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**Regional Specialisation and Sectoral
Concentration in an Enlarged EU**

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Regional Specialisation and Sectoral Concentration in an Enlarged EU: A comprehensive updated overview

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Abstract

Economic theories, be it (new) trade, (new) growth or (new) economic geography are far from being able to describe and explain regional concentration of sectors or sectoral specialisation of regions. Consequently, empirical work should shed more light on these developments in incumbent EU member states and Central and Eastern Europe.

Our analysis aims at providing a comprehensive overview over concentration and specialisation developments in the EU including both the enlargement process and the first impacts of the economic crisis. Data include all EU member states, various sectoral breakdowns for all sectors, different indicators for economic activity, various levels of regional disaggregation and spanning from 1995 to 2010. Measures used include relative and absolute indicators for concentration and specialisation.

Findings confirm that on an aggregated level specialisation and concentration are changing only gradually. While this holds true for the impact of EU enlargement, it even holds true for the impact of the economic crisis up to 2010. A more detailed analysis, however, reveals interesting results. While relative employment specialization decreases in EU Member States, relative production specialization (based on GVA) increases marginally over the observed time period. Sector developments are diverse and depend on the used economic variable, the regional level and the sectoral disaggregation. An overall concentration or de-concentration trend cannot be observed.

Findings also confirm that it is crucial to perform a comprehensive analysis. Results based only on one indicator or on one dataset with one economic variable, one sectoral and regional disaggregation might obstruct important developments.

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1 Introduction

Political enlargement has increased the diversity of the regional economic structure in the EU with diverse 27 member states. While this is only a statistical artefact, more interesting is what effect enlargement has on both incumbent member states (EU15) and central and eastern European (CEE) economies. In addition, the economic and financial crisis from 2008 is an economic shock, reshaping the economic landscape in Europe with plummeting production and employment in some sectors and regions. These academically fascinating questions also have political implications, especially for national and European regional policy.

Economic theories are far from being able to explain or even predict specialisation and concentration patterns. The various models from (new) trade, (new) growth and (new) economic geography come to different conclusions, depending on their assumptions, a possible change of simulation parameters in time, mobility patterns, transaction costs and the extent to which variables are endogenous. Consequently, empirical work should shed some more light on the European economic landscape.

The empirical literature provides a rich source of evidence of both – concentration and specialisation patterns in Europe, but results are pointing in different directions. This is due to differences in indicators, regional definitions, sectoral disaggregations and the available time span.

The aim of this paper is twofold: First, the descriptive analysis gives an overview of specialisation and concentration trends, using common indicators on different regional scales, on the basis of different economic variables and sector classifications. This allows a comparison with other empirical studies. It should be highlighted that all datasets include all current EU member states and the full range of economic activity, including primary, secondary and tertiary sectors. The use of the Structural Business Statistics, provided by Eurostat, even allows a relatively deep sectoral disaggregation of 34 sectors for analysing the employment structure in EU15 regions and 29 sectors for CEE regions.

Second, the extended time horizon with data up to 2010 offers insights into the impact of EU enlargement and even allows a first preliminary view on structural processes during the financial and economic crisis.

Data availability restricts the analysis to start in 1995 when the new sectoral classification ESA 1995 (European system of national and regional accounts 1995), giving more weight to services sectors was introduced.

The outline of the paper is the following: The main empirical results for concentration and specialisation in earlier empirical studies are briefly summarized in section 2. The indicators and measures applied here, as well as our data are explained in section 3. Data include all EU member states, various sectoral breakdowns for all sectors, different indicators for economic activity, various levels of regional disaggregation and partially spanning from 1995 to 2010. Measures used cover relative and absolute indicators for concentration and specialisation. Based on these new data, section 4 presents the empirical results. Section 5 concludes.

2 Review of empirical literature

In economic literature a number of studies analysing regional specialisation and sectoral concentration of European regions¹. These studies vary in many respects:

- Unit of investigation: NUTS0, NUTS1, NUTS2 regions, depending on data availability,
- Type of index: relative vs. absolute,
- In case of a relative measure the geographical benchmark distribution: country vs. Europe (in different compositions: EU12, EU15 etc.) or other,
- Sectors included: only manufacturing vs. inclusion of all sectors at various sectoral disaggregation levels,
- Economic variable: production (employment, gross value added, gross value of output), trade (imports / exports), investment (gross fixed capital formation, foreign direct investment),
- Regions included: Traditional EU member states, Newly Acceded member states, regions of Western European Countries etc.

These different approaches assessing the regional pattern of local economic activity make it difficult to compare the existing empirical evidence. For the literature overview we are only concentrating on studies which analyse more than one European member state and preferably include total economic activity.

Regional specialisation in former EU member states: As can be seen in table A1 most of the reviewed papers are focusing on the traditional EU member states and consider time periods

¹ For a short overview, see table 1.

up to 2003. Although the studies differ methodologically and include different disaggregation of sectors and regions two stylized facts can be inferred:

- i. The change in the regional economic structure in terms of regional specialisation is very slow.
- ii. Relative specialisation is either stable or shows a rather decreasing trend.

Taking a closer look at a combined measure of specialisation and concentration, the polarization measure as used by Krieger-Boden and Traistaru-Siedschlag (2008)², the authors find a trend break in the 90s. Following their analysis, relative polarization came to a halt in the old member states and the absolute measure even increased.³

Sectoral concentration in incumbent EU member states: The development of the structural pattern of sectors is not as clear as the economic structure of regions. Concentration patterns vary considerably across sectors and aggregation level as predicted by theory. Overall relative concentration seems to have increased which might be mainly driven by the manufacturing sector. However, Brülhart and Traeger (2005) detect a declining measure of “topographic” concentration in production in manufacturing, which relates the concentration of the sector to the physical space. They interpret their result as a shift from regions with high employment density to regions with low employment density. Duboz et al. (2009) repeating the analysis with employment data and including all economic activities show that concentration relative to the employment structure in manufacturing sectors especially increased after 1993. This could be due to the “Single-Market” effect, facilitating the concentration of manufacturing activities, but not all manufacturing sectors exhibit the same concentration trends, as e.g. Hallet (2000) and Cutrini (2010) demonstrate in their analysis. While high-tech industries (Cutrini) or industries with tradeable goods (Hallet) increased in concentration, low-tech industries rather showed a declining trend.

However, other studies find rather stable or declining concentration patterns. Bickenbach et al. (2010) argue that this trend might be related to the structural change from agriculture and manufacturing as rather concentrated sectors towards the service sectors which are more dispersed.

The empirical analysis of the production structure in new EU member states is still under development and few studies are going beyond individual countries.

² The polarization measure is a combination of the concentration and specialisation indicator as proposed by Bickenbach and Bode (2006). The index values are weighted by the reference employment shares (Krieger-Boden and Traistaru-Siedschlag, 2008).

³ Bickenbach et al. (2010a) clarify this structural break in more detail in their stylized fact 8.

Regional specialisation in new EU member states (CEE): To the authors' knowledge only two studies analyse regional specialisation for most of the new EU member states on NUTS2 level with data up to 2003 (Krieger-Boden et al., 2008, Von Schütz and Stierle (2003). Although using different basic economic variables, different sector disaggregations and indices, both find a decreasing trend in overall relative specialisation or polarization (Krieger-Boden et al., 2008) for the new member states, which could be interpreted as a tendency to converge to the economic structure of the EU15. Landesmann (2003) shows similar developments in his analysis of national trade structure in manufacturing at 3-digit NACE level. He finds that at the beginning of the transition process the CEE specialised according to the prediction of inter-industry trade theories. During the first ten transition years manufacturing exports changed in most of the observed countries to more technology intensive and high-skill intensive products, especially in Hungary, Estonia, Poland, the Czech and Slovak Republics. A similar convergence trend in production structures could be observed. In contrast, Romania, Bulgaria and Latvia specialised in rather labour-intensive exports.

The different development in the new member states is replicated in other studies. Kallioras and Petrakos (2010) detect comparable differences between new EU member states when taking a closer look at NUTS3 regions in five of the new member states. They calculate an index of dissimilarity and show that the difference in regional manufacturing with the EU15 decreases in Slovenia, Hungary and Estonia, i.e. these countries are converging to the EU15, while dissimilarity rises in Bulgaria and Romania between 1990 and 2000. Traistaru et al., (2002), using the same dataset, show that regional specialisation increased for Bulgaria and Romania, while specialisation decreased in Estonia. No significant changes could be observed for Hungary and Slovenia.

Sectoral concentration in new EU member states: The studies on industrial concentration in the new EU member states describe a rather mixed picture. Depending on the weight of the concentration indicator, agriculture is either the most (relative to overall employment) or the least (relative to space) concentrated sector in the new EU member states. Nevertheless, the sector seems to concentrate increasingly in low income and peripheral regions (von Schütz and Stierle, 2003, Duboz et al., 2009, Bickenbach et al., 2010a). The overall manufacturing sector shows lower concentration compared with the EU15 (von Schütz and Stierle, 2003, Mora et al., 2004) and is rather stable (Bickenbach et al., 2010a). The latter is due to the fact that opposing trends within one sector can be observed depending on the sub-sector classification in terms of technology intensity or capital use. While mining and quarrying activities

decrease substantially in their concentration measures, electronic industries and manufacturing of transport equipment concentrated considerably (Duboz et al. 2009, Bickenbach et al., 2010a). Concerning the tertiary sector, the market service sectors are more concentrated than the non-market sectors and especially the financial sectors shows increasing concentration trends (von Schütz, 2003, Duboz et al. 2009).

The literature review shows that results of different studies might come to different conclusions about the development of regional specialisation and sectoral concentration trends in old and new EU member states. This is mainly due to different classifications of sectors and regions used and the calculation of diverse indicators. The studies described so far included data up to 2004. That means that the period after the Central and Eastern European countries joined the EU has not yet been analysed. In addition, the financial and economic crisis starting in 2008 and the following adjustment process might have induced a dynamic of structural change. In order to analyse these trends this paper uses most recent available data for old and new EU member states.

