic integration and differentiation of regions, which alternates with the second phase of the dispersion of economic activities in peripheral regions, including related changes in the industry structure. Hirschmann (1967) cited in Blažek and Uhlíř (2002) considers the basis of sectoral regional disparities in available infrastructure and developed service sector. There is an obvious causality of the actual process of agglomeration of economic activities and regional economic policy in the areas, which support new investments (investment incentives, industrial zones, subsidies of new jobs). Not only the regional economic policy but also foreign direct investment is very important (Srholec, 2004). A significant regional specialization in a particular economic sector is an advantage not only in the relevant region but also for the hierarchically higher geographical area. There is no doubt that the geographical specialization and sectoral concentration bring, either directly or indirectly, significant economic and social benefits for the particular economy and society.

The concept of competitiveness is based on regional competitiveness in combination on sectoral competitiveness. This sectoral competitiveness is also transformed on microeconomic level where, for example, ICT has a positive effect on the international competitiveness of firms (Pena-Vinces, Capeda-Carrion & Chin, 2012). Muntean, Nistor, and Nistor (2015) emphasize a role of ICT for the firms in the example of firms in services sector when firms using appropriate information and communication technologies reaching increasing competitiveness and operational efficiency in particular business.

Regional competitiveness is a reflection of the quantity and quality of the structure of economic entities and subjects in the region (Nevima, 2014). These allow the region to be in the desired area (in the required field) better than others do. Regional competitiveness is a combination of Theory of comparative advantage (Ricardo, 1956), Porter's concept of competitive advantage (Porter, 1990) and Theory of X-inefficiency (Leibenstein, 1966). Competitiveness of the sector of the economy is also supported by the inherent "the attractiveness of the sector in the country" where the sector or country have a set of elements, characters, relationships and characteristics, which enables them to overcome others in the ability to generate higher national income and attract more permanent factors of production (Turečková, 2014). This attractiveness of the sector usually has a form called "soft externalities" (Benes, 2006). According to Kitson, Martin and Tyler (2004), referring to Alfred Marshall, these benefits are characterized by a triad of externalities which is comprised of a skilled workforce, supporting and related industries and transfer of knowledge, experience, and information. This creates a "special atmosphere", supported by the existence of public goods (knowledge, skills, common information), which creates conditions for the formation of wanted mostly - positive externalities reducing costs. This dynamic information dissemination, knowledge, technological processes and practices and innovation improves the competitiveness of the system itself (for example sectors as defined) and is reflected in the growth of competitiveness of businesses and other entities participating in it.

The subject of our research is the economic sector of ICT defined by the NACE Rev. 2 (Nomenclature générale des Activités économiques dans les Communautés Européennes), which defines the complete system of classifications of economic

activities and products used by the European Union and creates a framework for statistical data on economic issues used for the statistics generated throughout the entire European Union. The ICT sector is defined in the NACE Rev. 2 in Section J - Information and communication activities (services); (Information and Communication) (CSO, 2014). ICT sector is analyzed in the regions of a group of countries known as V4+. This specific group of countries includes Poland, the Czech Republic, Slovakia, Slovenia, Austria, and Hungary. The territorial definition of the regions is based on a uniform system of classification of territorial statistical units NUTS (Nomenclature of Territorial Units for Statistics - Nomenclature of Territorial Units for Statistics), which is predominantly used for statistical purposes in the EU. The regional level NUTS2 was used for the purpose of our analysis (MMR, 2015).

The period in which the analysis was performed covers the years 2005 - 2012. The data used in this paper are not available for a longer period. The data regarding Gross Value Added (GVA) applied basic prices of all NACE activities in ICT sector, and population number, all for NUTS2 regions. The empirical calculation is based on take-over public data from Eurostat (Database of General and regional statistics; Regional statistics by NUTS classification). The data regarding sectoral employment were not available and thus could not be used. The software used was MS Excel. All calculations and graphical analysis are author's own work.

Applied methods

The analysis of concentration and specialization of ICT sector in NUTS2 regions of V4+ is primarily based on the Herfindahl index for concentration, the Herfindahl index for specialization, Krugman dissimilarity index for concentration and for specialization, Specialization index, and Localisation index.

The first statistical measuring methods used here are the well-known indicators of concentration and specialization – the Herfindahl index for concentration (H_j^C) and for specialization (H_i^S):

$$H_j^C = \sum_{i=1}^n (g_{ij}^C)^2 \quad (1)$$

or

$$H_i^S = \sum_{j=1}^m (g_{ij}^S)^2 \quad (2)$$

where

$$g_{ij}^C = \frac{X_{ij}}{\sum_{i=1}^n X_{ij}} = \frac{X_{ij}}{X_j} \quad \text{and} \quad g_{ij}^S = \frac{X_{ij}}{\sum_{j=1}^m X_{ij}} = \frac{X_{ij}}{X_i} \quad (3)$$

and where i – region; j – sector (branch); X – total (national) gross value added (GVA); X_{ij} – GVA in sector j in region i ; X_j – total GVA in sector j ; X_i – total GVA in region i ; g_{ij}^C – the share of region i in the total national value of branch j ; g_{ij}^S – the share of branch j in the total value of region i .

Both Herfindahl indexes increase with the degree of regional sectoral concentration or specialization. If the value of index equals 1, the sector j is entirely concentrated in one region i , which means that the region i specializes in only one economic sector. The lower limit values are defined as $1/n$ for concentration and $1/m$ for specialization, i.e. all regions (sectors) have an equal share in sector j , respectively in region i . It is necessary to calculate with equally large regions to preserve the comparability and objectivity since the size of the region influences the final value of the index. For more information about the statistical measurement of concentration and specialization by Herfindahl index see Campos (2012), Goschin, Constantin, Roman & Ileanu (2009) or Rhoades (1993).

