SOCIO-ECONOMIC TRENDS AND NEW TERRITORIAL DYNAMICS IN THE EUROPEAN UNION:

CONVERGENCE AND AGGLOMERATION

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Abstract

In this study, we explore how general socio-economic trends within the European Union are reflected in the development of different types of regions during the period from 1995 to 2009 and how economic disparities between EU regions change in the course of these processes. Overall, there is a decrease of regional inequalities in terms of per-capita income, but this is mainly the result of catching up of the Middle and Eastern European countries. Disparities within the EU15 and the EU 12 have remained constant. Moreover, all of the socio-economic tendencies considered in this study in their spatial dimension the shift towards services, the shift towards technology and knowledge-intensive activities, the rise in labour market participation and the renewed tendency towards urbanisation point at a persistent or even increasing spatial concentration of economic activities. Thus, we observe two overlapping and opposing trends: convergence and agglomeration. Finally, the regions of the new member states have been gradually catching up in terms of income and productivity since 2000, but the wide gap between the EU12 and the EU15 regarding technology, knowledge-intensity and innovation is hardly narrowing. It might take very long for the EU12 countries to approach the development level of the old member states.

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Socio-economic trends and new territorial dynamics in the European Union: Convergence and Agglomeration

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1 Introduction

The aim of this study is, first, to explore how general socio-economic trends within the European Union are reflected in the development of different types of regions and, second, to analyse how economic disparities between EU regions change in the course of these processes.

Some of the trends we consider are well established long-term structural transformations that are driven by technological progress, shifts in consumer and intermediate demand and changes in the global division of labour. This applies to the sectoral shift from production to services and to the functional shift from basic to knowledge-intensive activities. Other trends are rooted in behavioural changes relating to employment and place of residence. In this category we explore the long-standing increase in labour market participation and the relatively new tendency towards urbanisation. The resurgence of cities as private locations is not only evidenced by the above-average population gains of metropolises like London, Paris or Rome in recent years, but it appears also to represent a much broader change in the residential preferences of people (Geppert, Gornig 2010).

In this study we are not able to analyse in detail these trends and their complex interrelations, we rather show in an aggregate way how the separate trends are mirrored in regional developments and what changes in the relative position of different types of regions go along with them.

Our typology of EU regions is based on a four-tier spatial hierarchy, ranging from large metropolitan areas at the top to rural regions at the bottom. The rationale behind this concept is the empirical finding that the size of the core cities largely determines the composition of economic functions and the level of income in the respective regions (Glaeser, Maré 1994 and 2001).

A stylised fact from many studies on the economic development of EU regions is convergence of per-capita income and productivity. This finding, however, is mainly due to the periodic inclusion of poorer, catching up countries in the European Union. If national effects are taken into account convergence turns out to be very slow or even non-existent (Giannetti 2002; Meliciani 2006). For many years, two overlapping and opposing trends have been determining the regional pattern of the EU: overall convergence, on the one hand, and spatial concentration (agglomeration), on the other

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(Geppert, Stephan 2008). In the present paper we examine whether this finding continues to hold for the EU27.

There are some significant limitations to this study that mainly arise from the definition of regions and the availability and quality of data. Essentially, structural information on EU regions is only available for NUTS 2 (or even NUTS 1) units of the classification of EU regions. But the grid of NUTS 2 regions is rather inhomogeneous across the member states, and in some cases even within states. Other restrictions of comparability are caused by the heterogeneity of the educational and occupational systems in the various EU countries. This affects the validity of a number of indicators on human capital and technology. Some other indicators are based on categorizations of economic sectors as technology-intensive or knowledge-intensive. In practice, these indicators can only be considered as very crude measures of what is actually taking place in the regions. All in all, there is a clear trade-off between the spatial scope of an investigation and the accurateness of analysis that can be achieved. One way out of this dilemma is to look at the larger countries of the EU separately. In the present study we chose this extension for a more informative description of urbanisation, using Germany as an example.

2 Indicators of socio-economic trends and the definition of regions

2.1 Major socio-economic changes in the regional context

In the present paper we consider four general socio-economic trends in their regional dimension:

    (1) the shift towards services

    (2) the shift towards knowledge-intensive activities

    (3) the rise in labour market participation

    (4) the renewed tendency towards urbanisation

Measuring these trends is easy insofar as there are quite a number of statistical indicators pertinent to each process of transformation, but it is problematic in that all indicators are more or less flawed in respect of accurateness and comparability across regions and countries.

The *shift towards services* is described here from a sectoral, not an activity-based perspective. We take the service sector as a whole as defined by the Statistical classification of economic activities (NACE rev1) and calculate the share of this sector in total Gross Value Added GVA) of the regional economies for the years from 1995 to 2008. Regional GVA for 2009 is not yet available from Eurostat for all EU countries, and if it were it would not be informative for two reasons: first, the data for 2009 is disaggregated according to the new classification NACE rev2, second and more importantly, the sectoral structure of GVA for 2009 is distorted by the deep financial and economic crisis in that year which essentially affected the production sector. The relative weight of the service sector was driven up by this shock, but with the recovery of production in 2010 and 2011 the share of services should have returned to its normal path.

We take GVA and not employment as an indicator for the shift towards services because employment is affected by part-time work which is widespread in the service sector, but with sizeable variation between countries and regions.

Since tertiarisation can happen through a relative decline of industry and/or a relative decline of the remaining sectors – agriculture and construction – we use as an additional identifying indicator the share of industry (mining, manufacturing, energy and water supply) in total regional GVA.

The description of the *shift towards knowledge-intensive activities* can be based on various sources of information and quite a number of statistical indicators on technology, knowledge intensity, human capital and innovation. In a first step, we adopt a sectoral perspective choosing the employment shares of:

- high-tech industries and technology-based services and

- knowledge-intensive services

as indicators of the technology and knowledge orientation of regional economies.[1] High-tech industries are defined by Eurostat as showing an above average amount of R&D expenditures relative to GVA.[2] By the NACE rev1 classification, the following manufacturing industries were considered high-tech: Pharmaceuticals, medicinal chemicals and botanical products (24.4), Office machinery and computers (30), Radio, television and communication equipment and apparatus (32), Medical, precision and optical instruments, watches and clocks (33) and Aircraft and spacecraft (35.3). With the introduction of the new NACE rev2 classification, effective for the data from 2008 onwards, the codes of these industries changed but the underlying fields of production largely remained the same. Technology-based services are a small subset of knowledge-intensive services defined as showing a high technology-orientation and high shares of employees with tertiary education. In the system of NACE rev1 technology-based services comprised Post and telecommunications (64), Computer and related activities (72) and Research and development (73). Here, the change to NACE rev2 involved a significant break in the time series. Among other revisions postal and courier services were dropped from the set of technology-based services and the film and music industry as well as radio and television were included. The net effect of these revisions is a significant decrease in the employment share of technology-based services and of the aggregate group of high-tech industries and technology-based services.

Knowledge-intensive services are defined as service industries with high shares of tertiary-educated employees. Unlike in manufacturing, the grouping of services by knowledge-intensity is only made at the 2-digit level of the NACE classifications, and this means that knowledge-intensity in the service sector is measured in a rather crude way.[3] In NACE rev1, the group of knowledge-intensive services consisted of Water transport (61), Air transport (62), Post and telecommunications (64), Financial intermediation (65 to 67), Real estate, renting and business activities (70 to 74), Education (80), Health and social work (85) and Recreational, cultural and sporting activities (92). Major changes that came with the switch to NACE rev2 were the exclusion of real estate and the inclusion of public administration and compulsory social security. As a result, the share of knowledge-intensive services in total employment went up by about five percentage points.

Our second step in describing technology and knowledge at the regional level is based on activities, not sectors. We use the most confined variant of the relevant indicators available from Eurostat – Core of Human Resources in Science and Technology (HRSTC). The indicator is calculated as the employment share of workers who have both completed tertiary education in a science and technology field and are employed in a science and technology occupation as professionals or technicians.[4] While HRSTC

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[1] Generally, employment-based indicators of regional development are problematic, because the weight of part-time work differs largely between sectors and countries, in particular between the EU15 and the EU12.

[2] http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/EN/htec_esms.htm

[3] The data for all these groupings of manufacturing and service sectors comes from household surveys. Therefore, the scope for regional and sectoral disaggregations is limited.

[4] http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-07-103/EN/KS-SF-07-103-EN.PDF

is a relatively narrow version of the Eurostat human resources indicators, it still covers a wide field of activities – not only in physical and life sciences but also in social sciences and humanities, and not only in professional jobs but also in non-scientific occupations in areas like child and health care or in culture and entertainment.

A serious problem with HRSTC as an indicator of regional technology and knowledge orientation is the lack of comparability across nations. There are still large differences between the educational and occupational systems of the EU countries. The international classifications ISCED and ISCO are supposed to bridge the discrepancies, but up to now this has not led to a sufficient degree of comparability. Figure 1 illustrates the problem: Denmark (like other Nordic countries) may have many people employed in science and technology, but it appears highly implausible that the real difference to Austria amounts to one hundred percent, as indicated by HRSTC. And it is equally implausible that Cyprus, Spain and Greece have available significantly more human resources than Austria.

Obviously, HRSTC is of rather limited use as an indicator of absolute differences in human resources in science and technology between EU regions, but it may be a suitable measure of the development of these resources over time.

In a third step, we consider directly the input and output of the innovation process, i.e., R&D expenditures and patents. Unfortunately, statistical information on R&D expenditures is only available for the years from 2005 onwards for most of the EU regions. But the two measures are highly correlated across regions, so that we can restrict our observation to patents for which we have regional data covering the period from 1995 to 2008.

One potential weakness of patent data may relate to the problem of regionalisation. Patent applications (and R&D expenditures) are disproportionately undertaken by large firms with plants and subsidiaries in many regions. It is possible that some patents are assigned to the headquarters or central R&D units, even if the innovative activities have actually taken place elsewhere.

For the observation of *the rise of labour market participation* we refer to the age group of 25 to 64 years. The reason is that we are interested in the activity rates of people that are actually on the labour market, i.e., that have finished their education. Many younger people below the age of 25 are still in their tertiary education and, therefore, cannot be active economically. Regions with high participation in tertiary education should tend to show relatively low rates of labour market participation if people below the age of 25 years are included. The statistical information necessary to calculate regional employment and participation rates for this age group is only available for the years from 1999 onwards.