Table 1: Literature overview: empirical studies on specialisation and concentration in EU countries

Authors	Regions	Years	Sectors	Indicator	Economic variable	Main results
Spezialisation						
Hallet (2000)	EU15 NUTS2	1980-1995	17 sectors	Dissimilarity index	GVA	decreasing relative specialisation
Mora et al (2004)	EU12 and EU15	1985-2001	17 sectors	Gini-Index, Polarization index, kernel density functions	No information provided (Employment?)	nearly no change on average, however, change is more pronounced for peripheral and southern regions
Brakman et al. (2005)	EU15 NUTS1/2	1980-1995	17 sectors	Entropy indices, Moran's I	GVA	increasing absolute specialisation, decreasing relative specialisation
Ezcurra et al. (2006)	EU15 NUTS2	1977-1999	17 sectors	Krugman specialisation index	No clear information provided	decrease in relative specialisation
Krieger-Boden et al. (2008)	EU15 NUTS2	1980-2003	15 sectors	Polarisation on basis of Theil index	Employment	decrease in polarization during the 80s, slower process or even reverse from the 1990s
Cutrini (2010)	EU10 NUTS2	1985-2001	12 manufacturing sectors	Theil index	Employment	decreasing locatization measure, decreasing or stable specialisation
Bickenbach et al. (2010a)	EU15 NUTS2	1980-2003	15 industries	Theil	Employment	decreasing relative specialisation
Traistaru et al. (2002)	CEE5 NUTS3	1990-1999	Manufacturing sectors	Krugman index (Dissimilarity index)	Employment	decrease in relative specialisation in Estonia, increase in relative specialisation in Romania and Bulgaria, no change in Hungary and Slovenia
Fotopoulos et al. (2003)	CEE 5, NUTS3 and country	1990-1999	3 overall sectors, 14 manufacturing	Theil	Employment	structural change more pronounced in countries at "intermediate" development level
Mora et al (2004)	CEE12	1995	9 sectors	No information provided (Gini-coefficient?)	No information provided (employment?)	increasing inequality and polarization
Kallioras and Petrakos (2010)	CEE5 NUTS3	1991-2000	NACE 2 digit industry sectors	Index of dissimilarity of industrial structures	Employment	Bulgaria & Romania increased dissimilarity, Slovenia, Hungary and Estonia rather converged to the EU15 structures
von Schütz and Stierle (2003)	EU27 NUTS2	1995-2000	15 sectors	Krugman index	GVA	decrease in relative specialisation
Krieger-Boden et al. (2008)	EU25 NUTS2	1993-2003	15 sectors	Polarisation on basis of Theil index	Employment	decrease in polarization in new member states within component shows that change in specialisation pattern occurs within regions and between bigger industries

Authors	Regions	Years	Sectors	Indicator	Economic variable	Main results
Concentration						
Hallet (2000)	EU15 NUTS2	1980-1995	17 sectors	CV, different measures taking location, income weights into account	GVA	stability in the 80s, slight increase in the 90s in concentration measure, agriculture dispersed, traded goods concentrated, non-traded goods dispersed
von Schütz and Stierle (2003)	EU14	1995-2000	15 sectors	Coefficient of Variation, different measures taking location, income weights into account	GVA	agriculture most dispersed sector in geographic terms, manufacturing above average concentrated, construction, electricity and water supply rather dispersed, no major changes in concentration pattern
Barrios and Strobl (2004)	EU15, NUTS3	1980-1995	17 sectors	Dumais (comparable with Krugman specialisation index)	GVA	slight increase in concentration for overall measure, more pronounced for manufacturing
Mora et al (2004)	EU12 and EU15	1985, 1995	17 sectors	No information provided (Gini-Coefficient?)	No information provided (employment?)	increasing concentration (4 out of 17 industries experienced lower concentration)
Brühlhart and Traeger (2005)	EU15 NUTS1/2	1980-1995	9 manufact. sectors	Theil	GVA	increased relative concentration during the 80s, but less topographic concentration
Brakman et al. (2005)	EU15 NUTS1/2	1980-1995	17 sectors	Entropy indices, Moran's I	GVA	stable absolute concentration, but decreasing relative concentration
Duboz et al. (2009)	EU15 NUTS2	1980-2004	15 sectors	Theil	Employment	agriculture most concentrated sector, together with textile manufacturing, manufacturing industries show increasing concentration, service sector and agriculture decreasing trend (this trend is highly influenced by the time periode after the opening of the single Market)
Cutrini (2010)	EU10	1985-2001	12 manufacturing sectors	Theil index	Employment	localization measure per high-tech and low-tech industry shows that high-tech industry tends to more agglomeration since the early 1990s overall sectors concentration declined
Bickenbach et al. (2010a)	EU15 NUTS2	1980-2003	15 sectors	Theil Index	Employment	decreasing relative concentration of industries, structural change from agriculture and manufacturing to service industry (which is more dispersed), manufacturing more concentrated
Brühlhart and Traeger (2005)	WE17 (NUTS2 and NUTS3)	1975-2000	8 sectors	Entropy measure (Theil index)	Employment	Increase in concentration of the manufacturing sector, services remain stable over the period (transport and communication services became less concentrated)

Authors	Regions	Years	Sectors	Indicator	Economic variable	Main results
Traistaru et al. (2002)	CEE5 NUTS3	1990-1999	Manufacturing sectors	Krugman index (Dissimilarity index)	Employment	no significant change in concentration of manufacturing sectors (except for Bulgaria with slight increase), classification of industries following technology level, economies of scale and wage level - results mixed for countries, but convergence tendencies between sectors
Stierle and von Schütz (2003)	CEE9	1995-2000	15 sectors	Coefficient of Variation, different measures taking location, income weights etc. into account	GVA	Agriculture most dispersed sector, concentrated in low income and peripheral regions, Mining and quarrying most concentrated sector but decreasing; services highly concentrated in high income regions, decline in concentration of almost all sectors
Mora et al (2004)	CEE12	1995	9 sectors	No information provided (Gini-Coefficient?)	No information provided (employment?)	high concentration in agriculture, fuel and power products, services of credit and insurance institutions, low concentration in manufactured products, construction and non-market services
Krieger-Boden et al. (2008)	EU25	1993-2003	15 sectors	Polarisation on basis of Theil index	Employment	higher concentration for market services, agriculture and manufacturing than for construction and public services, but rather constant over time
Duboz et al. (2009)	CEE8 NUTS2	1990-2004	15 sectors	Theil	Employment	Agriculture most concentrated sector with increasing concentration pattern, mining and quarrying and energy production second concentrated at the beginning, but then decreasing substantially, most of the service sectors deconcentrating, except Financial Services and non-market services

3 Data and measures

3.1 Data

For the analysis we use various data sets ranging from 1995 to 2010, covering in most cases all 27 EU member states (see Table 1). All economic sectors are included, reflecting the increased importance of services. We use both GVA and employment data. Data source is always the regional data base (REGIO) of Eurostat, partly complemented by national sources.¹

Table 2: Overview over data sets

Area	Regions	Sectors	Time	Data source
Employment data				
EU27	NUTS2 & NUTS3	6 (NACE Rev.1)	1996-2008	Branch Accounts (E-BA)
EU27	NUTS2	6 (NACE Rev.1)	1999-2008	Labour Force Statistics (E-LFS1)
EU27	NUTS2	10 (NACE Rev.2)	2008-2010	Labour Force Statistics (E-LFS2)
EU15	NUTS2	34 (NACE Rev.1)	1995-2007	Structural Business Statistics supplemented by Branch Accounts and national data sources (E-SBS)
CEE (excl. Bulgaria and Malta)	NUTS2	29 (NACE Rev.1)	2002-2007	Structural Business Statistics supplemented by Branch Accounts and national sources (E-SBS)
Gross value added (GVA)				
EU27	NUTS2 & NUTS3	6 (NACE Rev.1)	1995-2008	Branch Accounts (BA)

The sectoral breakdown varies from 6 to 34 sectors, the regional breakdown ranges from 271 NUTS2 regions to 1303 NUTS3 regions. The literature review showed that most regional analysis is done on NUTS2 level. Weaknesses of the use of this regional level lie in the fact that these administrative regions do not necessarily reflect economic flows and that for international comparisons there could be systematic differences in regional delineation between countries. Consequently, results could be influenced by the chosen regional delineation, which is known as the “Modifiable Areal Unit Problem” or MAUP (ESPON, 2006). In order

¹ Data gaps were closed as carefully as possible using e.g. the growth rate of the NUTS2 region if a further breakdown for NUTS3 was not available. However, especially where data gaps were significant, this approach can lead to an underestimation of specialisation and concentration. Gaps were especially significant in the case of branch accounts for employment up to 1999. Structural Business Statistics were supplemented by branch account data and national statistics.

to control for different zoning levels, we calculated the indicators, if possible, on different spatial scale – NUTS3-, NUTS2- and NUTS1-level.

A similar problem arises with the disaggregation of sectors. In some data sets economic activity is broken down only into 6 or 10 sectors and industry is not disaggregated. This might hide heterogeneous developments in specific sub-sectors or cannot show regional concentration of specific sub-sectors. However, these data allow for a more comprehensive overview of the entire economic activity instead of focussing on manufacturing which represents on average only 20% of production in the enlarged EU, contrasting to more than 70% for services. Moreover, despite their – though increasing – still limited tradability, services are more and more part of international production chains as becomes clear e.g. by FDI data. Services account for more than half of global FDI stocks, despite having been hit particularly hard by the economic crisis (UNCTAD, various years). Consequently, limiting the analysis of specialisation and concentration to manufacturing, as frequently done, leaves aside main parts of regional and also international economic transactions.

The use of GVA versus employment data has both pro and cons². The use of GVA encompasses several advantages:

- i) differences in labour productivity within and between regions are accounted for³,
- ii) employment definitions still vary internationally,
- iii) flexible employment schemes, which become increasingly important, make comparisons difficult,
- iv) employment data are more directly influenced by public policy like labour protection laws etc.,
- v) origin of data (e.g. firm-level vs. branch accounts) might influence data reliability.

However, GVA data also have disadvantages like the need to convert them into one currency. Possible misalignments of exchange rates are one major disadvantage of operating with GVA data (Brühlhart and Traeger, 2005).

In order to be able to compare results from both economic indicators, we thus compute all indicators for both GVA and employment.

² See e.g. Aiginger and Leitner (2002), von Schütz (2003) and Brühlhart and Traeger (2005).

³ The emerging problem is twofold: first, employees are counted with equal weights although the economic value they are producing could be highly different. This is especially relevant when analysing diverse economies. Second, structural characteristics of labour markets and labour market rigidities could influence the employment structure in countries to a varying extent.

3.2 Measures for specialisation and concentration

In empirical literature various indicators are used for sectoral specialisation of regions and regional concentration of sectors. All indicators have advantages and shortcomings.⁴ To obtain results that can easily be compared with other studies we apply several commonly used indicators. In the following brief description of these indicators, for simplification we partly refer to sectoral specialisation of regions and to GVA. However, all indicators can and will *mutans mutandis* be applied for measuring regional concentration of sectors and using employment data as well.

We compute both relative and absolute measures. Specialisation in *relative* terms should reveal how much the production structure in one region differs from the average of a given set of regions. Similarly, relative geographic concentration measures the spatial distribution of economic activities of a given sector, also related to a benchmark distribution. A sector is said to be concentrated if it primarily operates in few regions (WIFO, 1999).

When calculating relative measures, we compute the indicators relative to different country sets in order to sketch out distinct developments. The first set covers the entire EU27, the second and third regional sets contain the EU15 and CEE separately. Because of the ongoing process of transition and consequent substantial changes of production structures, we expect more dynamic changes in these regions. In order to arrive at an index for entire sets of regions we sum-up the regional indices weighted by their share in employment or GVA, depending on the economic variable.

For our analysis of relative regional specialisation we use two different indicators. The first one is the *dissimilarity index D*. This indicator is one of the most commonly applied indicators for regional specialisation, reused e.g. by Krugman (1991):

$$(1) \quad D_j = \frac{1}{2} \sum_{i=1}^I |x_{ij} - \bar{x}_{i\cdot}|.$$

For each branch i in a region j the absolute values of the differences of sectoral shares between region j and the average of all regions ($\bar{x}_{i\cdot}$) are summed up. In contrast to *Krugman* we divide the result by 2. Therewith, the index will take the value zero when no specialisation can be observed, i. e. the production structure does not differ from the average of all regions, and it will take the value 1 if full specialisation exists.