The second group of indicators applied is the well-known Krugman dissimilarity index for concentration (K_j^C) or for specialization (K_i^S):

$$K_j^C = \sum_{i=1}^n |g_{ij}^C - g_i| \quad (4)$$

or

$$K_i^S = \sum_{j=1}^m |g_{ij}^S - g_j| \quad (5)$$

where

$$g_i = \frac{x_i}{x} \quad \text{and} \quad g_j = \frac{x_j}{x} \quad (6)$$

The Krugman Dissimilarity Index is a relative measure of specialization or concentration that is applied to compare one economic sector/region with the overall national economy. Its values range from 0 to $\frac{2(n-1)}{n}$ resp. $\frac{2(m-1)}{m}$. If the index equals 0, it means identical territorial/sectoral structures, while if the value of index equals max limit, it demonstrates totally different sectoral structures in the analyzed unit (Goschin et al., 2009; Palan, 2010; Turečková & Martinát, 2016)

The third indicator applied in the present research is Specialization index (IS_{ij}) that combines both of Herfindahl indexes as is shown in Equation (7):

$$IS_{ij} = g_{ij}^C \times g_{ij}^S \times 100 \quad (7)$$

Specialization index measures the share of the regional sectoral characteristic in the total sectoral characteristic of the hierarchically higher territorial unit. $IS_{ij} \in (0|100)$. If the numeric value is close to 0, the relevant sector is not located within the analyzed region, and if $IS_{ij} = 100$, the sector is located entirely in this region, so the particular economic activity is concentrated there and this region (no other) specializes in this sector.

The last indicator measuring territorial concentration is Localisation index (IL_{ij}), also known as Localisation quotient, Proportionality index or Coefficient of concentration), take into consideration the population number in the relevant regions. The localization index is constructed based on this formula:

$$IL_{ij} = \frac{g_{ij}^c \times 100}{S_i / S}$$

(8)

where S_i – population in region i ; S – total population

Localization index takes values around one. When $IL_{ij} = 1$, it means that the economic sector is located proportionally in this region. If $IL_{ij} > 1$, it indicates over-proportionate representation of the analyzed sector in the region (in relation to its population), and vice versa $IL_{ij} < 1$, it indicates under-proportionate representation of the analyzed sector in the selected region (in relation to its population). More about Specialization and Localisation index in Turečková and Martinát (2016).

The limitations of used methods are (I) amount of input indicators, (II) availability of sources of indicators on required regional level and (III) methodology of assigning a value of particular production of economic subjects in a particular region. The indices used are based on the amount of GVA, which may not always be the only indicator reflecting the concentration of sector in the region. In the context of sectoral concentration it is also preferable to find it out on lower regional levels but for LAU 1 and LAU 2 data are not available. GVA value produced by the firm is assigned to the region where the company has its registered office and not to the region where the value of GVA actually have been produced.

The presentation of the results of the analysis is highlighted by using the semaphore method (traffic light method). More about the different types of rating scales/conditional formatting regarding the highlighting differences in result values see for example Melecký and Skokan (2011) or Tuleja (2010).

Empirical analysis of ICT Sector in V4+ Regions in context of concentration and specialization

Here are present the results of sectoral specialization in selected regions NUTS2 of V4+ country. In the context of theoretical approach, it is claimed that regions with a higher level of specialization and concentration in particular sector have in this economic sector also its competitive advantage.

Table 1 summarizes the relevant values of both found Herfidahl indexes for ICT sector for NUTS2 regions of V4+ countries between years 2005 – 2012. Based on the Herfidahl index for concentration, the ICT sector is significantly concentrated in the regions of the capital city. In 2012, about 60% of analyzed economic activities were concentrated in Prague, in Közép-Magyarország it was more than 80%, in Wien it was 62%, in Poland Region Mazowieckie it was 53%, in Zahodna Slovenija it was about 80% and in Bratislava Region only 32%. It was merely in Slovakia regions where the ICT sector was not concentrated specifically in one territorial unit but considerably expanded into all regions: Zápádné Slovensko (regional share of ICT in total ICT activities was about 25%), Stredné Slovensko (21%) and Východné Slovensko (22%). No other regions were involved in ICT activities by more than 20% during the selected time period. The regions where ICT was not represented at all are Burgenland, Swietokrzyskie, Podlaskie, Lubuskie and Warminsko-Mazurskie (their share of ICT in total ICT sector is lower than 1.5%). The results, which were obtained applying the

Herfindahl index for specialization, confirm sectoral orientations of each region, which can be seen in the second part of Table 1. Prague was the most specialized in ICT (ICT includes more than 12% of all economic activities) followed by Mazowieckie (9%-10%), Közép-Magyarország (9%) and Wien (8%). There were 12 NUTS2 regions where ICT was represented by less than 2% in 2005 and 20 regions in 2012. Accordingly, a process of gradual specialization of ICT activities in some regions can be noticed.

Table 1. Values of Herfindahl index for concentration and specialization, 2005 - 2012, NUTS2 in V4+