Like the data on high-tech industries and knowledge-intensive services, information on HRSTC is drawn from household surveys in the framework of the EU Labour Force Survey.

Figure 1
Human resources in science and technology (HRSTC) in selected EU countries

Percentages of total employment
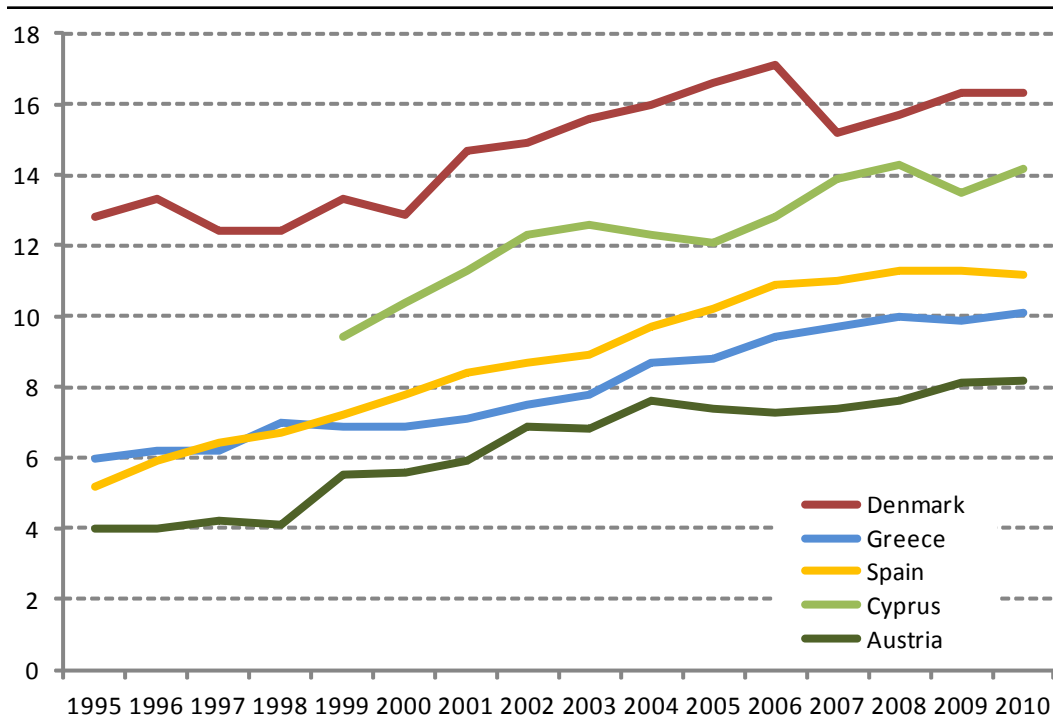
Sources: Eurostat; own calculations.

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The *tendency towards urbanisation* is the result of the locational behaviour of people and firms. In a first stage, we measure the behaviour of people regarding urbanisation by the share of large metropolitan areas in total EU population and the behaviour of firms by the share of large metropolitan areas in total GDP. However, a regional concept that is based on NUTS 2 units (see section 2.2) is not really suitable for analysing urbanisation in its classical sense. Most of the large metropolitan areas in the wide boundaries of NUTS 2 units contain a sizeable share of rural or intermediate territories. On this basis we can hardly identify a preference of people or firms for urban locations. In a second stage, we turn to a more detailed analysis of urbanisation for the largest country of the EU, Germany. The focus there is on the development of population and employment in the largest *core cities* (with more than half a million inhabitants).

2.2   Definition of regions

Ideally, our description of socio-economic regional trends and the analysis of regional economic disparities would be based on spatial units that approximately represent self-contained labour markets. But such systems of functional regions do not exist in all

European countries and EU wide statistical data is only available within the official EU classification of statistical areas, NUTS. Most of the statistical information is broken down no further than to the level of NUTS 2 units. The definition and the socio-economic relevance of these regions differ considerably across the various EU countries, leaving us with a rather heterogeneous set of spatial units of observation.[5] The land area of these regions ranges from 13 square kilometres to more 165 000 square kilometres and the population ranges from 27 000 to almost 12 million inhabitants. In many cases the NUTS 2 borderlines cut across socio-economic linkages, in other cases the intra-regional linkages are not fully captured by the NUTS 2 units.

As a compromise, we start from the official grid of NUTS 2 regions, but whenever appropriate, we combine two or more NUTS 2 units to form more integrated regional economies. This way, we can avoid the artificial separation of interlinked territories and improve the comparability between regions and countries, but we have to accept that some of our regional units of observation are rather wide. Specifically, we merge NUTS 2 regions to receive larger metropolitan areas in the following cases: Brussels, Prague, Berlin, Hamburg-Bremen, Vienna, Bucharest, Manchester-Liverpool, Birmingham and London.[6]

One essential aim of this study is to evaluate the level and development of the spatial concentration (agglomeration) of economic activities. This requires either a classification of regions by some continuous measure of agglomeration (like density) or a typology of regions according to their settlement structure. In the present paper we combine both ways of categorising regions with regard to agglomeration: first, we identify large and small metropolitan areas, i.e., regions with a large urban centre (main city > 500 000 inhabitants) and regions with a smaller urban centre (main city 300 000 – 500 000 inhabitants), respectively. Urban theory and empirical evidence suggest that income and productivity are positively related to the density of regions (Ciccone, Hall 1996). But apart from density, the size of the core city is also very important (Glaeser, Maré 1994 and 2001). The cut-offs at 500 000 and 300 000 are somewhat arbitrary, but groupings like the one defined here are commonly used in the urban literature and confirmed by empirical evidence on the economic hierarchy of cities (e.g. Glaeser, Maré 2001).

In a second step, we rank all non-metropolitan regions by population density and define a threshold density to distinguish between intermediate regions and rural regions. Our choice of 150 inhabitants per square kilometre as a threshold is certainly arbitrary, but there is no objective or stringent criterion to define rural regions.

A combination of density and city size is also applied by Eurostat for a typology of urban and rural regions on the basis of NUTS 3 units (Eurostat 2010) and by de Beer et al. (2012) in their adaption of the Eurostat concept to the NUTS 2 level.

The result of our classifications is a hierarchy of EU regions with large metropolitan areas at the top and rural regions at the bottom:

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[5] See also de Beer et al. (2012): The growth of the working age population: differences between rural and urban regions across Europe. NEUJOBS Working Paper D 8.1

[6] One advantage of large regions as units of observation is that commuting and spatial spillovers that can bias estimates are minimized or even non-existent (see also section 3.5).

- ▪ (1) large metropolitan areas with core cities > 500 000 inhabitants

- ▪ (2) small metropolitan areas with core cities of 300 000 – 500 000 inhabitants

- ▪ (3) intermediate regions with population density > 150 inhabitants per sqkm

- ▪ (4) rural regions with population density <= 150 inhabitants per sqkm[7]

According to this typology, there are 49 large metropolitan areas with an aggregate population of more than 210 million inhabitants, and 27 small metropolitan areas with a population of almost 63 million. Together, these two types of regions account for 55 percent of the EU population (Table 1).[8]

Table 1
Types of regions and their population

Types of regions	Number of regions	Population 2009		
		1 000 inhabitants	Percent of EU27	Min – Max 1 000 persons
Large metropolitan areas	49	210 249	42.3	999 – 17 655
Small metropolitan areas	27	62 779	12.6	617 – 6 165
Intermediate regions	47	74 285	15.0	247 – 4 885
Rural regions	123	149 558	30.1	274 – 3 717
EU27	246	496 871	100	27 – 17 655

Whole countries that are not subdivided into NUTS 2 regions are not assigned to metropolitan areas even if they have a large or medium-sized city (Estonia, Latvia, Lithuania).

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[7] For a previous application of this typology see Geppert, Stephan (2008).

[8] Due to significant gaps in the regional data for Denmark, this country could not be considered in most steps of the analysis. For the same reason, Cyprus, the French overseas regions and the Spanish territories in North Africa, Ceuta and Melilla, have been excluded altogether.

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3 Results

In many socio-economic respects the new Middle and Eastern European member states are still significantly different from the "old" EU countries. Averaging across all regions most likely would hide important disparities in the level of regional development and in the change over time. Therefore, we distinguish between the EU15 and the EU12 throughout the present paper. Within these separate groups the regional dimension of the analysis is implemented by our typology of regions discussed in section 2. At some points of the description of socio-economic trends in the regional context it is useful to refer to the situation of single countries because nation-specific production models or development paths can help to explain regional patterns in the EU.

3.1 Socio-economic trends

3.1.1 Shift towards services

The long-standing trend of tertiarisation, i.e., the shift of demand, production and employment from the goods producing sector to the service sector, has continued in the last 15 years, but at a significantly slowed down pace and with pronounced regional deviations. In the EU27, the share of services in total Gross Value Added (GVA) increased from 63.2 percent in 1995 to 67.8 percent in 2003 and virtually remained constant until 2008 (Figure 2). For the EU15, however, this stagnation does not signal a general break of the shift to services. In most of the Western European countries the share of services keeps on rising - with the important exception of Germany (Figure A1 in the Annex). The strong economic performance of Germany since 2004 was largely based on the success of German manufacturing firms on the European and global markets. Today (and probably in the years coming), the German production model rests upon technology-intensive manufacturing and related services. But if one large country specialises in manufacturing, almost necessarily, other countries specialise in services. These different paths are masked by the average development of the share of services in the EU15. Overall, the relative weight of services has increased very slightly in the recent years, and this trend is likely to continue in the near future.

In the EU12 the share of services increased from 1995 to 2003 by more than 5 percentage points. But unlike the development in the EU15, this rise did not primarily come at the expense of industry, rather it was accompanied by a decline of the agricultural sector which traditionally was relatively important in the Eastern European countries. These countries are catching up to the EU15 mainly through industrial growth. With 27 percent in 2008, the share of industry in total GVA was 7 percentage points higher than in the EU15 and the difference tends to increase.