⁴ For overviews see for example Amiti (1997), Krieger-Boden (1999), WIFO (1999), von Schütz and Stierle (2003), Bode et al. (2005), Combes and Overman (2004) or Brühlhart and Traeger (2005).

The dissimilarity index offers the advantage that it can be relatively easily interpreted. It also has been applied in several empirical studies so that our results can be compared with other findings. Moreover, outliers do not influence the values as much as it is the case for other indicators.

Besides the dissimilarity index the Theil-index has been used more and more in recent studies. For our analysis we use the weighted Theil-index calculated as follows:

$$(2) \quad T_j = \sum_{i=1}^I x_{ij} \ln \left(\frac{x_{ij}}{x_{i\bar{j}}} \right).$$

Among the advantages are its property to downgrade outliers and the possibility to decompose it into a “between” and “within” component. It can e.g. be analysed if a particular result for specialisation in a specific region is rather due to the fact that the region is part of a specific country (e.g. Poland) or group of countries (like the new member states) or if its due to developments of this particular region. However, while the lower band is 0 for an equal distribution, one of the disadvantages of the weighted Theil-index is that the results of different studies are not comparable as the upper band is not a specific number like 1 or 2 as in the case of the dissimilarity index.⁵

Among those indicators available for measuring *absolute* specialisation like the Gini-coefficient, standard deviation of the corresponding shares or the concentration ratio, we have chosen the *Herfindahl-Index H*. This index sums up the squared employment or GVA shares x_{ij} of each sector i in a region j .⁶ Values range from the lower bound $1/I$ for equal distribution to 1 for total specialisation.

$$(3) \quad H_j = \sum_{i=1}^I (x_{ij})^2.$$

The Herfindahl-Index has two main shortcomings: a result of $1/I$, i.e. an equal (and constant) distribution would rather be a statistical artefact and economically not desirable. Conventional statistical classifications like ISIC or NACE are not aiming at distinguishing between sectors that are equal in size. Therefore, the implicit assumption of the Herfindahl-Index of equal distribution cannot be reached. Therefore, the importance of the Herfindahl index lies rather in its development than in its level.

Similarly, even if the classifications would be agreed on so as to have sectors equal in size, due to dynamic economic developments like diverging productivity increases and changes in

⁵ See e.g. Bode et al. (2005).

⁶ An overview on the notation is provided in table A.5 in the annex.

preferences, a static equal distribution of sectors would be suboptimal. Therefore, we do not focus on single results, we rather use this absolute measure as a control variable by comparing its overall trend with those of relative indicators.

In addition to these indicators, some disaggregated results for single sectors in particular regions will be presented based on the Location Quotient L . The Location Quotient can be calculated as the share of one region j in GVA of sector i (x_{ij}) set in relation to the average share of region j in GVA of all sectors ($x_{j\cdot}$). It can also be described as the share of one sector i in GVA of region j (x_{ji}) set in relation to the average share of sector i of all regions ($x_{\cdot j}$). L can range from 0 when the sector under investigation does not produce at all in a particular region, but it has no upper band. If $L = 1$, GVA in this sector and region follows the average distribution.

$$L_{ij} = \frac{x_{ji}}{x_{j\cdot}} = \frac{x_{ij}}{x_{\cdot j}}.$$

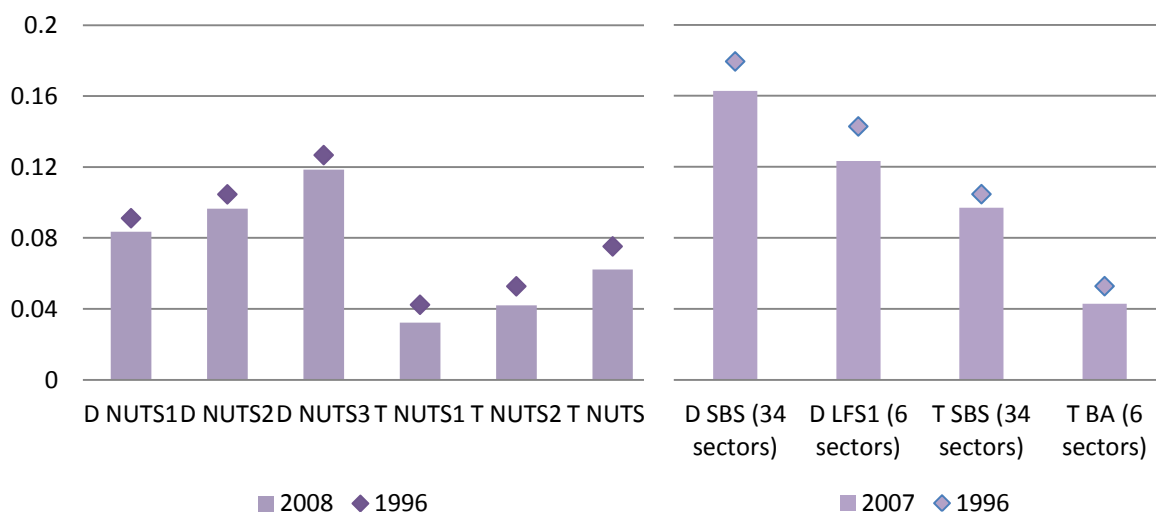
4 Specialisation and concentration developments

Since the findings for the entire EU are heavily influenced by the EU15, emphasis will be given to the description of developments in EU15 and the CEEs separately. We refer to employment specialisation when analysing employment data, while we refer to production specialisation when analysing GVA as economic variable.

We start with a rather general remark: In order to control for the MAUP, as described in data section (3.1), we calculate the indicators on different regional and sectoral levels. As expected, the more detailed the analysed data set is in terms of regions and / or sectors, the higher are the absolute values of the calculated indicators. As an example, figure 1 shows the results for the dissimilarity (D) and the Theil index (T) for employment data on different NUTS-levels and with different sector disaggregation in EU15 regions. In the graph on the left, the indicators are taken from the branch accounts (BA) with 6 sectors. The indicator values increase with a higher regional disaggregation. Similarly from a sectoral perspective, indicator values are higher when based on a more disaggregated data set. In the graph on the right, indicator values are calculated on the basis of 34 sectors from the structural business statistics (SBS) and of 6 sectors from the Labour Force Survey (LFS1) between 1996 and

2008 for NUTS2 regions. This is simply due to the fact that differences between sectors and regions are less averaged out when using a more detailed disaggregation level.

Figure 1: Relative employment specialisation in EU15 calculated at different regional level (left graph) and on the basis of different sectoral disaggregation (right graph)



In most cases, over time the development of the indicators show similar patterns on different aggregation levels. Significant exceptions will be highlighted in the following sections.

An implication of these in most cases parallel movements for different regional aggregation levels is that the possible MAUP cannot be solved automatically by simply using smaller regions. In an ideal case, functional regions should be used, which is currently not possible due to data problems.

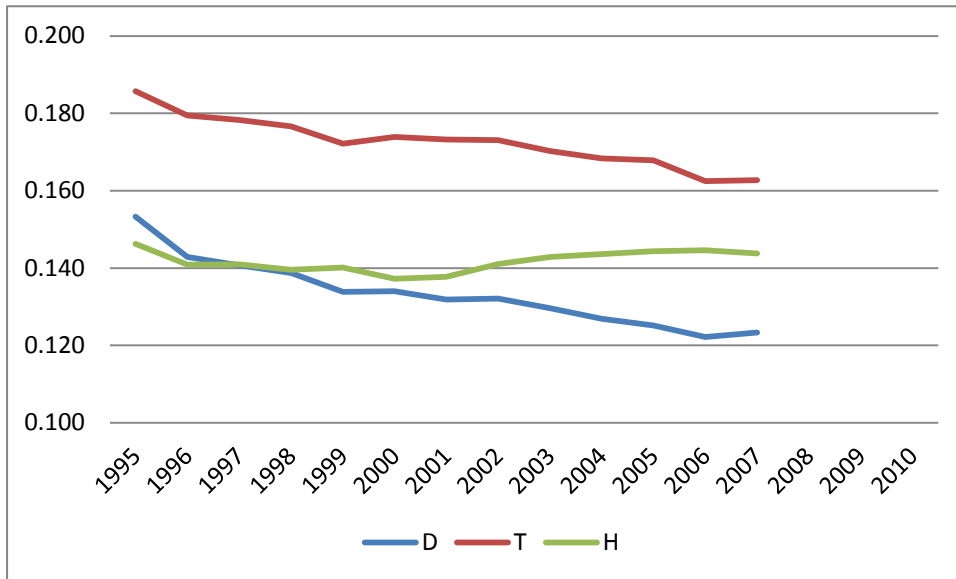
4.1 Relative and absolute specialisation

Relative and absolute specialisation in EU15

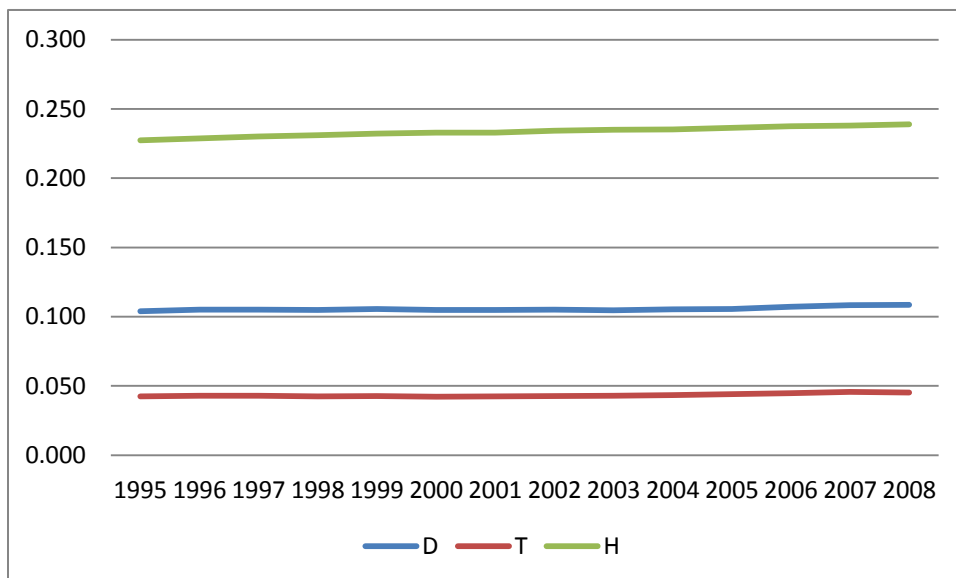
Employment specialisation in the EU15 is rather stable and shows a decreasing trend. Figure 2a) displays that irrespective of the corresponding starting level, all values of relative specialisation in the EU15 decreased between 1996 and 2007 or 2008, although the absolute value change is not very high. This could be interpreted as a very slow structural convergence trend for EU15 countries.