| GEO/TIME | The Herfindahl index for concentration | | | | | | The Herfindahl index for specialization | | | | | | | | | |
|-----------------------|--|-------|-------|-------|-------|-------|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| Czech Republic | | | | | | | | | | | | | | | | |
| Praha | 0,563 | 0,613 | 0,635 | 0,593 | 0,580 | 0,593 | 0,606 | 0,599 | 0,115 | 0,125 | 0,132 | 0,120 | 0,121 | 0,118 | 0,125 | 0,124 |
| Střední Čechy | 0,036 | 0,040 | 0,038 | 0,045 | 0,042 | 0,035 | 0,033 | 0,033 | 0,017 | 0,019 | 0,018 | 0,021 | 0,021 | 0,017 | 0,016 | 0,015 |
| Jihozápad | 0,065 | 0,062 | 0,051 | 0,049 | 0,048 | 0,046 | 0,045 | 0,040 | 0,030 | 0,029 | 0,026 | 0,026 | 0,025 | 0,023 | 0,023 | 0,020 |
| Severozápad | 0,046 | 0,040 | 0,035 | 0,047 | 0,047 | 0,046 | 0,041 | 0,041 | 0,025 | 0,023 | 0,022 | 0,029 | 0,029 | 0,028 | 0,026 | 0,026 |
| Severovýchod | 0,073 | 0,067 | 0,063 | 0,077 | 0,079 | 0,077 | 0,074 | 0,071 | 0,029 | 0,028 | 0,028 | 0,034 | 0,036 | 0,033 | 0,032 | 0,031 |
| Jihovýchod | 0,096 | 0,091 | 0,095 | 0,104 | 0,113 | 0,113 | 0,114 | 0,127 | 0,033 | 0,033 | 0,033 | 0,035 | 0,038 | 0,042 | 0,041 | 0,041 |
| Střední Morava | 0,042 | 0,035 | 0,037 | 0,032 | 0,035 | 0,032 | 0,029 | 0,031 | 0,022 | 0,019 | 0,021 | 0,018 | 0,020 | 0,018 | 0,016 | 0,017 |
| Moravskoslezsko | 0,059 | 0,052 | 0,046 | 0,053 | 0,057 | 0,058 | 0,058 | 0,057 | 0,028 | 0,026 | 0,024 | 0,027 | 0,031 | 0,030 | 0,030 | 0,029 |
| Hungary | | | | | | | | | | | | | | | | |
| Közép-Magyarország | 0,750 | 0,752 | 0,755 | 0,762 | 0,838 | 0,834 | 0,826 | 0,827 | 0,083 | 0,083 | 0,086 | 0,085 | 0,096 | 0,091 | 0,088 | 0,090 |
| Közép-Dunántúl | 0,038 | 0,039 | 0,037 | 0,034 | 0,025 | 0,024 | 0,026 | 0,026 | 0,019 | 0,020 | 0,020 | 0,018 | 0,015 | 0,013 | 0,014 | 0,015 |
| Nyugat-Dunántúl | 0,043 | 0,049 | 0,047 | 0,046 | 0,031 | 0,031 | 0,033 | 0,031 | 0,022 | 0,025 | 0,026 | 0,026 | 0,018 | 0,017 | 0,017 | 0,016 |
| Dél-Dunántúl | 0,037 | 0,036 | 0,037 | 0,036 | 0,027 | 0,028 | 0,025 | 0,024 | 0,028 | 0,029 | 0,031 | 0,030 | 0,024 | 0,023 | 0,020 | 0,020 |
| Észak-Magyarország | 0,037 | 0,035 | 0,035 | 0,033 | 0,021 | 0,021 | 0,023 | 0,021 | 0,022 | 0,023 | 0,024 | 0,023 | 0,016 | 0,015 | 0,016 | 0,015 |
| Észak-Alföld | 0,044 | 0,042 | 0,045 | 0,044 | 0,031 | 0,033 | 0,035 | 0,036 | 0,023 | 0,023 | 0,026 | 0,025 | 0,018 | 0,019 | 0,019 | 0,020 |
| Dél-Alföld | 0,051 | 0,046 | 0,045 | 0,044 | 0,028 | 0,030 | 0,032 | 0,035 | 0,028 | 0,027 | 0,028 | 0,027 | 0,018 | 0,019 | 0,019 | 0,021 |
| Austria | | | | | | | | | | | | | | | | |
| Burgenland (AT) | 0,013 | 0,013 | 0,013 | 0,011 | 0,010 | 0,011 | 0,012 | 0,012 | 0,021 | 0,021 | 0,020 | 0,017 | 0,015 | 0,016 | 0,018 | 0,017 |
| Niederösterreich | 0,055 | 0,056 | 0,056 | 0,059 | 0,060 | 0,061 | 0,061 | 0,062 | 0,013 | 0,013 | 0,012 | 0,012 | 0,013 | 0,013 | 0,013 | 0,013 |
| Wien | 0,695 | 0,683 | 0,673 | 0,666 | 0,662 | 0,654 | 0,642 | 0,622 | 0,094 | 0,090 | 0,087 | 0,084 | 0,082 | 0,080 | 0,082 | 0,079 |
| Kärnten | 0,025 | 0,030 | 0,030 | 0,030 | 0,029 | 0,029 | 0,030 | 0,028 | 0,015 | 0,018 | 0,018 | 0,018 | 0,017 | 0,017 | 0,018 | 0,016 |
| Steiermark | 0,056 | 0,056 | 0,061 | 0,061 | 0,062 | 0,062 | 0,063 | 0,067 | 0,016 | 0,015 | 0,016 | 0,016 | 0,016 | 0,016 | 0,016 | 0,017 |
| Oberösterreich | 0,080 | 0,083 | 0,084 | 0,084 | 0,088 | 0,092 | 0,098 | 0,105 | 0,017 | 0,017 | 0,017 | 0,016 | 0,017 | 0,018 | 0,019 | 0,020 |
| Salzburg | 0,029 | 0,030 | 0,033 | 0,034 | 0,034 | 0,037 | 0,040 | 0,049 | 0,014 | 0,014 | 0,015 | 0,015 | 0,015 | 0,016 | 0,018 | 0,022 |