Regarding the spatial dimension, the relative weight of services follows a clear hierarchy: in the large metropolitan areas of the EU15 the share of services in total GVA has risen from slightly more than 70 percent in 1995 to 75 percent in 2008. The

Figure 2
Shift to services

Percentages of total Gross Value Added
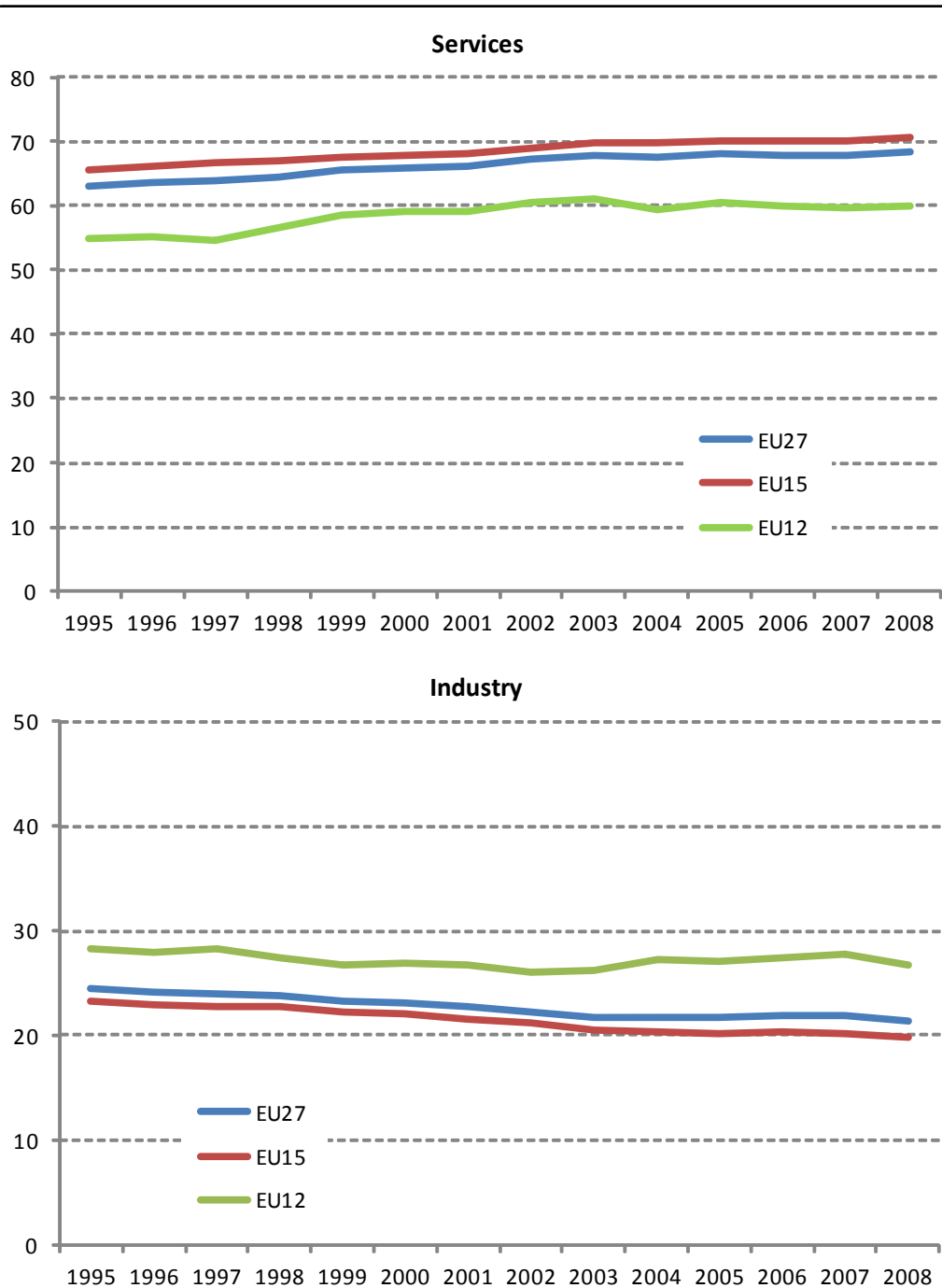
Due to data restrictions Denmark and Cyprus are not covered by this chart.

Industry = Mining, Manufacturing, Energy and water supply.

Unweighted averages across regions.

Sources: Eurostat Regio database; own calculations.

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small metropolitan areas and the other regions (intermediate and rural regions combined) show very similar developments over time, but at lower levels. For 2008, the difference compared to large metropolitan areas is 3 percent and 5.8 percent, respectively (Figure A2).

The regions of the EU12 generally show lower shares of services in total GVA, but the spatial hierarchy is more pronounced than among the regions of the EU15. The gap between large and small metropolitan areas was 5.7 percent in 2008, almost twice as much as in the EU15. Obviously, the role of large metropolitan areas as service centres of their respective countries is more important in the new member states than in the EU15. Five out of nine large metropolitan areas in the EU12 are capital city regions.

Inversely, the relative weight of industry in the large metropolitan areas of the EU12 is much lower than in the non-metropolitan regions of these countries. The difference increased from 3.2 percentage points in 1995 to 5.6 percentage points in 2008 (Figure A3). But unlike the EU15, there is no general "de-metropolisation" of industry in the new member states. On the contrary, the contribution of the large metropolitan areas to the whole industrial GVA of the EU12 tends to grow. And the small metropolitan areas have been experiencing some reindustrialisation during the recent years, even though these areas only could stabilise, not enhance their share in total industrial GVA of the EU12 countries (Figure A4).

While the spatial distribution of industry is further moving from metropolitan to non-metropolitan regions – at least in the EU15 – the overall degree of regional specialisation in industry tends to rise. The coefficient of variation for industry shares in total regional GVA is increasing, both in the EU15 and the EU12 (Figure A5).

3.1.2   Shift towards knowledge-intensity

The increasing knowledge- intensity of regional economies in the EU is considered here from three different perspectives: sectoral, activity-based and innovation-oriented. Regarding sectors, we analyse the shares of high-tech industries and knowledge-based services and the shares of knowledge-intensive services in total employment.

In the EU15, the combined employment share of high-tech industries and technology-based services increased from just below 4 percent in 1995 to 4.4 percent in 2001 (Figure 3). Since then the share has roughly remained constant if we take account of the break in the time series in 2008 (see the description of the data in section 2). In the new member states, the share of this technology-oriented sector of the economy was significantly lower than in the EU15 at the beginning of our period of observation, but the curves in Figure 3 suggest that the gap has been narrowing since then. This, however, is partly due to a general problem with statistical indicators based on head counts of employment. The denominator of the indicator is the number of persons employed, irrespective of working time. First, part-time work is widespread in the service sector at large but much less important in high-tech industries and technology-based services. Second, while the share of part-time workers in the EU15 increased from 17.5 percent in 2001 to 22.1 percent in 2010, this share stagnated in the EU12 at

Figure 3
Shift to knowledge-intensive sectors

Percentages of total employment

High-tech industries and technology-based services

Knowledge-intensive services
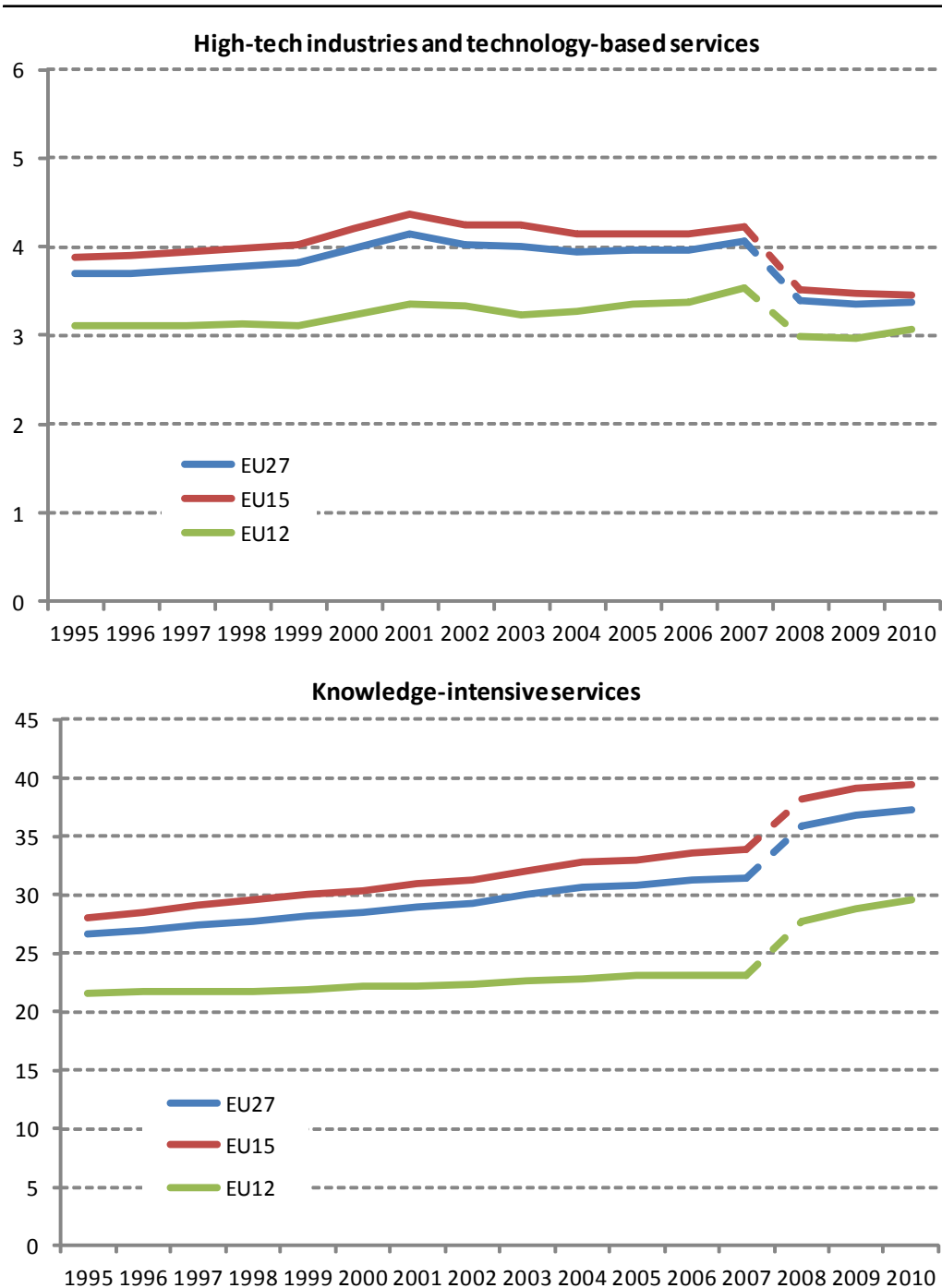
Due to data restrictions the Danish regions and 15 regions of other countries are not covered by this chart.
Unweighted averages across regions.
Sources: Eurostat Regio database; own calculations.