Considering GVA data instead of employment data, the production structure in EU15 remains nearly constant or shows a marginally increasing tendency (see Figure 2b).

Figure 2a) and b): Relative and absolute specialisation measures for NUTS2 regions in EU15, with (a) employment data from SBS and (b) GVA data from BA



(b)



With D for dissimilarity index, T for Theil index and H for Herfindahl index.

Values of absolute specialisation do not show a consistent pattern comparing data sets with varying number of included sectors and with employment or GVA data. The Herfindahl (H) index calculated for employment data in the EU27 and EU15 based on 6 to 10 sectors is relatively stable between 1996 and 2010. In contrast, absolute specialisation for employment in 34 sectors seems to decrease in the 1990s and early 2000s in the EU15, but increases again thereafter (see figure 2a). When analysing absolute specialisation based on the GVA produc-

tion structure, specialisation increases marginally in the entire period and all regions, similar to relative specialisation.

As Bickenbach et al. (2010b) point out, the development of measures of absolute specialisation are mainly influenced by the sectoral disaggregation. Absolute measures relate to the uniform distribution of sectors as the non-specialisation case. The production activities of the relative small⁷ manufacturing sector encompasses in the SBS 14 sectors, while the much larger service sector is divided into 16 sectors. Combining the effect of a shrinking manufacturing sector and growing service sector and relating these effects to the uniform distribution as non-specialisation reference, an increase in absolute specialisation is rather due to this statistical mechanisms than related to an actual economic specialisation trend (Bickenbach et al., 2010b).

When analysing the location quotient based on employment data, the least specialised regions are found in the Netherlands, France, and Finland, while highly specialised regions are located in Greece, Portugal and the UK. When analysing GVA, the least specialised regions are again spread over rather in the centre of the EU15 (Belgium, Germany, UK), while the most specialised regions are located in the Netherlands, UK, Portugal and Spain.

The following table gives an overview over the least and highest specialised regions. For the most specialised regions the sector/s in which the region is most specialised is added.

Table 3: Most and least specialised regions in EU15 in 2008

	Employment	Sector	GVA	sector
least	Denmark		East Anglia (UK)	
	Rhône-Alpes (FR)		Alsace (FR)	
	Limburg (NL)		Schleswig-Holstein (DE)	
	Etelä-Suomi (FI)		West Yorkshire (UK)	
	Herefordshire, Worcester-shire and Warwickshire (UK)		East Wales (UK)	
most	Centro (PT)	Agriculture	Groningen (NL)	Mining
	Algarve (PT)	Agriculture	Ciudad Autónoma de Ceuta y Melilla (ES)	Public services
	Greek regions (10 out of 13)	Agriculture	Inner London (UK)	Market services
	Åland (FI)	Water transport	Ionia Nisia (GR)	Transport, tourism
	Inner London (UK)	Market services	Notio Aigaio (GR)	Transport, tourism

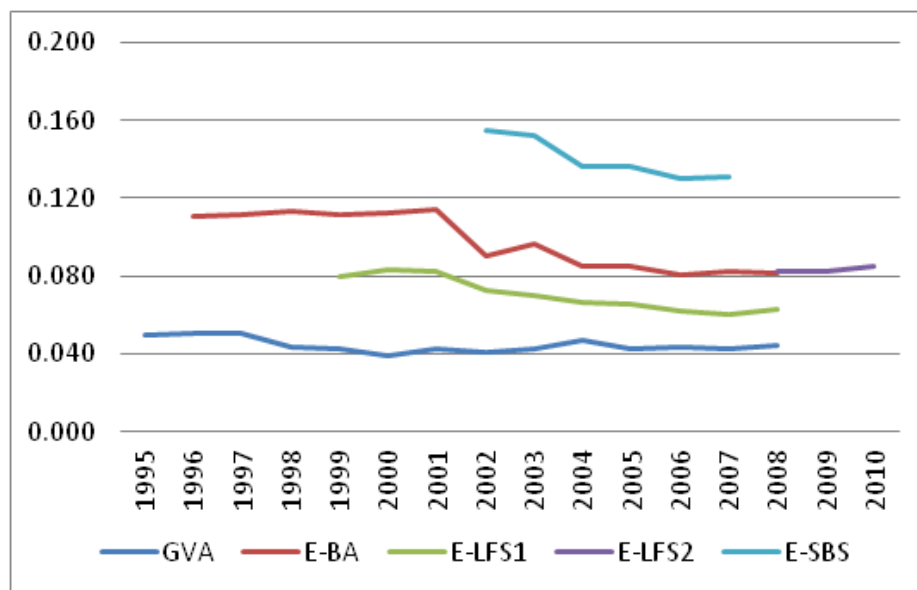
⁷ In terms of employment shares.

When analysing the employment structure, labour intensive sectors are the main occupation in highly specialised regions. In contrast, when analysing GVA, rather capital and human-capital intensive sectors dominate regions with high specialisation. The special case of Inner London (UK) shows that the high specialisation in market services affects both, the employment and production structure in the city.

Relative and absolute specialisation in Central European Countries (CEE)

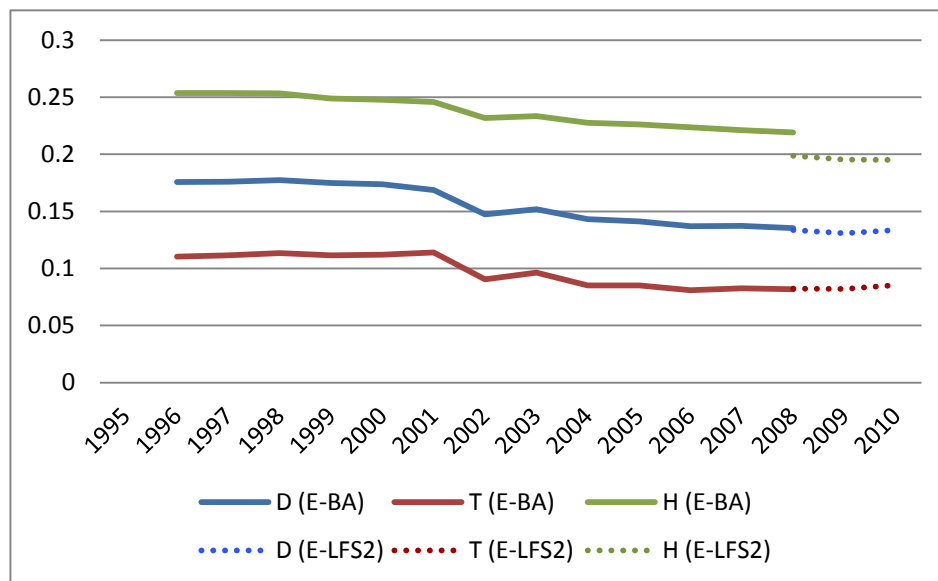
Empirical studies presented in the literature overview showed that the development of regional specialisation in CEEs is more dynamic. Our results confirm this finding while displaying remarkable differences between the developments of employment and production specialisation.

Figure 3: Regional relative specialisation trends in the CEEs, between 1995 and 2010, measured by the Theil index in NUTS2 regions



Independently from the data source and calculated indicator, relative and absolute employment specialisations show a clearly decreasing trend between 1995 and 2008, accelerating in 2001. This could be seen as a preparation period for EU accession for the by then candidate countries (see figure 3 and figure 4).

Figure 4: Regional relative and absolute employment specialisation trends in CEE NUTS2 regions between 1996 and 2010



Two observations seem to be remarkable. First, in the course of the financial and economic crisis beginning in 2008, specialisation seems to slightly increase again. If this is just a temporary development needs to be observed when future data is available. Second, specialisation in production structure follows a different path. Between 1995 and 2000, the decreasing trend in production specialisation mirrors the development of employment specialisation, what is in line with the results of von Schütz and Stierle (2003). In contrast, from 2000, when employment specialisation started to decrease and employment structure became more similar to EU15 structure, specialisation of the production structure in CEE seems to increase up to 2004.

These developments reveal that in CEE employment and GVA based indicators are getting closer, on average. This could indicate that employment patterns in CEE are increasingly reflecting differences in productivity. Discrepancies in results for different sector disaggregation reveal that average results might hide diverging trends in subsectors.

As shown in table 3 least specialised regions in terms of employment and GVA are located in Poland. Hungary seems to have a diverse economic structure. While two regions are among the least specialised in employment, in terms of GVA the same regions are highly specialised in agricultural. The employment of the capital region (Közép-Magyarország) is highly specialised in market services. The same is true for the Slovakian, Romanian and Czech capital region, as well as for Cyprus. This is in contrast to regions in EU15, where rather rural re-

gions or regions being rich in natural resources (London being the exception) are among the most specialised regions.

Table 4: Most and least specialised NUTS2 Regions in CEE in 2008, Theil index

	employment	Sector	GVA	sector
least	Polish regions (8 out of 16)		Polish regions (9 out of 16)	
	Dél-Alföld (HU)		Estonia	
	Észak-Alföld (HU)		Lithuania	
most	Romanian regions (5 out of 8)	Agriculture and Transport	Prag (CZ)	Market services
	Prag (CZ)	Financial intermediation, real estate and business services	Cyprus (CY)	Construction, Services
	Cyprus (CY)	Service sectors (tourism, transport)	Hungarian regions (4 out of 7)	Agriculture
	Közép-Magyarország (HU)	Financial intermediation, real estate and business services	Severozapaden (BG)	Agriculture
	Bratislavský kraj (SK)	Service sectors (financial intermediation, transport)	Moravskoslezsko (CZ)	Industry

Regarding the development of regional employment structure between 1995 and 2008 it is remarkable that most of the highly specialised regions in 1995 remained in their ranking for 2008. Lithuania and Latvia, being among the most diverse regions in 1995, increased the specialisation of their employment structure, which is mainly due to developments in the service sector.

Absolute employment specialisation is decreasing gradually and mirrors the development of relative specialisation, while GVA data show a slightly increasing trend. More recent data show an increase in the Herfindahl index from 2008 until 2009. If this remains a temporary raise in specialisation needs to be observed with future data.

4.2 Relative and absolute concentration

The development of concentration patterns in EU15 and CEE sectors is diverse. Results of indicator trends will be presented according to the broad sector classification into primary, secondary and tertiary sector⁸.

⁸ For sector abbreviation used, please refer to Annex Table A1 and A2.

Primary sector

Agriculture is the most concentrated sector relative to the average employment and production structure, when the dataset includes a relatively small number of sectors (up to ten sectors). In contrast, relative concentration is at medium level when 34 sectors are analysed. In the EU15 the high concentration in both GVA and employment based on 6 to 10 sectors is a statistical artefact as the share of this sector in employment and GVA is small compared with the other sectors. In contrast, when using a dataset with more sectors so that sectors have more similar shares in total employment or GVA, concentration is at medium level. In turn, in CEE the medium level concentration in employment when using 34 sectors is rather misleading as the sector has a far above average share in total employment and thus differences between regions should be rather averaged out.