| Tirol | 0,031 | 0,033 | 0,032 | 0,036 | 0,037 | 0,036 | 0,036 | 0,037 | 0,013 | 0,013 | 0,012 | 0,014 | 0,014 | 0,014 | 0,013 | 0,014 |
| Vorarlberg | 0,017 | 0,017 | 0,018 | 0,018 | 0,018 | 0,018 | 0,018 | 0,017 | 0,014 | 0,013 | 0,013 | 0,013 | 0,013 | 0,013 | 0,013 | 0,012 |
| Poland | | | | | | | | | | | | | | | | |
| Łódzkie | 0,028 | 0,028 | 0,031 | 0,030 | 0,029 | 0,029 | 0,028 | 0,028 | 0,020 | 0,019 | 0,020 | 0,020 | 0,020 | 0,019 | 0,018 | 0,018 |
| Mazowieckie | 0,550 | 0,544 | 0,514 | 0,520 | 0,509 | 0,526 | 0,526 | 0,531 | 0,117 | 0,109 | 0,100 | 0,106 | 0,098 | 0,094 | 0,092 | 0,093 |
| Mazowieckie | 0,054 | 0,064 | 0,067 | 0,067 | 0,071 | 0,065 | 0,068 | 0,070 | 0,031 | 0,035 | 0,036 | 0,037 | 0,038 | 0,033 | 0,033 | 0,035 |
| Śląskie | 0,073 | 0,074 | 0,078 | 0,074 | 0,075 | 0,071 | 0,070 | 0,071 | 0,024 | 0,024 | 0,025 | 0,024 | 0,024 | 0,021 | 0,020 | 0,021 |
| Lubelskie | 0,021 | 0,020 | 0,021 | 0,020 | 0,020 | 0,020 | 0,018 | 0,019 | 0,023 | 0,021 | 0,022 | 0,021 | 0,021 | 0,020 | 0,017 | 0,019 |
| Podkarpackie | 0,016 | 0,017 | 0,022 | 0,026 | 0,027 | 0,028 | 0,027 | 0,026 | 0,018 | 0,018 | 0,023 | 0,028 | 0,028 | 0,029 | 0,026 | 0,026 |
| Świętokrzyskie | 0,012 | 0,011 | 0,012 | 0,012 | 0,011 | 0,011 | 0,010 | 0,010 | 0,021 | 0,018 | 0,018 | 0,018 | 0,017 | 0,016 | 0,015 | 0,015 |
| Podlaskie | 0,011 | 0,010 | 0,011 | 0,010 | 0,010 | 0,010 | 0,010 | 0,009 | 0,021 | 0,019 | 0,019 | 0,019 | 0,019 | 0,017 | 0,016 | 0,015 |
| Wielkopolskie | 0,058 | 0,058 | 0,065 | 0,066 | 0,069 | 0,068 | 0,072 | 0,063 | 0,027 | 0,026 | 0,028 | 0,030 | 0,029 | 0,028 | 0,029 | 0,025 |
| Zachodniopomorskie | 0,022 | 0,021 | 0,021 | 0,023 | 0,022 | 0,021 | 0,020 | 0,019 | 0,024 | 0,023 | 0,022 | 0,024 | 0,024 | 0,022 | 0,020 | 0,020 |
| Lubuskie | 0,012 | 0,012 | 0,012 | 0,011 | 0,011 | 0,011 | 0,010 | 0,010 | 0,022 | 0,021 | 0,021 | 0,020 | 0,020 | 0,018 | 0,017 | 0,017 |
| Dolnośląskie | 0,042 | 0,042 | 0,046 | 0,047 | 0,052 | 0,053 | 0,054 | 0,057 | 0,023 | 0,022 | 0,023 | 0,024 | 0,026 | 0,024 | 0,024 | 0,025 |
| Opolskie | 0,009 | 0,009 | 0,009 | 0,008 | 0,008 | 0,007 | 0,007 | 0,006 | 0,017 | 0,016 | 0,016 | 0,014 | 0,015 | 0,012 | 0,012 | 0,011 |
| Kujawsko-Pomorskie | 0,022 | 0,021 | 0,022 | 0,021 | 0,020 | 0,019 | 0,017 | 0,017 | 0,020 | 0,018 | 0,019 | 0,019 | 0,018 | 0,016 | 0,015 | 0,014 |
| Warmińsko-Mazurskie | 0,015 | 0,013 | 0,013 | 0,013 | 0,013 | 0,012 | 0,012 | 0,011 | 0,024 | 0,019 | 0,019 | 0,020 | 0,019 | 0,017 | 0,016 | 0,016 |
| Pomorskie | 0,055 | 0,057 | 0,056 | 0,052 | 0,053 | 0,049 | 0,051 | 0,053 | 0,043 | 0,042 | 0,040 | 0,039 | 0,038 | 0,034 | 0,034 | 0,035 |
| Slovenia | | | | | | | | | | | | | | | | |
| Vzhodna Slovenija | 0,185 | 0,181 | 0,180 | 0,190 | 0,194 | 0,196 | 0,200 | 0,194 | 0,017 | 0,016 | 0,016 | 0,017 | 0,017 | 0,018 | 0,019 | 0,019 |
| Zahodna Slovenija | 0,815 | 0,819 | 0,820 | 0,810 | 0,806 | 0,804 | 0,800 | 0,806 | 0,058 | 0,059 | 0,059 | 0,058 | 0,056 | 0,058 | 0,058 | 0,061 |
| Slovakia | | | | | | | | | | | | | | | | |
| Bratislavský kraj | 0,320 | 0,347 | 0,357 | 0,357 | 0,357 | 0,352 | 0,332 | 0,324 | 0,046 | 0,052 | 0,055 | 0,055 | 0,060 | 0,057 | 0,054 | 0,056 |
| Západné Slovensko | 0,245 | 0,237 | 0,236 | 0,246 | 0,239 | 0,219 | 0,230 | 0,241 | 0,029 | 0,027 | 0,029 | 0,030 | 0,035 | 0,031 | 0,032 | 0,035 |
| Stredné Slovensko | 0,200 | 0,194 | 0,190 | 0,188 | 0,199 | 0,206 | 0,202 | 0,211 | 0,040 | 0,039 | 0,039 | 0,037 | 0,047 | 0,046 | 0,046 | 0,051 |
| Východné Slovensko | 0,235 | 0,222 | 0,217 | 0,209 | 0,205 | 0,223 | 0,236 | 0,224 | 0,044 | 0,043 | 0,044 | 0,041 | 0,049 | 0,051 | 0,052 | 0,052 |