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around 7.5 percent. As a consequence, both the relative level and the relative growth of the technology-oriented sector in the EU12 countries are overestimated by the commonly used employment-based indicator.

The employment share of knowledge-intensive services has been steadily rising during the period of observation. In 2010 this sector accounted for almost 40 percent of all persons employed in the EU15 and for 30 percent in the EU12. The gap has widened during the last 15 years, corroborating the view that the process of catching up of the Middle and Eastern European countries is mainly based on industrial growth.

While the importance of large metropolitan areas in the EU15 as locations of overall industrial production is gradually diminishing, their strong relative position as centres of high-tech industry and technology-based services has not changed compared to small metropolitan areas and has even improved compared to other regions (Figure A6). This is consistent with empirical evidence on the long-term spatial division of functions within manufacturing (Duranton, Puga 2005; Bade et al. 2004). For the EU12, the spatial picture is very much the same as for the EU15.

The employment shares of knowledge-intensive services are almost uniformly moving upwards in all types of regions, but the rising tendency is significantly stronger in the EU15 than in the EU12 (Figure A7). Conversely, the well-established spatial hierarchy with large metropolitan areas at the top is more pronounced in the new member states. The relative strong position of these regions, not only in terms of overall economic performance but also with regard to structural change, appears to be a general trait of the spatial pattern of the EU12 countries. This has already been shown in connexion with the share of the service sector as a whole and it will again become obvious in the following passages.

The difference between the large metropolitan areas and the other regions in the share of knowledge-intensive services appears somewhat smaller after the break in the time series in 2008, in particular for the EU15. But this is likely to be a consequence of the inclusion of the public administration and compulsory social security in the sector of knowledge-intensive services. The newly included sectors are generally spread more evenly across space than most other knowledge-intensive services.

For the activity-based view on knowledge intensification we use data on skilled persons that are employed in science and technology occupations (HRSTC). The share of these workers in total employment has been continuously rising in the last 15 years (Figure 4, upper chart). The EU12 countries are behind the EU15 and appear to be catching up gradually. But, as with high-tech industries, this result might be spurious due to part-time effects. Since part-time work is less common among skilled workers than among unskilled persons, and part-time rates in general are much lower in the EU12 than in the EU15, both the level and the development of human resources in science and technology is likely to be overestimated for the EU12 in Figure 4.

In the spatial dimension, we find again the usual graduation between the different types of regions. One deviation is that in the EU15 large and small metropolitan areas are very close to each other with their shares of human resources (Figure A8). This, however, is not a real exception to the general spatial hierarchy but rather a result of

Figure 4
Shift to knowledge-intensive activities and innovation
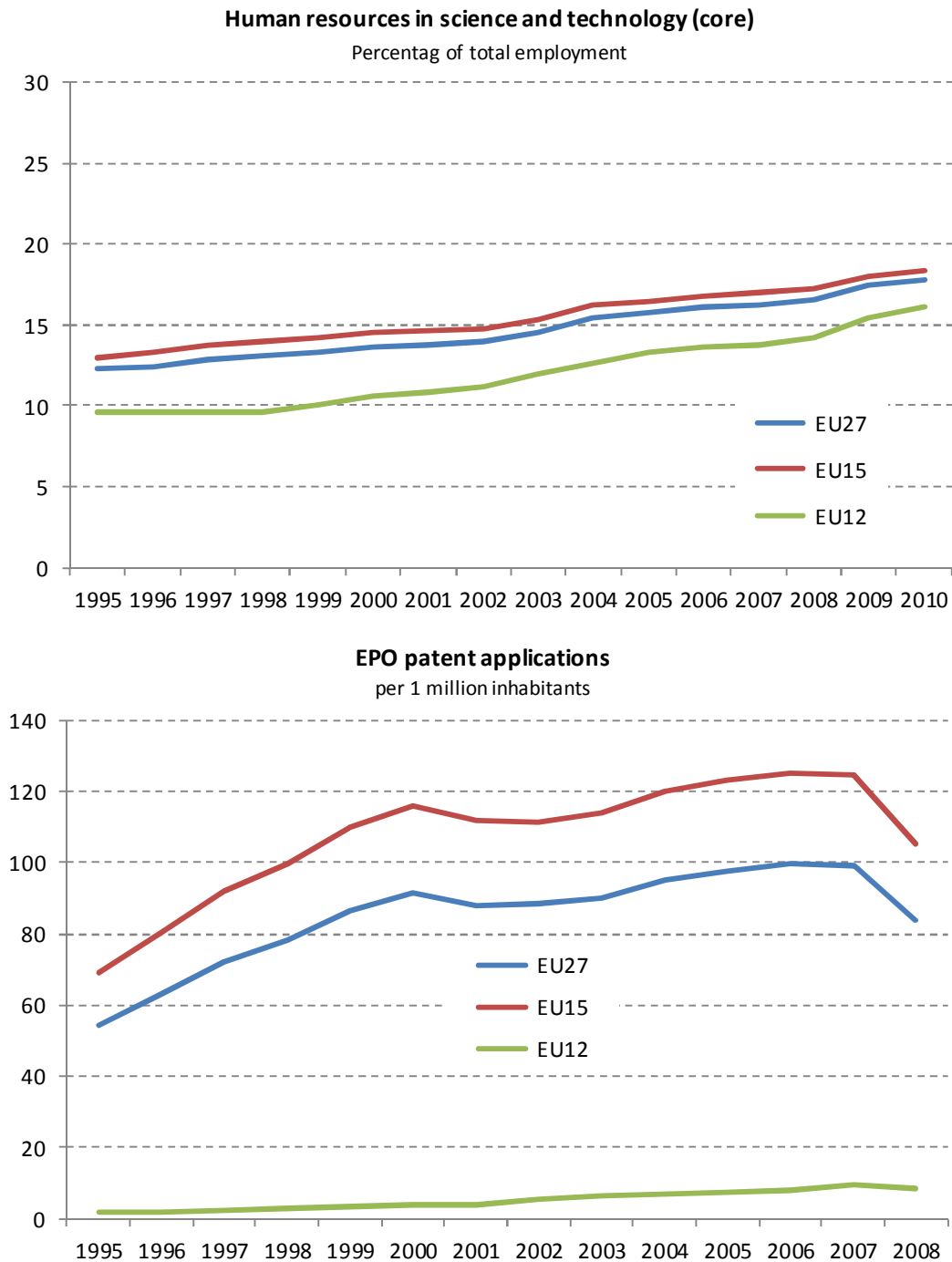
Human resources in science and technology (core)
Percentag of total employment

EPO patent applications
per 1 million inhabitants

Due to data restrictions Denmark and Cyprus are not covered by this chart.

Unweighted averages across regions.

The patent figures for 2008 may be revised upwards with the next update of the data.

Sources: Eurostat Regio database; own calculations.

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the statistical problems with the indicator HRSTC in terms of comparing the *levels* across nations (see section 2). Many of the small metropolitan areas defined here belong to countries with relatively high values of HRSTC. In the EU12, the large metropolitan areas have augmented their human resources in science and technology more than the other types of regions. The difference in level has grown to around 5 percentage points.

The indicators discussed so far are all broadly defined measures that give more or less crude information on regional trends towards knowledge-intensity. Now we turn to a narrowly defined, relatively demanding criterion for innovative activity: patent applications. In this field, the regional disparities in the European Union are enormous. Applications by firms in the EU15 (per one million inhabitants) are more than twelve times higher than applications by firms in the EU12. The increase during the period from 1995 to 2008 was arithmetically stronger for the EU12 than the EU15, but this process started from virtually zero (Figure 4, lower chart).

We cannot discuss in detail here potential reservations against patents as an indicator for innovation output,[9] but we have checked the relation between patents and R&D expenditure – an indicator for innovation input. These two measures, which are completely independent from each other, are very highly correlated across regions, both in the EU15 and the EU12. This makes us confident that patents indeed are a valid indicator of regional innovative activity (see also Buerger et al 2012).

If the difference in patents between the old and the new member states essentially is not due to measurement problems, the huge gap has to be attributed to fundamental structural disparities between the economies of the EU15 and the EU12 countries. One potential explanation is that many firms and establishments in the EU12 are subsidiaries or plants of foreign companies. Within large companies functions are often divided spatially, with R&D located near the headquarters and production dispersed over many regions. This spatial division of labour is the reason why a purely sectoral perspective as with the share of high-tech industries is not sufficient to characterise regional developments.

The distribution of patents across regions shows a similar pattern as for other indicators of knowledge and technology. In the EU15, the absolute differences between large metropolitan areas and the other two types of regions roughly remained constant during the whole period from 1995 to 2008 – at about 40 and 50 patents per one million inhabitants, respectively (Figure A9). With the general rise in patent applications, the relative differences between the types of regions gradually became smaller. But in 2008 the number of patents of large metropolitan areas in the EU15 still exceeded that of small metropolitan areas by 30 percent and that of other regions by almost 50 percent. For the EU12 a leading position of the large metropolitan areas in terms of patenting is also evolving, but this process still takes place at an extremely low level.

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[9] See for instance Griliches, Z. (1990): Patent Statistics as Economic Indicators: A Survey. Journal of Economic Literature, 28, 1661-1707 and Moed, H. F., Glänzel, W., Schmoch, U. (eds.) (2004): Handbook of Quantitative Science and Technology Research. The Use of Publications and Patent Statistics in Studies of S&T Systems. Dordrecht.

3.1.3 Rise in labour market participation

Employment is considered here not as an indicator of economic performance but rather as an element of the labour market behaviour of the workforce. This in turn can have an impact on the economic development of regions. We analyse the employment rate and the participation rate of the population aged between 25 and 64 for the years from 1999 to 2009. The participation rate is calculated as

Participation rate = Employment rate + Unemployment rate

where the denominator of these fractions is the population aged between 25 and 64.[10]

In the EU15, the employment rate is clearly tending upwards. It increased from 67.5 percent in 1999 to 72 percent in 2009 (Figure 5). The sudden break of this trend in 2009 will probably turn out to be a temporary phenomenon caused by the international financial and economic crisis and prolonged by the public debt crisis in a number of European countries. The long-standing rise of the participation rate slowed down in 2009 – which is normal for periods of economic downturn – but it was not interrupted.