Employment concentration in the primary sector in EU15 shows a steady decline which came to a halt in 2008, independently from the dataset and indicator. A look at the location quotient shows that especially in Spanish and Greek regions concentration in agriculture increased after 2008. Especially in Spain, this might be related to the financial and economic crisis, when workers, coming from construction and related business sectors went back to the country side to do farming activities.

The de-concentration trend in the EU15 is in stark contrast to developments in the CEE. Up to 2001 the sector concentrated considerably in terms of employment. Duboz et al. (2009) explain this development by increased trade with EU member states.⁹ However, between 2001 and 2004 agriculture shows a substantial decline in concentration, nearly to its level from 1996, but starts to concentrate again once the ten former candidate countries joined the EU in 2004. Looking at individual regions, the location quotient for agriculture in Bulgarian, Hungarian and Romanian regions increased between 1996 and 2008.

Considering the production concentration, agriculture does not show a specific trend in EU15, increases slightly between 1995 and 2008.

In CEE the development of the production structure of the sector is different between bigger administrative regions (NUTS1) and the smaller regions (NUTS2 and NUTS3). While the sector rather de-concentrates within the first ones, it increases in relative and absolute concentration in the latter two. Thus, the sector change occurs within rather small spatial units than between larger regions or countries (see also Bickenbach et al. 2010a).

⁹ Duboz et al., analysing employment data only, also propose that this trend might be due to increased productivity in the sector. However, this argument seems not to be supported by our findings as concentration based on GVA increases slower than specialisation in employment.

Figure 5: Relative employment and production concentration of agriculture between 1995 and 2010, measured by the Theil index in NUTS2 regions in EU15

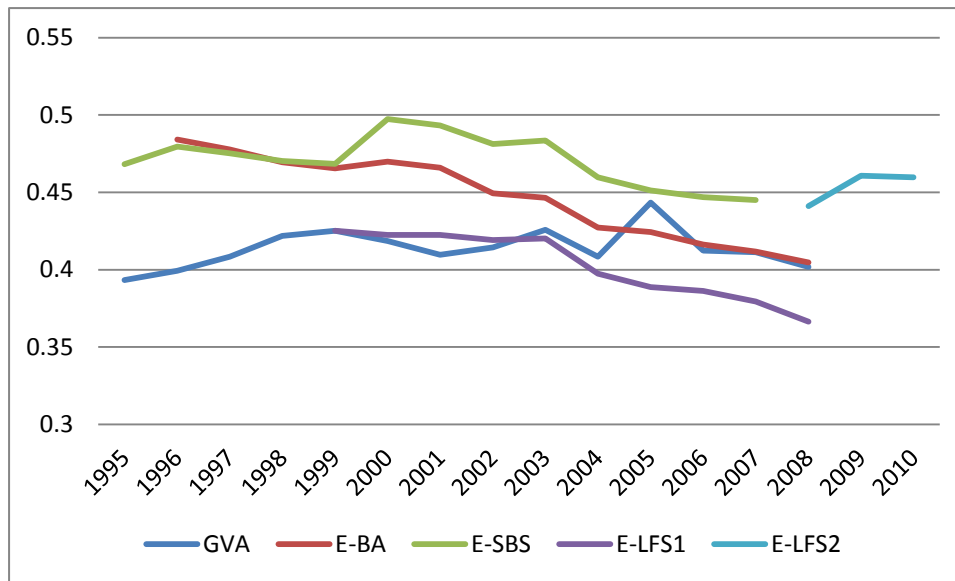
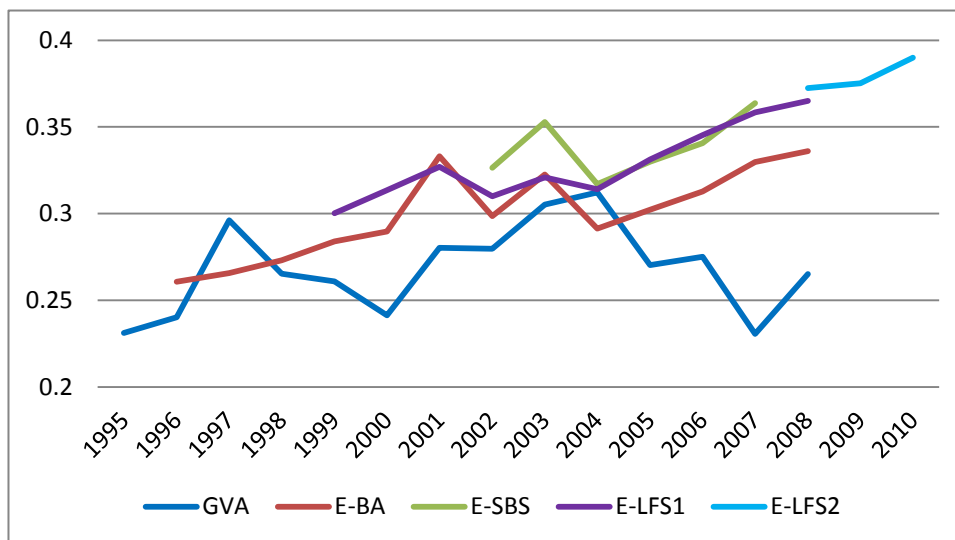


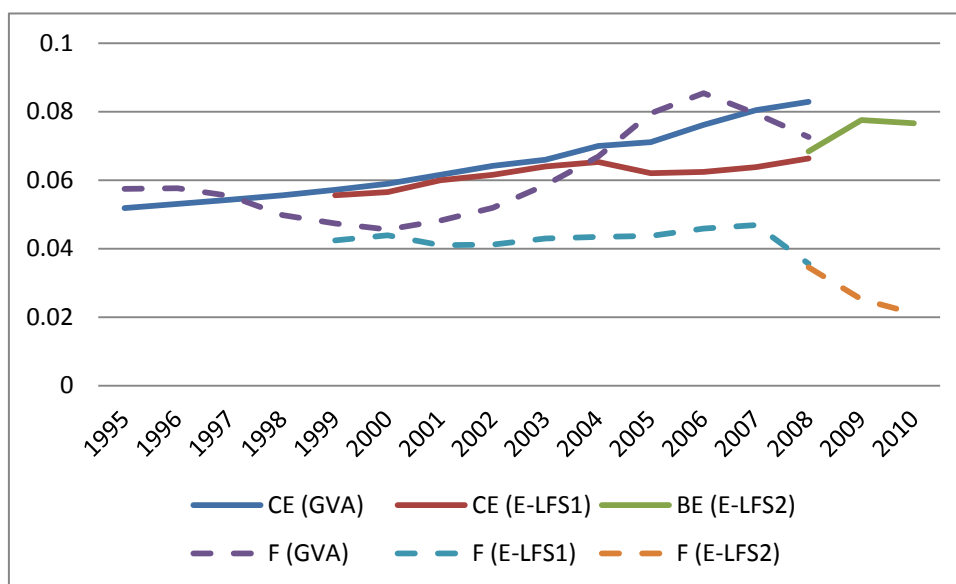
Figure 6: Relative employment and production concentration of agriculture between 1995 and 2010, measured by the Theil index in NUTS2 regions in CEE



Secondary sector

The secondary sector includes economic activities with diverse characteristics such as high-tech vs. low-tech and labour vs. capital intensity. However, most of the available data sets group these sectors together which leads to a stark averaging out of different developments. The results for the whole secondary sector in EU15 and CEE show an increasing trend and compared with all other sectors on a lower concentration level, especially when considering the production structure, see figure 7 and 8.

Figure 7: Relative employment and production concentration of the secondary sector between 1995 and 2010, measured by the Theil index in EU15 NUTS2 regions



With the financial and economic crisis in 2009 this raise came to a halt. One possible reason might be the contraction of industrial production with a decrease in employment, especially in the manufacturing sector.

The construction sector, F (dashed line in Figure 7), started to concentrate substantially after 2000 in EU15, especially in GVA terms. When the construction boom in some EU15 regions started reversing, concentration in the sector fell markedly in terms of GVA as from 2007 and in terms of employment as from 2008.

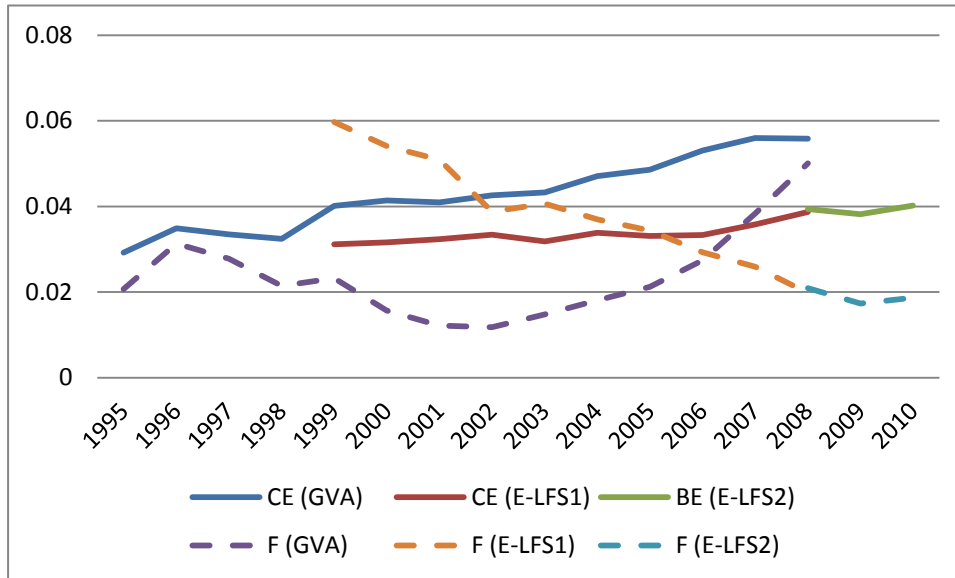
In the CEE the sector development is different with regard to employment and production structure (see Figure 8). While the output of the construction sector concentrates significantly from 2002, employment concentration decreases over the whole observation period.

There might be two reasons for these developments. First, a reform of the PHARE programme has been introduced in 1999 dedicating EUR 1.1 billion annually to 10 Candidate countries for financing environmental and infrastructure projects under the ISPA¹⁰ programme. After the accession to the EU in 2004 the countries and infrastructure projects remained supported by European Cohesion and Structural Funds (Bailey and de Propris, 2004). For the construction sector this could mean that the realization of bigger project was now possible and thus a concentration of production seemed more likely. Second, the steady decrease in employment concentration might be related to the continuing increase in employment shares of this sector. This trend came to a halt after 2008 due to the financial and economic

¹⁰ Instrument for Structural Policies for Pre-Accession (ISPA).

crisis. Interestingly, concentration in the sector has not been affected that strongly in the CEE compared with the EU15.

Figure 8: Relative employment and production concentration of the secondary sector between 1995 and 2010, measured by the Theil index in CEE NUTS2 regions



While the overall trends in main sectors are displayed in graphs 7 and 8 above, the structural business statistics (SBS) allow for a more detailed sectoral analysis between 1995 and 2007 for the EU15 regions and between 2002 and 2007 for the CEE regions, offering employment data for 14 manufacturing sectors, mining, electricity and water supply as well as construction separately. Following (Cutrini, 2010), the manufacturing sector can be divided into low-tech and high-tech sectors. The table 5 gives an overview of the sectors.