Krugman dissimilarity indexes in the present analysis compare an economic structure of single region with the economic structure of the reference level (i.e. the particular country in this case). Picture 1 shows eight average values of the Krugman index of concentration and specialization in each region. The lower value of the index of concentration (close to zero) states that ICT sector in the particular region resembles the ICT structure of the whole country. The results following from Krugman index of concentration in NUTS2 regions of V4+ confirm that only in regions with the capital city the ICT sector is much largely represented compared to what is typical (average) for the overall national economy. The consistency of results of indexes in both Slovenian regions is caused by the existence of merely two regions within the analyzed country. A similar explanation can be applied in the case of Krugman index of specialization. The value of this index indicates the similarity of the regions towards the reference region (formed by their average) regarding the specialization in ICT activities. There are also results confirming the previously mentioned conclusions.

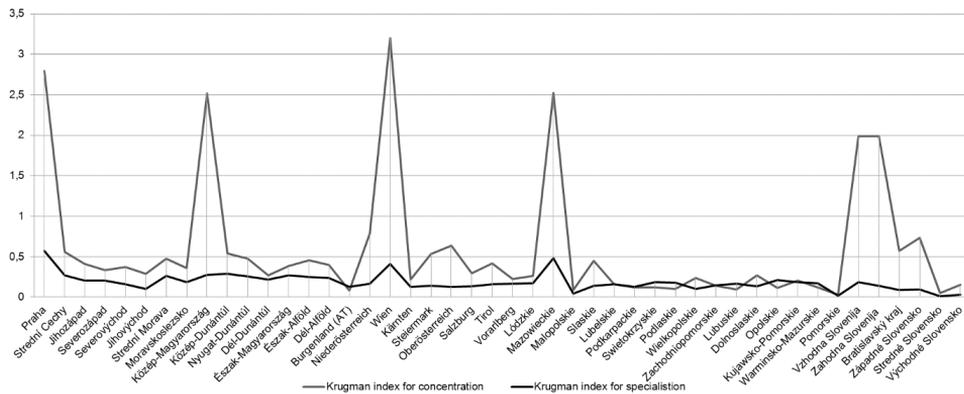


Figure 1. Values of Krugman dissimilarity indexes, average 2005 – 2012, NUTS2 in V4+

Table 2 presents us with values of Specialization index, its average and rank of NUTS2 regions based on average data. The higher the index value, the higher amount of ICT activities in the particular region can be noticed (note: the size of the total output of the particular economic sector together with the output of the whole economy (all sectors) is taken into account. From this perspective, different regions could be relevantly compared with each other). The most successful region as far as the participation in ICT activities is Prague, followed by Közép-Magyarország region, Wien, Mazowieckie, Zahodna Slovenija, Bratislava Region and the rest of Slovak regions, Southeast, Vzhodna Slovenija, Malopolskie, Northeast, Pomorskie and Wielkopolskie (15 places). Five Polish regions (Swietokrzyskie, Podlaskie, Lubuskie, Opolskie and Warminsko-Mazurskie) and two Austrian (Burgenland and Vorarlberg) regions are engaged in ICT activities only marginally and contributed the least to the ICT sector.

Table 2. Values of Specialization index, 2005 – 2012, average and rank, NUTS2 in V4+

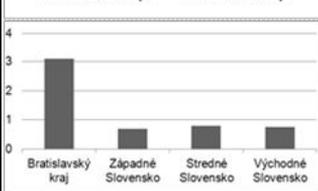
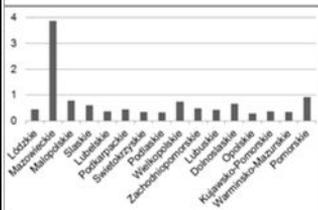
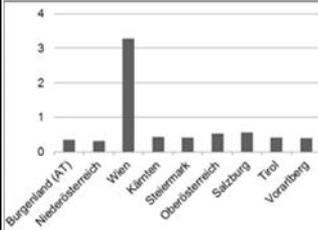
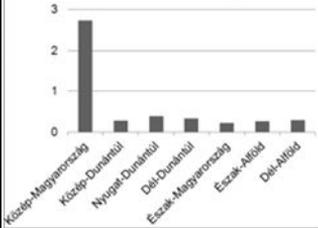
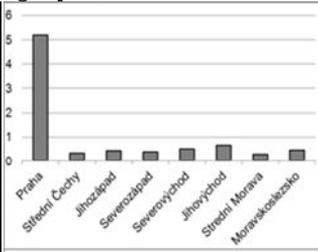
| GEO/TIME | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Average | Rank |
|----------------|-------|-------|-------|-------|-------|-------|-------|-------|---------|------|
| Czech Republic | | | | | | | | | | |
| Praha | 6,720 | 7,686 | 8,352 | 7,088 | 6,991 | 7,019 | 7,587 | 7,439 | 7,360 | 1 |
| Střední Čechy | 0,062 | 0,077 | 0,068 | 0,095 | 0,086 | 0,060 | 0,052 | 0,050 | 0,069 | 28 |
| Jihozápad | 0,194 | 0,180 | 0,133 | 0,129 | 0,121 | 0,107 | 0,105 | 0,081 | 0,131 | 19 |
| Severozápad | 0,118 | 0,093 | 0,077 | 0,135 | 0,137 | 0,129 | 0,106 | 0,106 | 0,113 | 21 |
| Severovýchod | 0,213 | 0,186 | 0,173 | 0,260 | 0,283 | 0,258 | 0,237 | 0,219 | 0,228 | 13 |
| Jihovýchod | 0,320 | 0,301 | 0,334 | 0,392 | 0,472 | 0,457 | 0,465 | 0,563 | 0,413 | 10 |