The development in the EU12 was more varied, with the employment rate falling until 2004 due to an increase of unemployment and then rising in the course of an improving labour market situation. The participation decreased from about 74 percent in 1999 to just over 72 percent in 2004 and goes up since then very slowly.

The level of labour market participation – by head count - is much lower in the EU12 than in the EU15. In 2009 the difference amounted to 3.5 percentage points. But again, we have to take account of the part-time effect. In the EU15, full-time employment increased by a mere 2 percent from 2001 to 2009 whereas part-time employment soared by one third. In the EU12, the development of both kinds of employment was more balanced: the number of full-time jobs increased by 8 percent compared to 5 percent for part-time jobs. All in all, in the old member states more people are active on the (official) labour market, but with a shorter average working time than in the new member states.

Differences between the EU15 and the EU12 are also evident in the spatial dimension of employment and labour participation. While the employment rate and, in particular, the participation rate are similar for the various types of regions of the EU15, we observe significant spatial disparities for the new member states. The employment rate in the large metropolitan areas of the EU12 is higher than in the other types of regions. This is due to a lower unemployment and, more importantly, a higher labour market participation in the large metropolitan areas (Figures A11 and A12). It is beyond the scope of this study to examine the socio-economic and behavioural factors behind these spatial differences in labour market activity.

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[10] Data on unemployment is only available for persons aged 25 and more, i.e., including unemployed persons above the age of 64. This means that the unemployment rate calculated here in relation to the population from 25 to 64 is slightly exaggerated.

Figure 5
Employment rate and labour market participation

Age group 25-64
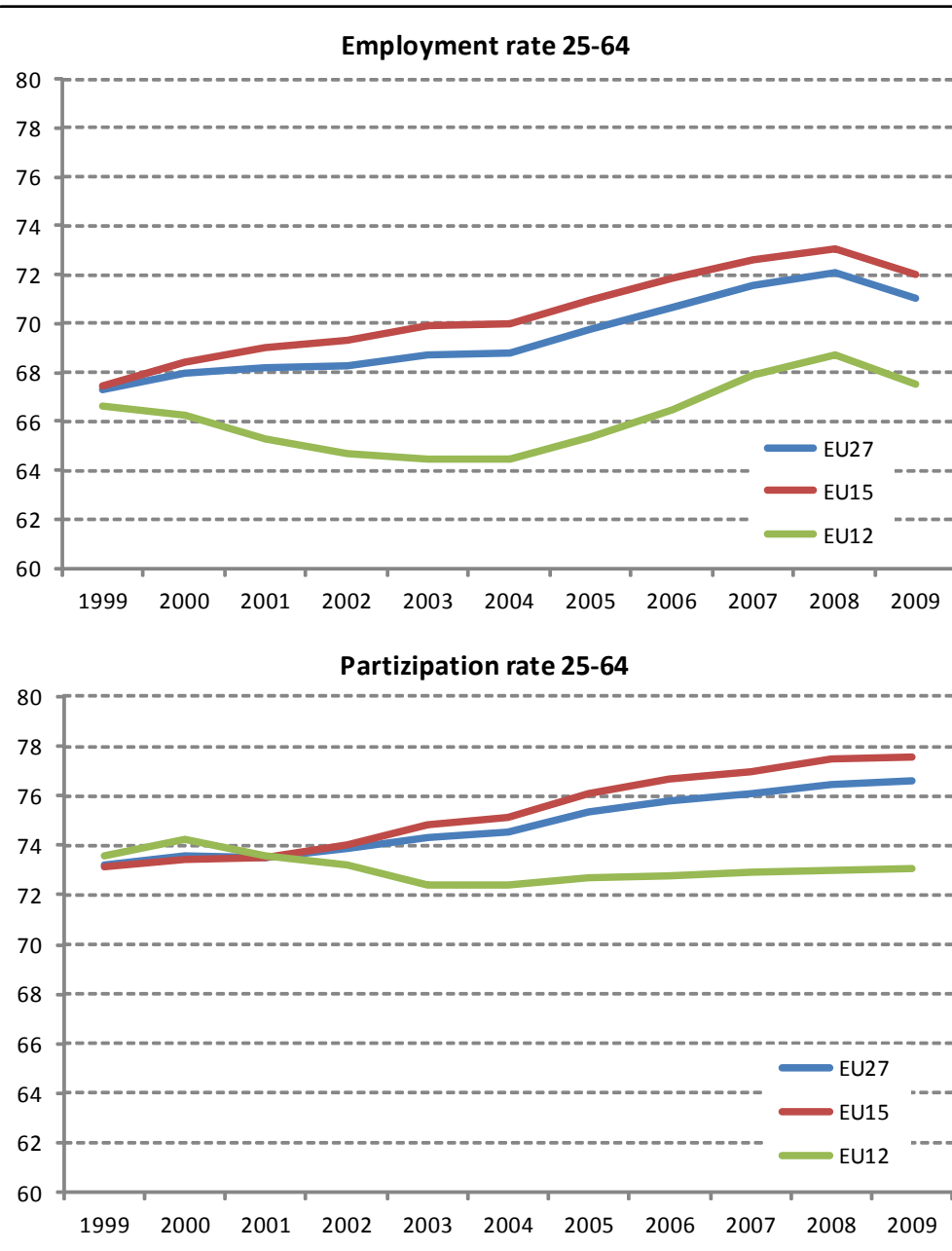
Due to data restrictions Denmark and Cyprus are not covered by this chart.

Employment rate 25-64 = persons employed aged between 25 and 64 / population
aged between 25 and 64.

Partizipation rate 25-64 = persons employed aged between 25 and 64 + unemployed persons
aged 25 and more / population aged between 25 and 64.

Unweighted averages across regions.

Sources: Eurostat Regio database; own calculations.

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3.1.4 Tendency towards urbanisation

During the past decades there have been several turns in the spatial distribution of population and economic activities. Periods of urbanisation were replaced by periods of deurbanisation, and back again (Frey1993; Cheshire 1995). Each time, factors like changes on commodity or financial markets were cited as drivers of divergent spatial developments, and some authors came up with evidence for asymmetric spatial effects of business cycles (DevBhatta et al. 2004; Petrakos et al. 2005). For all these ups and downs in spatial development, many regional economists believed that the occasional rebounds of cities and metropolitan areas were only exceptions from the general trend towards spatial dispersion of population and economic activities due to disadvantages of agglomeration, progress in information technology and infrastructural improvements in non-urban areas (Gordon et al. 1998).

In the present study, we check the dispersion hypothesis using the distribution of population and GDP across different types of regions as indicators of the spatial development in the EU. We observe a slow but constant trend of urbanisation both for the EU15 and the EU12. The shares of large metropolitan areas in total population and total GDP are rising, the shares of small metropolitan areas are remaining constant and the shares of the other regions are falling (Figures 6 and 7). Of course, there are factors acting towards spatial concentration and other factors favouring dispersion, but the net result is concentration.

The gradual process of spatial concentration described above does not necessarily involve urbanisation in a stricter sense. Most of the large metropolitan areas defined here on the basis of NUTS 2 units are characterised by core cities and vast hinterlands of intermediate and rural territories. Such a regional concept is not really appropriate for the identification of potential changes in the behaviour of individuals or firms in terms of urban locations. Therefore, we turn to a case study for Germany where we can use more detailed data and, in particular, information on cities proper.

Since the end of the 1990s the big German cities, i.e., those with a population of at least half a million, are developing better than the other regions of the country. These cities were not affected by the general process of shrinking population that started in 2003. Instead, they increased the number of their inhabitants by 4 percent (Figure 8, upper chart). Another striking difference to earlier trends is that big cities are now able to leave behind even their surrounding suburbs (Geppert, Gornig 2010).

An evaluation of the population development by age group shows that big cities are getting younger compared to the national average. The number of people under the age of 18, for example, is decreasing only half as much in cities as in Germany as a whole. At the same time, the number of people aged 18-25 is growing nearly twice as fast in big cities as on average. The differences are even greater for the age group of 25-30 years: This group is increasing in big cities but shrinking in Germany as a whole (Geppert, Gornig 2010).[11]

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[11] None of these results is driven by foreign immigrants and their children.