The *low-tech sectors* in the EU are concentrated at different levels, regardless the relative or absolute concentration measure. DC, DB and DF are the most concentrated sectors in EU15 and show to some extent an increasing concentration during the observation period, while especially DC and DF are very small sectors, where already minor changes in employment can lead to considerable concentration changes. The other low-tech industries are rather stable or show a slight decreasing trend in EU15.

Most of the low-tech sectors in CEE (eight out of nine) are decreasing in relative and absolute concentration. DF is the most concentrated sector with a very low and decreasing employment share. Only the wood processing manufacturing sector shows some slight concentration trend.

Table 5: Sector classification of the manufacturing sector according to Cutrini (2010) and OECD (2003)

	NACE Rev. 1	Sector: manufacture of
Low-tech	DA	food products, beverages and tobacco
	DB	textiles and textile products
	DC	leather and leather products
	DD	wood and wood products
	DE	pulp, paper and paper products; publishing and printing
	DF	coke, refined petroleum products and nuclear fuel
	DH	rubber and plastic products
	DI	other non-metallic mineral products
	DJ	basic metals and fabricated metal products
High-tech	DG	chemicals, chemical products and man-made fibres
	DK	machinery and equipment n.e.c.
	DL	electrical and optical equipment
	DM	transport equipment
	DN	Manufacturing n.e.c. (furniture, recycling)

The *high-tech sectors* are concentrated at a medium level and three sectors increased their employment concentration in EU15 (DK, DL, DM) and in CEE (DK, DM, DN). Cutrini (2010) explains this development with a relative high agglomeration need of these sectors in order to benefit from knowledge spillovers. Except for electrical and optical equipment (DL), the high-tech sectors are more concentrated in EU15 than in CEE. Thus, further concentration trends might be expected in the CEE regions.

Mining and quarrying is relatively highly concentrated at the beginning of the analysed period, but values of relative and absolute concentration decrease rapidly in EU15. This development has been accompanied by a strong decrease in employment shares of the sector. In CEE, the sector is the most concentrated and only shows a very slight decrease in relative concentration, but increases in absolute concentration. Consequently, relative to the employment structure in the EU, the sector is highly concentrated in CEE regions and de-concentrates in EU15. In individual regions it even gained in importance in the CEE, especially in Polish and Czech regions. These different developments might be related to productivity issues, competition and political decisions. As an example, coal mines in Germany have been closing since 1965, but remained under strong political and financial support. Due to the Council Regulation (EC) No 1407/2002 on State aid to the coal industry, increasing competition after the EU enlargement and stronger global competition, federal and state governments, unions and employers decided on a long-term exit strategy in 2007 (IEA, 2007).

Two diverse developments might have influenced the concentration of the sector E (*electricity, water and gas supply*). On the one hand, the liberalization of the European Energy market

starting in 1996 might lead to a de-concentration of the sector due to a higher competition between former state-owned firms and new competitors. On the other hand, increasing concentration could be a sign that firms exploit economies of scale in the sector more efficiently. The first effect seems to dominate in CEE while the latter seems more important in the EU15. In the EU15, after a period of decreasing relative concentration, the sector started to concentrate again. This development is mainly influenced by regions in Belgium, Finland, Greece, Spain and Portugal. In contrast, in the CEE, the concentration in the sector decreases after 2003 continuously (except in 2007) and the employment structure is much more dispersed than in EU15. However, there is a considerable difference between employment and production concentration in the CEE. Using GVA data, von Schütz and Stierle (2003) found a highly concentrated electricity, water and gas supply sector in 2000 in CEE.

The results per sector in EU15 show that the increase in industrial concentration measured at a very broad sector definition (CE or BE) is mainly due to concentration tendencies of high-tech and utilities sectors, while low-tech sectors as well as mining rather remain stable or de-concentrate. Manufacturing sectors in the CEE show similar trends, but especially high-tech sectors are more concentrated in EU15. Thus, broad sector definitions give a rather vague view on concentration tendencies of sectors. The same conclusion can be drawn for the tertiary sector.

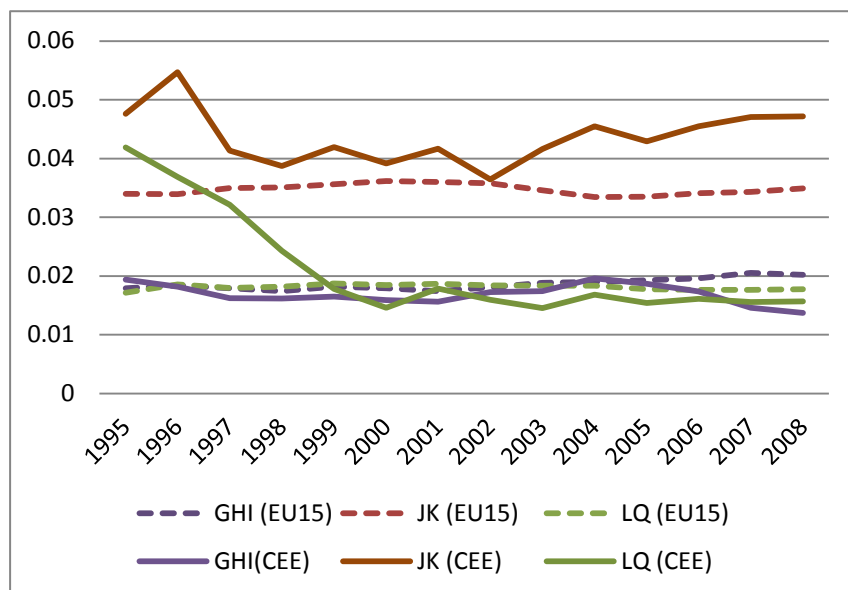
Tertiary sector

Considering broad sectors in services (see figure 9 and 10), *financial intermediation and real estate activities* (JK) are the most concentrated services based on GVA and employment data in EU15 regions. In terms of employment, the sector shows a clear tendency to disperse during the observation period. In terms of GVA, no specific pattern can be detected for the sector.

The *other market-service sectors* (GHI)¹¹ and *public service sectors* (LQ) are widely spread out and show very low values of relative concentration independently from the economic variable (employment or GVA). While the employment structure of both sectors is very stable, the production structure (GVA) increases slightly for the GHI sectors.

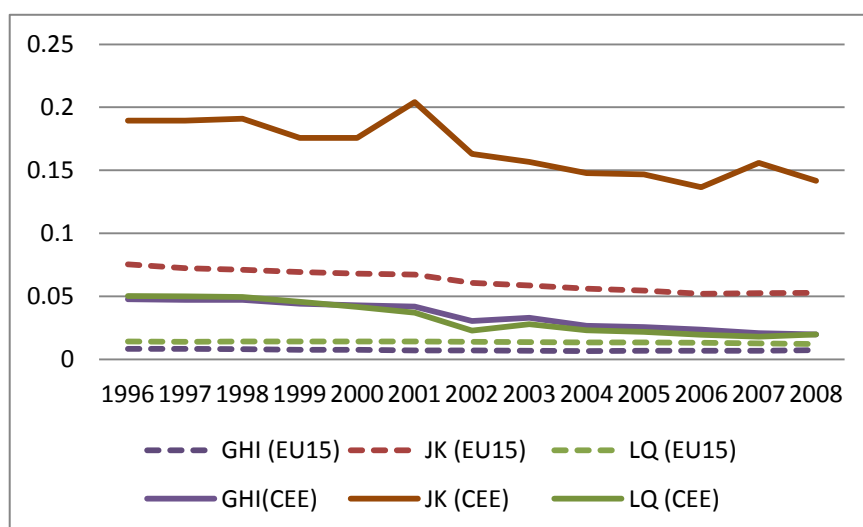
¹¹ Wholesale and retail trade (G), hotels and restaurants (H) transport (I).

Figure 9: Relative production (GVA) concentration of the tertiary sector between 1995 and 2008, measured by the Theil index in EU15 (dashed lines) and CEE NUTS2 regions



Even though the concentration ranking for these sectors, when considering employment and GVA data, is the same in CEE, the level of concentration is in most cases much higher than in EU15 regions. All three sectors decrease in their concentration, independently from the economic variable, especially the public service sector between 1995 and 2000. This decentralisation trend might be due to efforts made in these countries to adapt their public institutions in light of the opening toward the EU15.

Figure 10: Relative employment concentration of the tertiary sector between 1995 and 2008, measured by the Theil index in EU15 (dashed lines) and CEE NUTS2 regions



Again, a more detailed dataset allows a differentiated view inside the sector developments in terms of employment.

After the highly concentrated leather processing sector in manufacturing, *air and water transport* (I61, I62) are the most concentrated sectors in EU15.¹² The sectors depend to a great extent on available natural (navigable rivers, lakes and seas) and planned infrastructure (channels and airports). In terms of employment, these sectors are among the smallest in the EU15, so it is not surprising that their weight within a broader sector definition is too small to influence the aggregated result for the “other market services” (GHI). While most of the *transport and communication sectors* (I60 – I64) decrease in concentration, water transport shows a slight increasing tendency in relative concentration. When looking at absolute concentration, the *post and telecommunications sector* (I64) was comparatively highly concentrated in 1995, but de-concentrated considerably after 2000. On 1st January 1998 the legal liberalization of telecommunication services and networks was established. So, it took about two years until a structural change could be observed in the data.

In the CEE, all analysed service sectors show decreasing tendencies of their employment structure. The transport sector, specifically *water and air transport* (I62 and I61) are again the most concentrated sectors.

Employment structure of the *trade and repair sectors* (G50-G52) is one of the least concentrated in EU15 and does not show any clear trend. In CEE regions this sector is more concentrated than in EU15, but the values of relative concentration decreased continuously. *Hotels and restaurants* (H) spread out constantly in EU15, which is mainly due to developments in Spain and Greece. Maybe here more and remote areas have been developed for tourism activities so that the structure of the sector changed accordingly. The same trend can be observed for CEE regions, mainly located in the Czech Republic and Hungary, although the developments do not evolve as fast as in the EU15.

As mentioned before, the financial intermediation, real estate and other business sectors are, in a broad definition, the most concentrated service sectors with decreasing trend in the analysed areas. In EU15 this trend is mainly influenced by the *real estate and business sector* (K70-K74) as the more detailed analysis in figure 11 shows. *Financial intermediation* (J), starting from an intermediate level, is increasingly concentrating. The *R&D sector* (K73) was the most concentrated service sector among the business sectors and decreased considerably in its concentration level. This might be due to a relative increase in the importance of the sector in terms of employment shares. For the CEE, it is not possible to disentangle the sector

¹² They are part of the overall sector *I – transport, storage and communication*.

developments of these two sectors (J and K) due to data availability. The sector, as a whole (JK), shows a strong de-concentration tendency which came to a halt in 2007.