| | | | | | | | | | | |
|---------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|
| Střední Morava | 0,090 | 0,067 | 0,080 | 0,056 | 0,068 | 0,058 | 0,045 | 0,053 | 0,065 | 29 |
| Moravskoslezsko | 0,166 | 0,137 | 0,111 | 0,147 | 0,179 | 0,173 | 0,172 | 0,167 | 0,157 | 18 |
| Hungary | | | | | | | | | | |
| Közép-Magyarország | 6,255 | 6,223 | 6,454 | 6,501 | 8,046 | 7,569 | 7,277 | 7,461 | 6,973 | 2 |
| Közép-Dunántúl | 0,072 | 0,078 | 0,072 | 0,061 | 0,037 | 0,032 | 0,036 | 0,038 | 0,053 | 34 |
| Nyugat-Dunántúl | 0,096 | 0,121 | 0,124 | 0,120 | 0,057 | 0,052 | 0,056 | 0,050 | 0,085 | 25 |
| Dél-Dunántúl | 0,102 | 0,103 | 0,114 | 0,110 | 0,065 | 0,065 | 0,049 | 0,048 | 0,082 | 26 |
| Észak-Magyarország | 0,082 | 0,080 | 0,082 | 0,075 | 0,032 | 0,031 | 0,038 | 0,031 | 0,056 | 32 |
| Észak-Alföld | 0,102 | 0,096 | 0,114 | 0,112 | 0,056 | 0,062 | 0,067 | 0,073 | 0,085 | 24 |
| Dél-Alföld | 0,142 | 0,123 | 0,124 | 0,119 | 0,050 | 0,055 | 0,061 | 0,073 | 0,093 | 23 |
| Austria | | | | | | | | | | |
| Burgenland (AT) | 0,027 | 0,028 | 0,025 | 0,019 | 0,015 | 0,017 | 0,021 | 0,019 | 0,021 | 43 |
| Niederösterreich | 0,070 | 0,071 | 0,067 | 0,072 | 0,075 | 0,076 | 0,078 | 0,081 | 0,074 | 27 |
| Wien | 6,529 | 6,121 | 5,832 | 5,596 | 5,423 | 5,251 | 5,277 | 4,914 | 5,618 | 3 |
| Kärnten | 0,038 | 0,055 | 0,053 | 0,053 | 0,050 | 0,049 | 0,054 | 0,045 | 0,050 | 35 |
| Steiermark | 0,087 | 0,084 | 0,096 | 0,094 | 0,097 | 0,098 | 0,105 | 0,116 | 0,097 | 22 |
| Oberösterreich | 0,135 | 0,144 | 0,141 | 0,138 | 0,150 | 0,163 | 0,187 | 0,214 | 0,159 | 17 |
| Salzburg | 0,041 | 0,043 | 0,050 | 0,053 | 0,052 | 0,061 | 0,072 | 0,107 | 0,060 | 31 |
| Tirol | 0,040 | 0,042 | 0,040 | 0,049 | 0,052 | 0,048 | 0,050 | 0,051 | 0,047 | 37 |
| Vorarlberg | 0,024 | 0,021 | 0,023 | 0,024 | 0,024 | 0,022 | 0,022 | 0,021 | 0,023 | 41 |
| Poland | | | | | | | | | | |
| Lódzkie | 0,057 | 0,053 | 0,062 | 0,059 | 0,057 | 0,055 | 0,050 | 0,050 | 0,055 | 33 |
| Mazowieckie | 6,407 | 5,934 | 5,126 | 5,499 | 4,998 | 4,956 | 4,811 | 4,918 | 5,331 | 4 |
| Małopolskie | 0,169 | 0,220 | 0,238 | 0,249 | 0,268 | 0,219 | 0,226 | 0,241 | 0,229 | 12 |
| Śląskie | 0,177 | 0,177 | 0,192 | 0,176 | 0,180 | 0,151 | 0,142 | 0,152 | 0,169 | 16 |
| Lubelskie | 0,048 | 0,043 | 0,047 | 0,043 | 0,041 | 0,038 | 0,031 | 0,036 | 0,041 | 38 |
| Podkarpackie | 0,030 | 0,029 | 0,049 | 0,075 | 0,076 | 0,082 | 0,071 | 0,069 | 0,060 | 30 |
| Świętokrzyskie | 0,026 | 0,020 | 0,021 | 0,021 | 0,019 | 0,017 | 0,016 | 0,015 | 0,019 | 44 |
| Podlaskie | 0,022 | 0,020 | 0,021 | 0,019 | 0,019 | 0,016 | 0,016 | 0,013 | 0,018 | 45 |
| Wielkopolskie | 0,156 | 0,152 | 0,185 | 0,195 | 0,203 | 0,190 | 0,207 | 0,157 | 0,181 | 15 |
| Zachodniopomorskie | 0,052 | 0,048 | 0,047 | 0,055 | 0,053 | 0,046 | 0,041 | 0,039 | 0,048 | 36 |
| Lubuskie | 0,027 | 0,024 | 0,025 | 0,022 | 0,023 | 0,019 | 0,018 | 0,017 | 0,022 | 42 |
| Dolnośląskie | 0,098 | 0,092 | 0,106 | 0,112 | 0,134 | 0,130 | 0,128 | 0,143 | 0,118 | 20 |
| Opolskie | 0,016 | 0,014 | 0,014 | 0,011 | 0,012 | 0,009 | 0,008 | 0,007 | 0,011 | 46 |
| Kujawsko-Pomorskie | 0,044 | 0,038 | 0,043 | 0,041 | 0,038 | 0,031 | 0,025 | 0,024 | 0,035 | 39 |
| Warmińsko-Mazurskie | 0,035 | 0,024 | 0,025 | 0,025 | 0,023 | 0,020 | 0,019 | 0,018 | 0,024 | 40 |
| Pomorskie | 0,234 | 0,239 | 0,225 | 0,202 | 0,198 | 0,166 | 0,174 | 0,187 | 0,203 | 14 |
| Slovenia | | | | | | | | | | |
| Vzhodna Slovenija | 0,305 | 0,299 | 0,295 | 0,328 | 0,338 | 0,358 | 0,373 | 0,368 | 0,333 | 11 |
| Zahodna Slovenija | 4,735 | 4,801 | 4,805 | 4,702 | 4,488 | 4,663 | 4,660 | 4,932 | 4,723 | 5 |
| Slovakia | | | | | | | | | | |
| Bratislavský kraj | 1,464 | 1,793 | 1,952 | 1,947 | 2,146 | 2,008 | 1,780 | 1,820 | 1,864 | 6 |
| Západné Slovensko | 0,717 | 0,644 | 0,678 | 0,742 | 0,842 | 0,674 | 0,728 | 0,842 | 0,733 | 9 |
| Stredné Slovensko | 0,808 | 0,758 | 0,747 | 0,698 | 0,938 | 0,941 | 0,928 | 1,068 | 0,861 | 8 |
| Východné Slovensko | 1,035 | 0,950 | 0,965 | 0,858 | 1,007 | 1,126 | 1,225 | 1,161 | 1,041 | 7 |