Figure 6
Population by types of regions

Percentages of total population
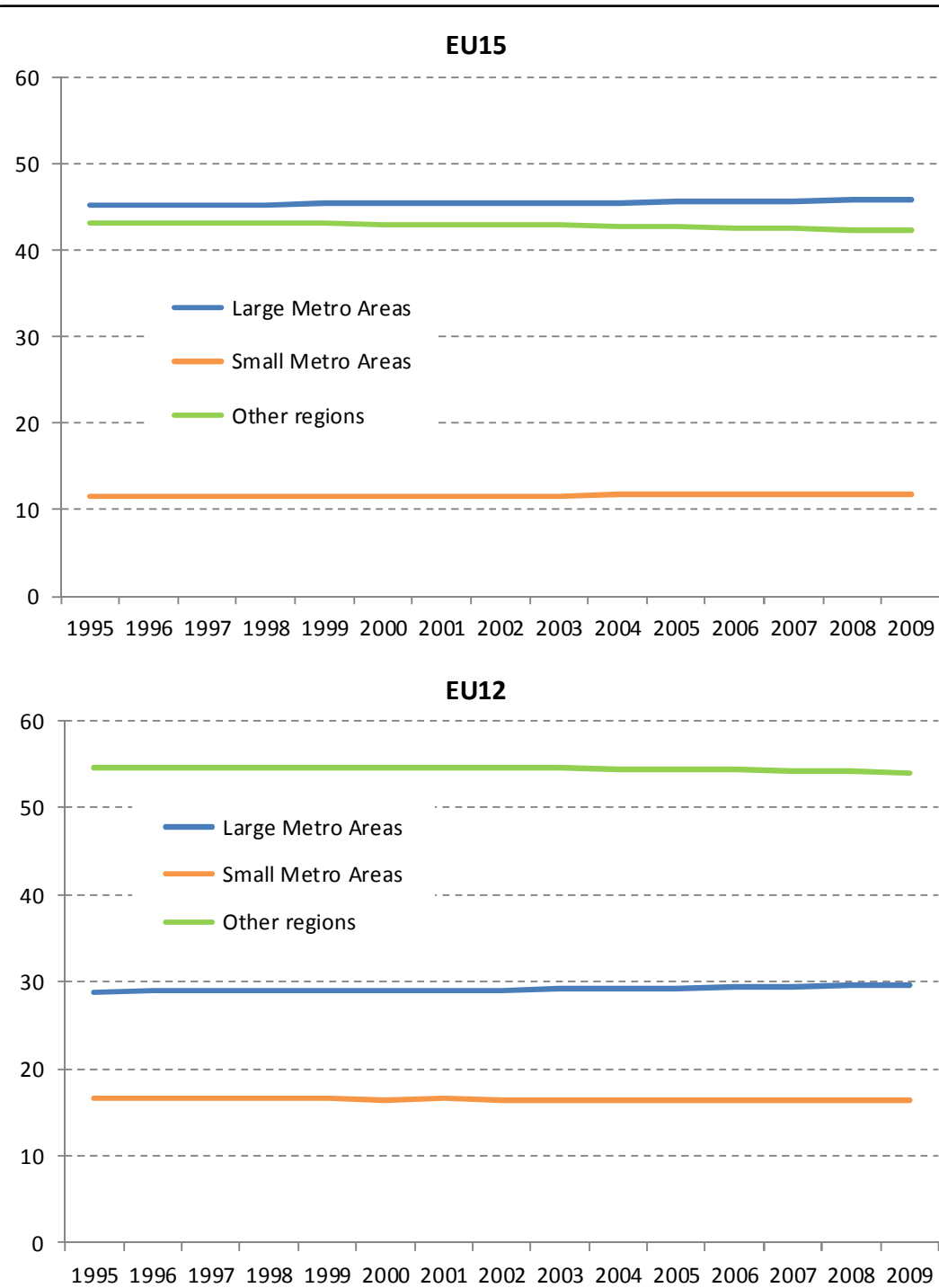
EU15

EU12

Due to data restrictions Denmark and Cyprus are not covered by this chart.

Sources: Eurostat Regio database; own calculations.

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Figure 7
GDP by types of regions
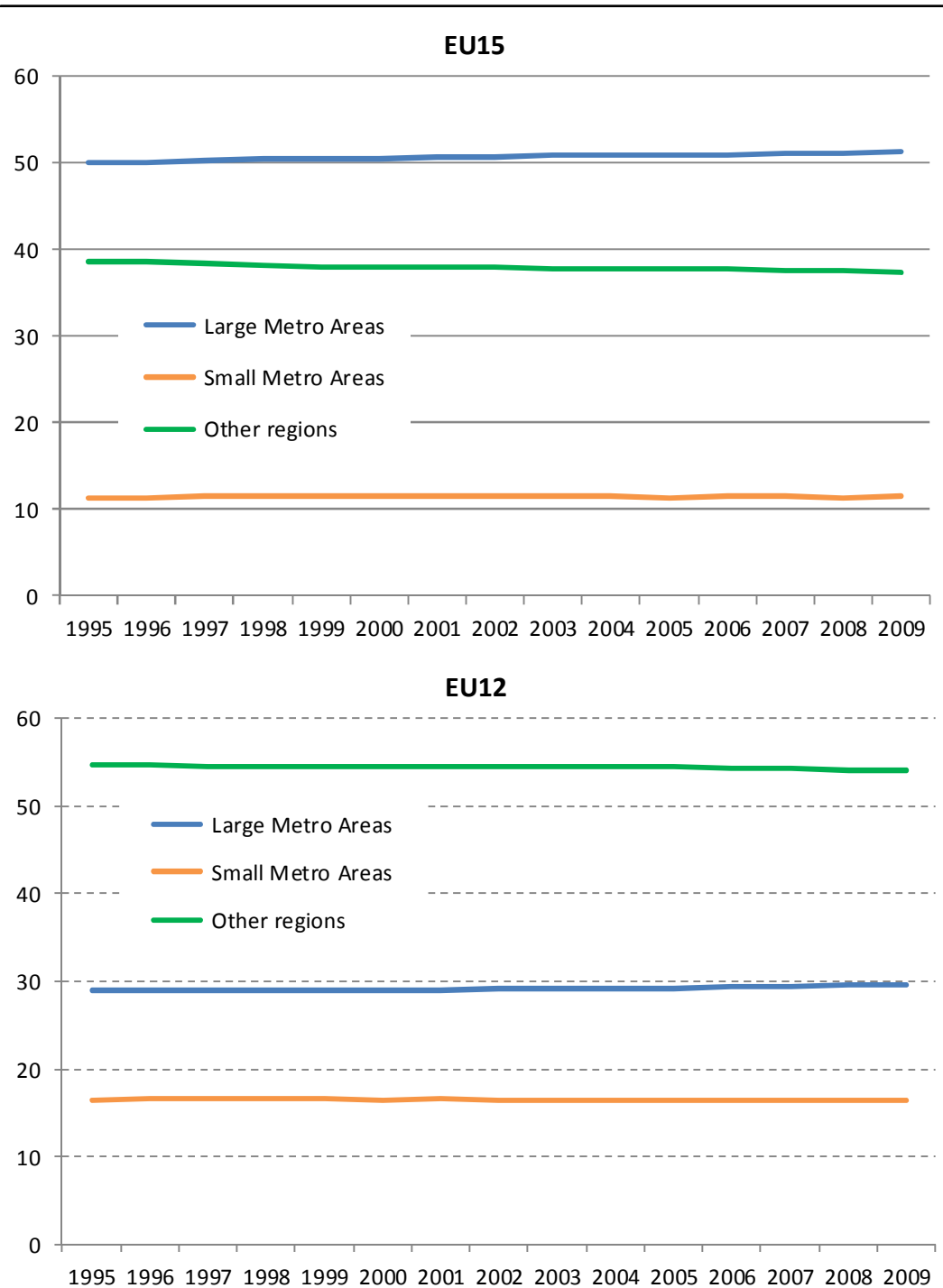
Percentages of total GDP

EU15

EU12

Due to data restrictions Denmark and Cyprus are not covered by this chart.

Sources: Eurostat Regio database; own calculations.

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One traditionally important reason for moving to a city is education, especially at universities. But the big cities also benefit from young people after completion of higher education. A reason to stay in a big city could be a change of lifestyle. Apparently, the diverse cultural opportunities afforded by living in big cities more than ever makes people want to stay in or move to urban neighbourhoods, even after they have completed their education and begin to think of families and children. At the same time new housing is being developed in the core city, including developments that appeal to households with high incomes.

Since the cities are getting younger, their birth potential is increasing compared to the other regions. From 1999 to 2010 the number of births has risen in the cities while having declined in the rest of Germany. The birth rate per inhabitant is now significantly higher in cities than in other areas (Figure 8, lower chart).

Apart from urban amenities, a decisive factor in favour of cities is the availability of jobs for skilled people. Economic structural change in big cities was characterised by two contrasting trends in the past decades - the reduction of jobs in the industrial sector on the one hand, and the expansion of the service sector on the other hand. In total, employment in the cities has increased, but the speed of growth was considerably lower than in the surrounding areas and other regions in Germany.

This process of spatial decentralisation of jobs and income could be observed until the second half of the 1990s.[12] Since then, employment in big cities increased more than in other areas. Between 1999 and 2009, the number of jobs subject to social insurance contributions in big cities increased by nearly 4 percent, while it stagnated in Germany on the whole (Table 2). Over the last 10 years, German cities have lost disproportionally more industrial jobs, 15 percent, than the national average of 8.5 percent. The increase of total employment in big cities is mainly due to the improved position of cities in traded services. Knowledge-intensive services like financing, insurance and consulting are, in most cases, fast growing intermediate services used by other firms. Big cities with multiple contact and exchange opportunities, a large supply of skilled workers, and their transport infrastructure obviously offer good conditions for the providers of such services. In 2009, the percentage of jobs that such services provide was 19 percent in cities, while only 11 percent in all of Germany. This structural pattern is so important for the cities because most subsectors of knowledge-intensive intermediate services generally develop dynamically. As a hub for these services, cities benefit most from this trend. But beyond this structural effect, cities have also witnessed a better development than other regions within the sector of knowledge-intensive intermediate services: the number of jobs subject to social insurance contributions increased by 23 percent between 1999 and 2009 in cities while the national average was only about 15 percent.

But what forces are driving spatial concentration processes? Do people move to the city because of good economic prospects and the hope for a good job, or do companies choose cities because that is where skilled employees are found? There are strong arguments for both explanations. Economic structural change in developed economies

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[12] Bade et al. 2000.

Figure 8
Urbanisation in Germany

Population
1999 = 100

Child births per 1 000 inhabitants
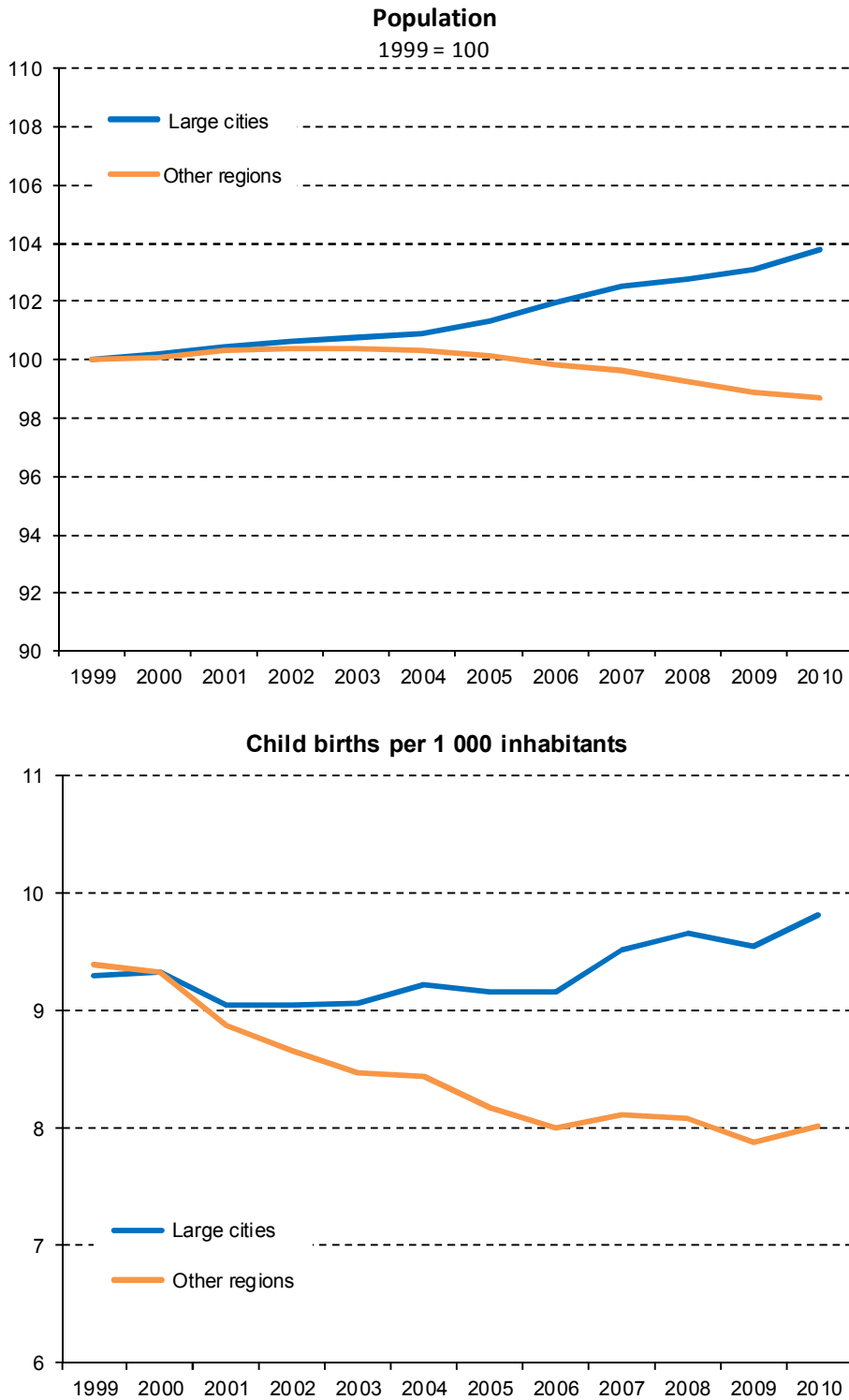
Large cities = cities with more than half a million inhabitants.
Sources: Federal Statistical Office of Germany; own calculations.