Figure 11: Sector details of financial intermediation (J) as well as real estate, renting and business activities (K) between 1995 and 2007, measured by the Theil index in EU15 NUTS2 regions

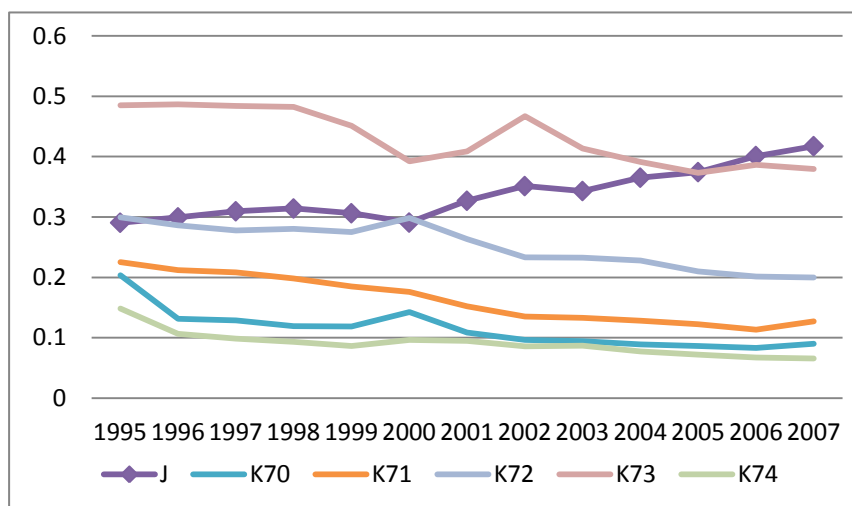
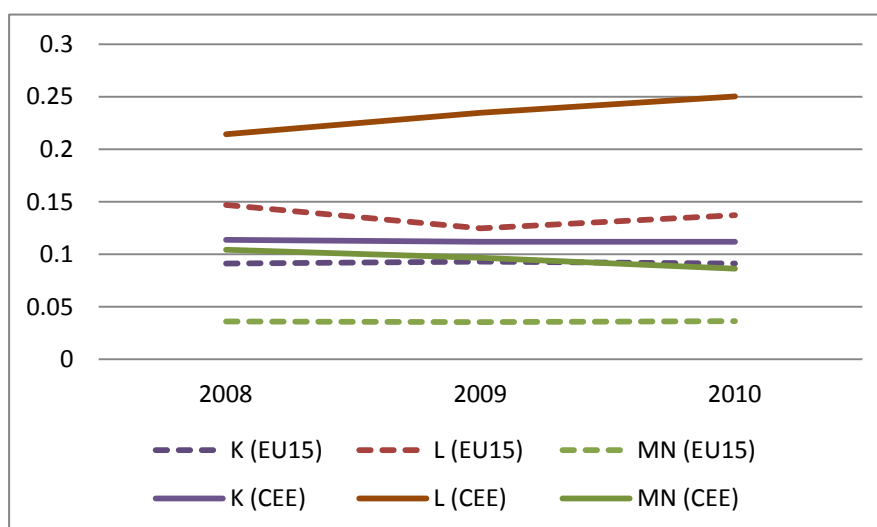


Figure 12: Sector details of financial intermediation (K), real estate activities (L) and professional, scientific and technical activities as well as administrative and support service activities (MN) in EU15 (dashed lines) and CEE, between 2008 and 2010, measured by the Theil index in NUTS2 regions



More recent data¹³ also offering the differentiation between the two sectors show that the real estate activities (L) continued decreasing in 2009, while the financial intermediation (K) and

¹³ In NACE Rev. 2, with financial and insurance activities (K), real estate activities (L), Professional, scientific and technical activities, Administrative and support service activities (MN).

business services sector (MN) nearly remained unchanged between 2008 and 2010 in EU15. In the CEE very different developments can be observed between 2008 and 2010. While L is decelerating its concentration trend, K and MN decrease in concentration (see figure 12).

The public services sectors (LQ) are among the least concentrated sectors with a strong decreasing tendency in both relative and absolute concentration. Due to its broad definition, the sector is one of most important in terms of employment shares in EU15 and CEE. However, the sector trend varies in different countries as shown by the location quotient. While German, Dutch, Greek and Spanish regions specialised more in public service sectors, Italian, French and Belgian regions decreased their specialisation. Estonia achieved an impressive reduction in public sector concentration between 2002 and 2007, as well as Sud – Muntenia in Romania, while Latvia, other Romanian and Polish regions increased in relative public sector concentration.

This very detailed description of concentration trends of EU15 and CEE sectors shows that the more the sectors are aggregated the less information the concentration indicators are providing about sector developments. Additionally, only looking at overall sector developments in the EU15 or CEE is obstructing diverse developments of sectors in single regions.

5 Conclusions

This analysis contributes to the current discussion on regional specialisation and sectoral concentration in several dimensions. This analysis i) applies relative and an absolute measures and is based on a dataset covering ii) all economic sectors, including a more detailed sectoral breakdown for services, iii) all regions in the EU, iv) GVA and employment data and v) spanning over a relatively long period, including the economic crisis years up to 2010. The findings confirm that a broad approach is necessary to get in-depth insights into concentration and specialisation.

Overall and on an aggregated level, both specialisation and concentration have hardly moved in the EU over last 15 years. Regional specialisation and sectoral concentration decrease slightly based on employment data, but increase marginally using GVA. This observation holds true for both the EU15 and CEE and for absolute and relative measures.

When analysing specialisation patterns in the EU15, based on employment data, rural regions tend to be highly specialised in labour intensive sectors. In contrast, based on GVA data, regions, including capital regions, tend to be specialised in capital and human capital intensive sectors. CEE capital regions tend to be highly specialised in human capital intensive market services. Interestingly, some regions are among the least specialised based on employment data but based on GVA data they are among the most specialised.

The analysis of sectoral concentration can be summarized as follows: The primary sector is highly concentrated in the EU15 and CEE based on employment data. However, while the sector de-concentrates progressively in EU15, it increasingly concentrates in CEE. In the secondary sector no major movements could be detected on an aggregated level. On a more disaggregated level construction was increasingly concentrated in the EU15 based on GVA data and broadly stable based on employment data. In the CEE, in contrast, the construction boom led to a marked increase in employment concentration but the contrary holds true for GVA. In the manufacturing sector some low-tech industries as well as mining are highly concentrated with a falling trend, while high-tech industries are less concentrated with an increasing trend. These observations hold for both, EU15 and CEE regions, although high-tech industry concentration here is on a lower level than the same industries in EU15, so that further concentration tendencies could be expected. The utilities related sector is increasingly concentrating in employment between 1995 and 2007 in EU15 but constantly de-concentrating in the CEE.

Concerning the impact of an enhanced integration in Europe and the convergence process of CEE, similarly to other studies and in line with economic theory, our analysis draws a mixed picture. In some regions and sectors these trends result in an assimilation of the production structures between CEE and the EU15. This holds e.g. true for high-tech sectors in manufacturing as well as for hotel and restaurant services. In contrast, in other sectors / regions the effect of making better use of comparative advantages seems to dominate. Examples for the latter are agriculture as well as mining and quarrying.

The impact of the economic crisis on the employment structure in Europe is hardly visible on an aggregated level.¹⁴ While the focus of this paper is not the crisis impact, a more detailed sectoral and regional analysis shows a significant impact. For example, regional specialisation, having embarked on a declining trend, started to increase again during the crisis. More specifically, con-

¹⁴ GVA data is only available until 2008.

centration in the agriculture sector strongly increased in Spanish and Greek regions, while concentration in the construction sector declined when construction bubbles in corresponding regions burst.

A more detailed and in-depth analysis reveals additional interesting results, particularly in view of the need to analyse a wider range of measures, economic variables and disaggregation levels to derive a balanced picture.

First, purely statistically, the more data are disaggregated, the higher values of specialisation or concentration are for the identical object under investigation. Consequently, value levels can only be compared if the same indicators are calculated based on data sets with the same regional and sectoral disaggregation. Consequently, while probably trends over time can be compared between different papers, comparing indicator levels is hardly possible.

Second, researchers are frequently confronted with the trade-off between a higher regional or sectoral disaggregation. Therefore, data used here include both, data with a high sectoral disaggregation on only NUTS2 level as well as data on NUTS3 level, i.e. with a higher regional disaggregation, but with a limited sectoral breakdown. To include both data sets is important to unveil developments that are averaged out when using aggregated data. For example, concentration of the agricultural sector decreases on a lower regional aggregation level (NUTS1) while it increases when using NUTS3 level data.

Third and similarly, the detailed description shows that the more sectors are aggregated the less information the concentration indicators provide about, in some cases very diverse, developments in sub-sector. For example, the slightly increasing concentration of manufacturing is hiding the strong decline in e.g. the mining sector in EU15. Additionally, only looking at overall sector developments in the EU15 or CEE is obstructing very diverse developments of sectors in single regions.

Forth, while in most cases results for GVA and employment have a similar trend, this does not always hold. For example, the construction boom in CEE led to an increasing concentration of this sector based on GVA data, while the opposite is true when analysing employment data. Similarly, the highest specialisation values in EU15 regions is found in regions specialising in labour intensive sectors while based on GVA the highest values are found in regions specialising in human capital and capital intensive sectors. In addition, while major differences between the various employment data have not been found, to include various data sets is important to include data with partially higher regional, partially higher sectoral breakdown, as discussed above.

Finally, while findings are mainly consistent among the different relative and absolute measures, this does not hold for all cases. The most prominent example is the declining trend for both overall relative concentration and specialisation, while absolute measures show a stable or in some periods a slowly increasing trend.

Given the slow changes in concentration and specialisation, fears of a deindustrialisation in Europe, recently frequently brought forward in the context of the economic crisis, seem not justified. Similarly, in some cases, current specialisation and concentration seem to be determined more by pure chance in the past, combined with path dependency, than by current economic and administrative determinants. The emerging research strand on evolutionary economic geography (EEG) around Ron Boschma and Koen Frenken (2011) deals specifically with path dependencies, historical processes and clustering of economic activities. E.g. it will remain difficult to capture by an econometric analysis why Gottlieb Wilhelm Daimler (1834 – 1900), Carl Benz (1844 – 1929) and Robert Bosch (1861 – 1942) lived mainly at the same time in the same region and contributed with their ideas and developments to an important still existent automotive cluster in Baden-Württemberg. As they also employed August Horch (1868 – 1951), the founder of Audi, and Ferdinand Porsche (1875 – 1951), this former cluster was enforced.

Consequently, an economic policy aiming at the support of specific sectors seems not warranted. This not only holds true for the aim of picking future winners, but also for attempts to slow down the decline of some sectors with financial support. In contrast, policy should aim at enhancing growth by facilitating structural change and reducing related frictions. This can be achieved e.g. by improving the general business climate, fostering competition, improving financing conditions for start-ups and SMEs as well as enhancing education and training.