The values of localization index make regional sectoral concentration more accurate in the context of the level of population density. These values are shown in Table 3 and are supplemented by graphs for each country. The regions with an index higher than 1 (regions with capital cities) are characterized by the over-proportional representation of the ICT activities, and vice versa. From this point of view, the ICT sector was on average the lowest in Central Bohemia and Central Moravia in the Czech Republic, Észak-Magyarország and Észak-Alföld in Hungary, Niederösterreich and Burgenland in Austria, Opolskie and Podlaskie in Poland, Vzhodna Slovenija in Slovenia and Western Slovakia in Slovakia. For these regions, under-proportional representation of ICT activities is typical compared to the nationwide situation

Table 3. Values of Localisation index, 2005 – 2012, average, graphs, NUTS2 in V4+

| GEO/TIME | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Average |
|---------------------|-------|-------|-------|-------|-------|-------|-------|-------|---------|
| Czech Republic | | | | | | | | | |
| Praha | 5,118 | 5,357 | 5,545 | 5,131 | 4,979 | 5,053 | 5,147 | 5,070 | 5,175 |
| Střední Čechy | 0,324 | 0,357 | 0,328 | 0,386 | 0,352 | 0,296 | 0,274 | 0,269 | 0,323 |
| Jihozápad | 0,566 | 0,535 | 0,441 | 0,430 | 0,416 | 0,399 | 0,392 | 0,347 | 0,441 |
| Severozápad | 0,421 | 0,365 | 0,324 | 0,430 | 0,435 | 0,425 | 0,383 | 0,384 | 0,396 |
| Severovýchod | 0,503 | 0,460 | 0,434 | 0,531 | 0,548 | 0,536 | 0,513 | 0,493 | 0,502 |
| Jihovýchod | 0,596 | 0,568 | 0,591 | 0,647 | 0,704 | 0,704 | 0,713 | 0,797 | 0,665 |
| Střední Morava | 0,345 | 0,291 | 0,313 | 0,267 | 0,293 | 0,276 | 0,246 | 0,267 | 0,287 |
| Moravskoslezsko | 0,483 | 0,428 | 0,380 | 0,445 | 0,479 | 0,486 | 0,493 | 0,490 | 0,461 |
| Hungary | | | | | | | | | |
| Közép-Magyarország | 2,666 | 2,654 | 2,644 | 2,642 | 2,873 | 2,828 | 2,775 | 2,792 | 2,734 |
| Közép-Dunántúl | 0,350 | 0,355 | 0,336 | 0,306 | 0,223 | 0,218 | 0,238 | 0,244 | 0,284 |
| Nyugat-Dunántúl | 0,437 | 0,491 | 0,478 | 0,468 | 0,309 | 0,313 | 0,333 | 0,312 | 0,392 |
| Dél-Dunántúl | 0,378 | 0,375 | 0,383 | 0,382 | 0,289 | 0,294 | 0,261 | 0,256 | 0,327 |
| Észak-Magyarország | 0,290 | 0,283 | 0,279 | 0,264 | 0,168 | 0,171 | 0,192 | 0,170 | 0,227 |
| Észak-Alföld | 0,290 | 0,278 | 0,295 | 0,293 | 0,207 | 0,223 | 0,238 | 0,241 | 0,258 |
| Dél-Alföld | 0,379 | 0,346 | 0,336 | 0,334 | 0,211 | 0,226 | 0,247 | 0,267 | 0,293 |
| Austria | | | | | | | | | |
| Burgenland (AT) | 0,381 | 0,393 | 0,378 | 0,328 | 0,300 | 0,320 | 0,354 | 0,344 | 0,350 |
| Niederösterreich | 0,287 | 0,294 | 0,293 | 0,307 | 0,312 | 0,316 | 0,315 | 0,324 | 0,306 |
| Wien | 3,490 | 3,409 | 3,354 | 3,313 | 3,285 | 3,234 | 3,160 | 3,047 | 3,287 |
| Kärnten | 0,362 | 0,440 | 0,447 | 0,450 | 0,438 | 0,437 | 0,454 | 0,418 | 0,431 |
| Steiermark | 0,383 | 0,382 | 0,419 | 0,418 | 0,426 | 0,430 | 0,440 | 0,469 | 0,421 |
| Oberösterreich | 0,468 | 0,491 | 0,496 | 0,498 | 0,518 | 0,546 | 0,581 | 0,627 | 0,528 |
| Salzburg | 0,450 | 0,469 | 0,522 | 0,536 | 0,533 | 0,590 | 0,632 | 0,781 | 0,564 |
| Tirol | 0,374 | 0,389 | 0,386 | 0,425 | 0,440 | 0,426 | 0,426 | 0,437 | 0,413 |
| Vorarlberg | 0,396 | 0,379 | 0,401 | 0,419 | 0,414 | 0,402 | 0,399 | 0,383 | 0,399 |
| Poland | | | | | | | | | |
| Łódzkie | 0,420 | 0,414 | 0,455 | 0,441 | 0,438 | 0,441 | 0,427 | 0,425 | 0,433 |
| Mazowieckie | 4,077 | 4,022 | 3,789 | 3,823 | 3,729 | 3,830 | 3,817 | 3,842 | 3,866 |
| Malopolskie | 0,631 | 0,742 | 0,779 | 0,785 | 0,820 | 0,758 | 0,784 | 0,801 | 0,763 |