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Table 2
Employment in German cities and Germany as a whole

| | Employment 2009 | | | |
| | Industry structure | | 1999 = 100 | |
	Cities	Germany	Cities	Germany
Total employment	100.0	100.0	103.6	100.1
Manufacturing	12.6	23.3	85.2	91.5
Knowledge-intensive business services	18.9	10.8	123.0	115.4
Financial services	6.7	3.7	101.5	96.2
Banks	4.1	2.6	102.7	93.8
Insurances	2.6	1.1	99.6	102.2
Consulting services	12.2	7.1	139.2	128.7
IT-services	2.9	1.7	183.6	176.8
R&D services	1.0	0.7	117.7	133.8
Legal and business services	5.3	2.9	146.3	127.2
Architecture and engineering services	1.6	1.2	94.7	92.7
Laboratories	0.4	0.3	126.6	142.4
Advertising	1.0	0.4	144.2	124.9

Cities with more than 500 000 inhabitants.

Sources: Federal Agency of Employment; own calculations.

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is without doubt characterised by a growing importance of knowledge as a production factor. Spatial clustering and localised knowledge spill-overs play an important role for firm productivity and allow companies to make use of the advantages of big city agglomerations (Storper, Manville 2006). These locations attract highly skilled people who are, in general, more mobile than less qualified workers. The scarcer well-educated people are in a knowledge society, the more they can ignore the labour market situation of specific locations. There is evidence for "semi-autonomous" behaviour of highly skilled workers regarding their choice of residence (Markusen, Schrock 2006; Glaeser, Gottlieb 2006; Borck 2007). Since the "creative class" (Florida 2002) wants to live in cities and the knowledge economy needs their know-how, companies follow the employee's choice. Obviously, the two tendencies reinforce each other: knowledge-intensive firms are pulling skilled workers to urban places and skilled workers are pulling knowledge-intensive firms to these places.

In light of these results for Germany the conclusion by de Beer et al. (2012) for the period from 2000 to 2004 might change if more recent years are considered: "The cohort effect [on the size of the working age population] is negative for young ages in most predominantly urban regions. Many couples having children move from urban to rural or intermediate regions." The trend that has become evident during the last years for Germany represents a significant shift in the spatial distribution of population and employment, and there is little reason to assume that this tendency is a German specialty.

3.2 Interim balance

In the previous sections we have described a number of socio-economic trends in their spatial dimension. But there is another important transition process that is obvious, although not explicitly considered in the present paper: the shift to the information society. After 15 years of widely spread, and ever increasing, use of the internet as a means of communication and data transfer, the question of the spatial implications of this process might be raised again. Many augurs and popular writers have foretold the spatial structure of the information age as a "digital planet" (Negroponte 1995) or a "spaceless world" Knoke (1996) where we all live in "electronic cottages" (Toffler 1980) connected to each other by wires and radio waves. In this scenario, the "end of geography" (O'Brien 1992) and the "death of distance" (Cairncross 1997 and 2001) will lead to the dispersion of economic activities and the dissolution of urban agglomerations. In the same vein as these more futuristic views, some regional economists have tried to find evidence for the demise of cities. One study on the spatial pattern of employment in the USA concludes that "Traditional high-density cores are becoming increasingly obsolete as major employment centers" (Gordon et al. 1998. 1038).

The death-of-distance hypothesis has been rebutted by many contributions to the economic and spatial literature, both for the USA and Europe (Gaspar, Glaeser 1998; Glaeser et al. 2001; Charlot, Duranton 2006; Brülhart, Mathys 2008). And virtually all of the socio-economic tendencies described in this section in their spatial dimension point at a persistent or even increasing spatial concentration of economic activities. One exception might be seen in the fact that in the EU15 the process of deindustrialisation is slightly stronger for the metropolitan areas than for the other regions. But in the new member states the trend has gone in the opposite direction. From 1995 to 2008 the large metropolitan areas in the EU12 have increased their share in total Gross Value Added of the manufacturing sector from 30.3 to 32.8 percent. All in all, we observe a trend towards spatial concentration and urbanisation of population and economic activities within the European Union.

3.3 Regional disparities of income and productivity

The socio-economic trends described here came along with a persistence of economic disparities between the regions of the EU. For the EU as a whole, inequalities – measured by the coefficient of variation – have decreased from 2000 to 2009 (Figure 9, upper chart), but this appears to be solely the result of catching up of the Middle and Eastern European countries. Disparities *within* the EU15 and the EU 12 have remained constant in the period of observation (Figure 9, middle and lower parts). Some backward regions in the new member states have improved their relative productivity, but comparing the curves for income and productivity suggests that the improvement was not achieved through a particularly strong output growth, but rather by an enhancement of efficiency.

Figure 9
Regional disparities in income and productivity

Coefficient of variation across regions
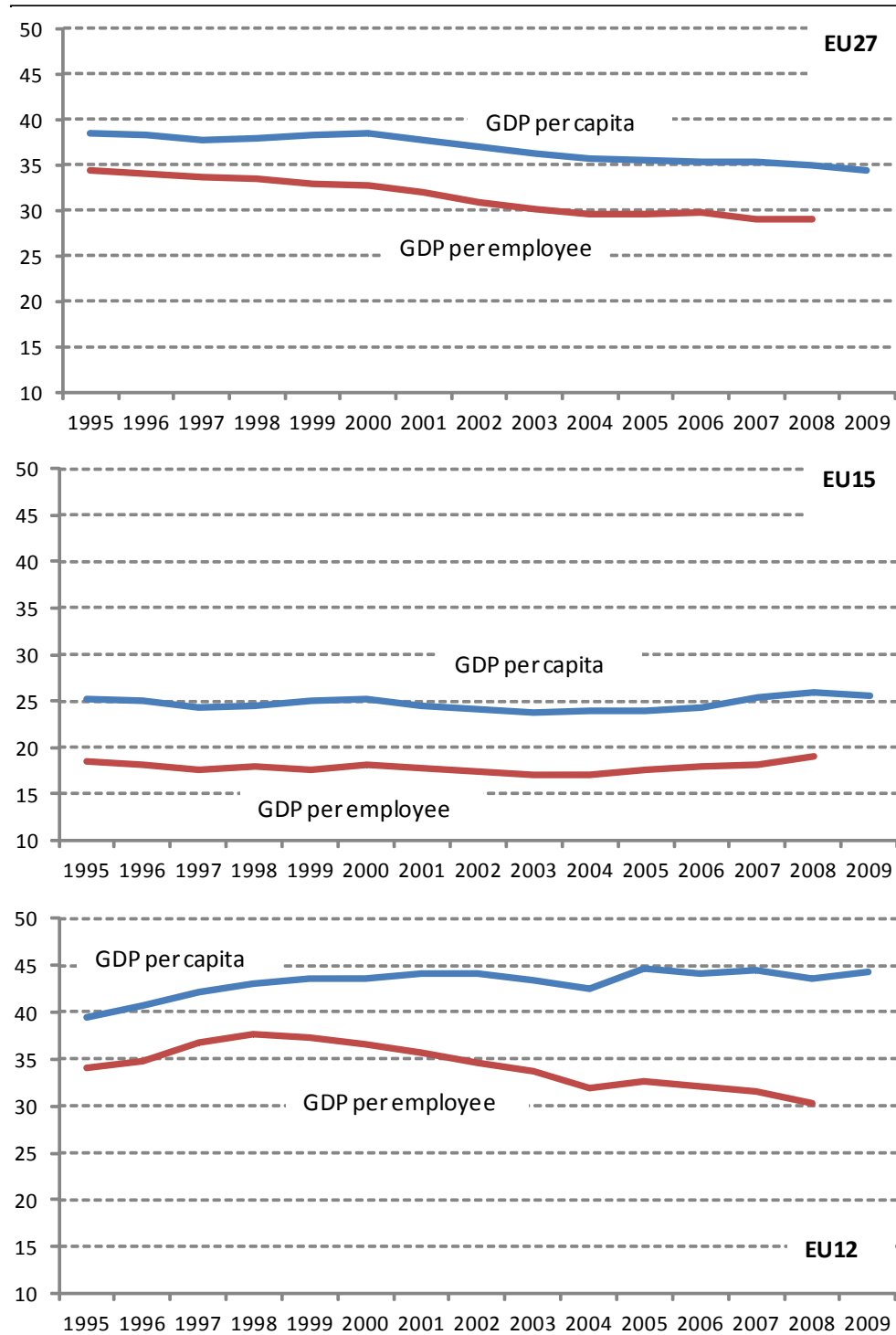
Due to data restrictions Denmark and Cyprus are not covered by this chart.