References

- Aiginger, K. and Leitner, W. (2002). Regional Concentration in the USA and Europe: Who follows whom? *Weltwirtschaftliches Archiv*, 138(4), 652-679.
- Amiti, M. (1997). Specialisation patterns in Europe, Centre for Economic Performance, Discussion Paper 363, London.
- Bailey, D. and Proprius, L. de. (2004). A Bridge Too Phare? EU Pre-Accession Aid and Capacity-Building in the Candidate Countries. *Journal of Common Market Studies*, 42(1), 77 - 98.
- Bickenbach, F. and Bode, E. (2006). Disproportionality Measures of Concentration, Specialization, and Polarization, IfW, Kiel Working Paper 1276, Kiel.
- Bickenbach, F., Bode, E., and Krieger-Boden, C. (2010a). Structural Cohesion in Europe : Stylized Facts, IfW, Kiel Working Paper 1669, Kiel.
- Bickenbach, F., Bode, E., and Krieger-Boden, C. (2010b). Closing the Gap between Absolute and Relative Measures of Localization, Concentration or Specialization, IfW, Kiel Working Paper 1660, Kiel.
- Bode, E., Krieger-Boden, C., Siedenburg, F., and Soltwedel, R. (2005). European integration, regional structural change and cohesion in Spain. IfW, Kiel Working Paper 3766, Kiel.
- Boschma, R. and Frenken, K. (2011). The emerging empirics of evolutionary economic geography. *Journal of Economic Geography*, 11(2), 295 - 307.
- Brühlhart, M. and Traeger, R. (2005). An account of geographic concentration patterns in Europe. *Regional Science and Urban Economics*, 35(6), 597-624.
- Combes, P.-P. and Overman, H. G. (2004). The spatial distribution of economic activities in the European Union. In J. V. Henderson & J.-F. Thiesse (Eds.), *Handbook of Regional and Urban Economics* (Volume 4, pp. 2845 - 2909). Amsterdam, San Diego, London: Elsevier.
- Cutrini, E. (2010). Specialization and Concentration from a Twofold Geographical Perspective: Evidence from Europe. *Regional Studies*, 44(3), 315-336.
- Duboz, M.-L., Guillain, R., and Gallo, J. L. (2009). Les schémas de concentration sectorielle au sein de l'Union européenne : l'Est miroir de l'Ouest ? *Économie et Statistique*, 423(1), 59 - 76.
- ESPON. (2006). *The modifiable areas unit problem - Final Report*, 3.4.3.
- Eurostat. (2008). NACE Rev. 2 - Statistical classification of economic activities in the European Community. Eurostat, Eurostat Methodologies and Working papers, Luxembourg.

- Hallet, M. (2000). Regional specialisation and concentration in the EU. Directorate General Economic and Monetary Affairs, European Commission, European Economy - Economic Papers 141, Brussels.
- IEA. (2007). *Energy Policies of IEA Countries - Germany*. Paris.
- Kallioras, D. and Petrakos, G. (2010). Industrial growth, economic integration and structural change: evidence from the EU new member-states regions. *The Annals of Regional Science*, 45(3), 667-680.
- Krieger-Boden, C. (1999). Nationale und regionale Spezialisierungsmuster im europäischen Vergleich. *Die Weltwirtschaft*, 2, 234-254.
- Krieger-Boden, C. and Traistaru-Siedschlag, I. (2008). Regional structural change and cohesion in the enlarged European Union: An Introduction. In C. Krieger-Boden, E. Morgenroth, and G. Petrakos (Eds.), *The Impact of European Integration on Regional Structural Change and Cohesion* (pp. 1-34). London, New York: Routledge.
- Krugman, P. (1991). *Geography and Trade*. Cambridge (MA), London: MIT.
- Landesmann, M. A. (2003). Structural features of economic integration in an Enlarged Europe: patterns of catching-up an industrial specialisation. Economic and Monetary Affairs, European Commission, European Economy - Economic Papers 181, Brussels.
- Mora, T., Vaya, E., and Surinach, J. (2004). The Enlargement of the European Union and the Spatial Distribution of Economic Activity. *Eastern European Economics*, 42(5), 6-35.
- OECD. (2003). *The Source of Economic Growth in OECD Countries*. Paris.
- Traistaru, I., Nijkamp, P., and Longhi, S. (2002). Regional Specialisation and Concentration of Industrial Activity in Accession Countries. ZEI, ZEI Working Paper B16, Bonn.
- UNCTAD. (n.d.). *World Investment Report, different years*.
- von Schütz, U. (2003). *Regionale Spezialisierung und Konzentration in einer erweiterten EU*. University of Trier, mimeo.
- Von Schütz, U. and Stierle, M. (2003). Convergence in an Enlarged EU? An Empirical Analysis of Regional Specialisation and Sectoral Concentration. In C. Hausen, M. Resinek, N. Schürmann, and M. Stierle (Eds.), *Determinants of Growth and Business Cycles: Theory, Empirical Evidence and Policy Implications, INFER Annual Conference 2003* (INFER Research Report., pp. 253 - 271). Berlin: VWF.
- WIFO. (1999). Specialisation and (Geographic) Concentration for European Manufacturing - Background Paper for "The Competitiveness of European Industry 1999 Report." Directorate Generale Enterprise, European Commission, Working Paper 1, Brussels.

Annex

Table A1: Sectors included according to NACE Rev. 1.1 (up to 2008) and NACE Rev. 2 (2008-2010)

NACE Rev. 1.1		NACE Rev. 2	
Section	Description	Section	Description
A	Agriculture, hunting, forestry	A	Agriculture, forestry and fishing
B	Fishing		
C	Mining and quarrying	B	Mining and quarrying
D	Manufacturing	C	Manufacturing
E	Electricity, gas and water supply	D	Electricity, gas, steam and air conditioning supply
		E	Water supply, sewerage, waste management and remediation activities
F	Construction	F	Construction
G	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	G	Wholesale and retail trade; repair of motor vehicles and motorcycles
H	Hotels and restaurants	I	Accommodation and food service activities
I	Transport, storage and communication	H	Transportation and storage
		J	Information and communication
J	Financial intermediation	K	Financial and insurance activities
K	Real estate, renting and business activities	L	Real estate activities
		M	Professional, scientific and technical activities
		N	Administrative and support service activities
L	Public administration and defence; compulsory social security	O	Public administration and defence; compulsory social security
M	Education	P	Education
N	Health and social work	Q	Human health and social work activities
O	Other community, social, personal service activities	R	Arts, entertainment and recreation
		S	Other service activities
P	Private households with employed persons	T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
Q	Extraterritorial organisations and bodies	U	Activities of extraterritorial organisations and bodies

Source: Eurostat (2008).

Table A2: Sectors included according to NACE Rev. 1.1 in database E-SBS

Section	Description	Data availability
AB	Agriculture and fishing	EU15 and CEE
C	Mining and quarrying	EU15 and CEE
DA	Manufacture of food products, beverages and tobacco	EU15 and CEE
DB	Manufacture of textiles and textile products	EU15 and CEE
DC	Manufacture of leather and leather products	EU15 and CEE
DD	Manufacture of wood and wood products	EU15 and CEE
DE	Manufacture of pulp, paper and paper products; publishing and printing	EU15 and CEE
DF	Manufacture of coke, refined petroleum products and nuclear fuel	EU15 and CEE
DG	Manufacture of chemicals, chemical products and man-made fibres	EU15 and CEE
DH	Manufacture of rubber and plastic products	EU15 and CEE
DI	Manufacture of other non-metallic mineral products	EU15 and CEE
DJ	Manufacture of basic metals and fabricated metal products	EU15 and CEE
DK	Manufacture of machinery and equipment n.e.c.	EU15 and CEE
DL	Manufacture of electrical and optical equipment	EU15 and CEE
DM	Manufacture of transport equipment	EU15 and CEE
DN	Manufacturing n.e.c.	EU15 and CEE
E	Electricity, gas and water supply	EU15 and CEE
F	Construction	EU15 and CEE
G50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	EU15 and CEE
G51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	EU15 and CEE
G52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	EU15 and CEE
H	Hotels and restaurants	EU15 and CEE
I60	Land transport; transport via pipelines	EU15 and CEE
I61	Water transport	EU15 and CEE
I62	Air transport	EU15 and CEE
I63	Supporting and auxiliary transport activities; activities of travel agencies	EU15 and CEE
I64	Post and telecommunications	EU15 and CEE
J	Financial intermediation, except insurance and pension funding	EU15
K70	Real estate activities	EU15
K71	Renting of machinery and equipment without operator and of personal and household goods	EU15
K72	Computer and related activities	EU15
K73	Research and development	EU15
K74	Other business activities	EU15
L_Q	Public services	EU15 and CEE

Table A3: Regional disaggregation

member state	NUTS1	NUTS2	NUTS3
Austria (AT)	3	9	35
Belgium (BE)	3	11	44
Bulgaria (BG)	2	9	28
Cyprus (CY)	1	1	1
Czech Republic (CZ)	1	8	14
Denmark (DK)	1	1	11
Estonia (EE)	1	1	5
Finland (FI)	2	5	20
France ¹ (FR)	8	22	96
Germany (DE)	16	39	429
Greece (GR)	4	13	51
Hungary (HU)	3	7	20
Ireland (IE)	1	2	8
Italy (IT)	5	21	107
Latvia (LV)	1	1	6
Lithuania (LT)	1	1	10
Luxembourg (LU)	1	1	1
Malta (ML)	1	1	2
Netherlands (NL)	4	12	40
Poland (PL)	6	16	66
Portugal (PT) ²	1	5	28
Romania (RO)	4	8	42
Slovak Republic (SK)	1	4	8
Slovenia (SI)	1	2	12
Spain (ES) ³	6	18	51
Sweden (SE)	3	8	21
United Kingdom (UK)	12	37	133

¹ Overseas departments have been excluded.

² PT20 (Região Autónoma dos Açores) and PT30 (Região Autónoma da Madeira) have been excluded.

³ ES63 (Ciudad Autónoma de Ceuta) and ES64 (Ciudad Autónoma de Melilla) have been calculated as one region. ES70 (Canarias) has been excluded.

Table A4: Data adjustments

- Due to data problems, some regions had to be excluded or sub-regions to be taken together as one region as explained in table A2.
- Negative values or zero values have been replaced by a value equal to 1 promille of the reported value for the corresponding region. This was particularly necessary in detailed manufacturing sectors in the whole observation area and sector P in several CEE in order to be able to calculate the Theil Index.
- Missing values in a region in the first or last year were calculated using the corresponding growth rate in the next higher regional aggregate for which data was available.
- Missing values in the middle of the time span were calculated using linear interpolation.
- After all adjustments, new sums were calculated before calculating regional or sectoral shares.

Table A5: Notation

D	Dissimilarity Index
H	Herfindahl-Index
T	Theil Index
L	Location Quotient
i	Sector, $i = (1, \dots, I)$, $I = 15$
j	Region, $j = (1, \dots, J)$, $J = 242$ for EU24, $J = 202$ for EU15 and $J = 40$ for RAMS9
x_{ij}	Share of sector i in GVA (employment) of region j
$\bar{x}_{i\cdot}$	Average share of sector i in GVA (employment) of all regions
$\bar{x}_{\cdot j}$	Average share of all sectors in GVA (employment) of region j
x_{ji}	Share of region j in GVA (employment) of sector i
$\bar{x}_{\cdot j}$	Average share of region j in GVA (employment) of all sectors
$\bar{x}_{\cdot i}$	Average share of all regions in GVA (employment) of sector i