| Slaskie | 0,594 | 0,603 | 0,638 | 0,606 | 0,618 | 0,586 | 0,580 | 0,592 | 0,602 |
| Lubelskie | 0,366 | 0,351 | 0,376 | 0,357 | 0,350 | 0,347 | 0,316 | 0,341 | 0,351 |
| Podkarpackie | 0,300 | 0,302 | 0,394 | 0,480 | 0,486 | 0,521 | 0,493 | 0,481 | 0,432 |
| Swietokrzyskie | 0,367 | 0,336 | 0,351 | 0,346 | 0,327 | 0,318 | 0,310 | 0,301 | 0,332 |
| Podlaskie | 0,345 | 0,332 | 0,346 | 0,328 | 0,333 | 0,317 | 0,319 | 0,288 | 0,326 |
| Wielkopolskie | 0,659 | 0,661 | 0,736 | 0,741 | 0,774 | 0,757 | 0,801 | 0,695 | 0,728 |
| Zachodniopomorskie | 0,490 | 0,483 | 0,479 | 0,513 | 0,505 | 0,478 | 0,455 | 0,438 | 0,480 |
| Lubuskie | 0,456 | 0,444 | 0,453 | 0,417 | 0,421 | 0,398 | 0,384 | 0,369 | 0,418 |
| Dolnoslaskie | 0,550 | 0,559 | 0,611 | 0,617 | 0,688 | 0,706 | 0,716 | 0,748 | 0,649 |
| Opolskie | 0,328 | 0,311 | 0,320 | 0,293 | 0,292 | 0,270 | 0,261 | 0,241 | 0,290 |
| Kujawsko-Pomorskie | 0,398 | 0,379 | 0,409 | 0,395 | 0,376 | 0,348 | 0,317 | 0,304 | 0,366 |
| Warmińsko-Mazurskie | 0,403 | 0,337 | 0,346 | 0,342 | 0,335 | 0,318 | 0,312 | 0,305 | 0,337 |
| Pomorskie | 0,957 | 0,988 | 0,972 | 0,890 | 0,905 | 0,836 | 0,867 | 0,901 | 0,914 |
| Slovenia | | | | | | | | | |
| Vzhodna Slovenija | 0,343 | 0,337 | 0,335 | 0,354 | 0,364 | 0,369 | 0,379 | 0,368 | 0,356 |
| Zahodna Slovenija | 1,770 | 1,774 | 1,773 | 1,743 | 1,723 | 1,711 | 1,697 | 1,705 | 1,737 |
| Slovakia | | | | | | | | | |
| Bratislavský kraj | 2,898 | 3,147 | 3,243 | 3,233 | 3,225 | 3,176 | 2,985 | 2,887 | 3,099 |
| Západné Slovensko | 0,708 | 0,688 | 0,685 | 0,718 | 0,698 | 0,641 | 0,676 | 0,708 | 0,690 |
| Stredné Slovensko | 0,796 | 0,772 | 0,756 | 0,748 | 0,793 | 0,822 | 0,807 | 0,844 | 0,792 |
| Východné Slovensko | 0,804 | 0,755 | 0,737 | 0,709 | 0,694 | 0,750 | 0,792 | 0,753 | 0,749 |



Conclusions

This article deals with the analysis of territorial concentration and regional sectoral specialization in NUTS2 region of V4+ countries between years 2005-2012. 4(6) statistical measures were applied to define specialization and concentration in particular regions.

The major findings of this analysis were that the ICT activities that form the ICT economic sector tend to concentrate into one specific region in all the respective countries. It is typical for these regions that they are the capitals of the country. The level of concentration in these regions is rather unchanged. ICT strengthened slightly in Hungary and Slovakia during the analyzed period of time, in other regions (capitals of the country) weakened moderately. The region most specialized in ICT activities was Praha (Czech Republic), the least specialized regions from a V4+ group of countries, in the economic branch of ICT, were regions Tirol, Vorarlberg, Eszák-Magyarország, Opolskie a Kujawsko-Pomorsie. Moreover, the representation of ICT within the regions is significantly disproportionate (except Slovakia), with a gradual tendency to become more concentrated in a few particular regions within each country. The ability of countries to be in a certain economic activity better than others is a source of competitive advantage and further development. Therefore it is appropriate to increase the concentration of economic sectors in these economies.

The results of the presented analysis are (might be) the groundwork for a further research on the importance and role of sectoral concentration and specialization exceeding the regional economic level and development.

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