Sources: Eurostat Regio database; own calculations.

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The persistence, if not the increase, of economic inequalities is also evident when we turn to the level of nations. Within the larger countries of the EU, the regional disparities in income and productivity were more pronounced in 2009 than in 1995 Figures 12 and A13). At first sight, Germany appears to be an exception, but a more detailed analysis shows that convergence was the result of the specific development in the eastern part of the country. Regional disparities in West Germany were the same in 2009 as in the middle of the 1990s.

3.4 Regional distribution of income and the mobility of regions

The coefficient of variation in the previous section gives only a first indication of the regional development within the EU in terms of per-capita income. It is a concentrated index number with limited explanatory power. Thus, a more detailed look at the whole distribution of income growth and its variation over time is needed. We apply kernel density estimation to derive univariate (two-dimensional) density functions of regional per-capita income for the years 1995, 2002 and 2009. We look separately at the shape of income distribution for three different samples: EU27, EU15 and EU12. The density functions presented in Figure 10 were estimated using the Epanechnikov kernel and 'optimal' bandwidths as proposed by Fox (1990).

Figure 10
Estimated density functions for EU27 regions

EU-relative per-capita income in 1995, 2002 and 2009
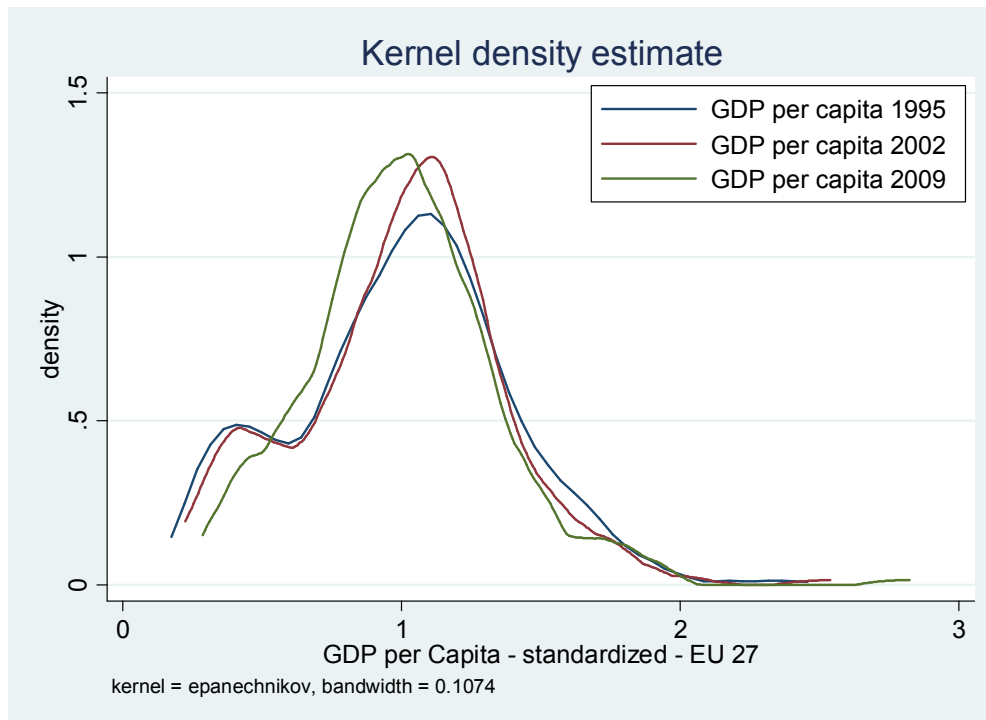
A first look at the EU-relative per-capita income reveals a maximum income of about 2.35 (Luxemburg) in 1995 compared to 2.54 (Luxemburg) in 2002 and 2.82 (Luxemburg) in 2009. The minimum income was 0.28 (Bulgaria - Yuzhentsentralen) in 1995 compared to 0.22 (Romania - Nord Est) in 2002 and 0.29 (Bulgaria - Severozapaden) in 2009.

The distribution of per capita income has undergone several notable changes during the time span from 1995 until 2009. A second peak at the lower tail apparent in 1995 and 2002 has largely disappeared in 2009. This is an additional indication that the poorest regions of the EU27 have grown and improved their relative income position which can be explained by the catching-up process of the new member states since the turn of the century (see also Figure 9 in section 3.3). In addition to the disappearance of the separate peak at the lower tail, the shape of the distribution has changed from 1995 to 2009 in two ways: the density around the average per-capita income has increased, indicating convergence, and the upper tail has stretched out further, indicating that a few rich areas have grown further away from the bulk of regions.

The estimated density functions for the EU15 and the EU12 regions are shown in Figures A14 and A15 in the Annex. Within the EU15, the poorest regions caught up, but the richest areas also improved their relative income position (the upper tail of the distribution stretched out). Unlike the distribution for the EU15, the peak of the density function for the EU12 has become lower and wider. Thus, regional inequality around the average income of the new member states has increased.

Density estimation reveals little about the way regions move up or down the income hierarchy. Therefore, we analyse the mobility over time of regions within the regional income distribution. To evaluate the intra-distributional mobility of the regions during the period observed we discretise the distribution into income classes and analyse the movements of regions between classes. Table 3 shows the transition of the EU27 regions between seven different income classes. The classification of per capita income has been made relative to the EU27 average with 7 cutpoints at 50, 75, 100, 125, 150, 175, and more than 175 percent of the EU average. For our study, we chose the whole time span (1995 - 2009) as transition period to describe the movement of regions comparing their initial income in 1995 to the relative income position in 2009.

We observe a remarkable mobility of the regions between income classes, but most of the regions that change their position move only one class up or down during the whole period of 15 years. Half of the regions in the poorest income class 1 could improve their relative income position and reached the income classes 2 or 3, and 90 percent of the regions with initial income below the unweighted EU average kept or improved their position. Thus, relatively poor regions, mainly those of the new member states, have become richer which confirms the previous results. Many high-income regions fell back in the ranking. This is also evident by the kink in the upper tail of the density function for 2009 in Figure 10. Half of the relatively rich areas that lost ground in the hierarchy are regions in Germany, reflecting the below average economic performance of that country during the first ten years of the period observed. Given the relatively high growth rates of Germany since 2005 the mobility picture would probably change if a transition matrix for a more recent sub-period would be calculated.

Table 3
Transition matrix for EU27 regions (1995 – 2009)

Classification of per capita income relative to EU average

Income Classes	Observations	Upper bounds	Transition probabilities						
			0.5	0.75	1	1.25	1.5	1.75	open
1	38	0.5	0.500	0.474	0.026				
2	23	0.75		0.522	0.391	0.087			
3	52	1		0.096	0.731	0.135	0.038		
4	70	1.25			0.314	0.600	0.071		0.014
5	34	1.5			0.029	0.529	0.353	0.059	0.029
6	19	1.75				0.053	0.684	0.158	0.105
7	5	open						0.400	0.600

Notes: Due to rounding, probabilities and distributions do not always add up exactly to unity. The number of observations is the total sum of regions available from 1995 to 2009 (241 observations). The upper bounds of the income classes indicate regional per-capita income relative to the unweighted EU average (50, 75, 100, 125, 150, 175 percent, open).

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For all regional mobility in detail, we find a pronounced persistence at the top of the hierarchy. Among the ten leading regions, there are five large metropolitan areas, both in 1995 and 2009: Paris, Brussels, Stockholm, Munich and Frankfurt.[13]

3.5 Factors for regional income and growth

Kernel density estimation and the analysis of regional mobility provide valuable insights into the development of income disparities between EU regions; however, there are clear limitations to these approaches regarding potential explanations of regional growth processes. We use multivariate regression analysis as a complementary tool to simultaneously assess the impact of initial income, settlement type of regions, national effects and a set of structural factors on regional income growth. The choice of these factors is based on the description of socio-economic trends in section 3.1. We take

- the employment share of high-tech industries and technology-based services

  (HITEC) as an indicator for technology orientation of regions;

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[13] The other five top-income regions in 2009 are all special cases in one way or the other: Groningen and North Eastern Scotland (oil and gas industry), Luxemburg (finance), the small Finnish Island Aland and the Slovakian capital city region Bratislava. Given the income level of the rest of Slovakia, the GDP per capita reported for Bratislava – 188 percent of the unweighted average across all EU regions – appears implausible.

- the employment share of knowledge-intensive services (KIS) as an indicator for a broader knowledge orientation of regions;

- patent applications (PAT) as an indicator for the innovation output of regions;

- the share of the production sector in total Gross Value Added (PROD) as a rough indicator for the sectoral structure of the regional economies.

As a starting point we use a limited growth model with only the initial per-capita income and the settlement type dummies as independent variables represented by

$$lny_{it} - lny_{it-1} = (\beta - 1)lny_{it-1} + f(\text{settlement type}_i)$$

with the growth rate of per-capita income, $lny_{it} - lny_{it-1}$, as dependent variable. We expect $(\beta - 1)$ to be significantly negative in case of convergence of regional incomes. The settlement-type dummies mirror the net influence of (1) positive and negative effects of density, (2) type of region specific infrastructures and human capital, (3) high-performance modern cities and slow-growing declining industrial cities, and (4) type of region specific impacts of structural policy. As most of the explanatory variables in our regressions, settlement-type and country dummies, represent time-invariant characteristics of regions, it is not possible to apply the standard approaches of panel data analysis. The influence of these broad categories of factors on regional income has to be evaluated in a cross-sectional setting. Nonetheless, for the purposes of the present study, it is important to allow for changes in patterns of regional growth during the period observed. We divide the entire time span into two sub-periods (1995 – 2002 and 2002 – 2009), thus performing not just one but a sequence of two cross-sectional regressions. We look again at three different samples (EU27, EU15, EU12). Estimation results are summarised in Table 4.

Regarding the EU27, the estimates indicate that regional income disparities have decreased in both sub-periods. In the second period from 2002 on this process of convergence has become sizeably stronger, reflecting the kernel density estimates for the lower tail of the distribution. At the same time, large metropolitan areas of the EU27 have grown significantly faster than the other types of regions in both sub-periods. Thus, we observe two opposing trends: convergence and agglomeration. This picture is largely confirmed when we look at the EU 15 and the EU12 separately – with two notable deviations: there was absolutely no regional convergence within the EU12 in the first sub-period and there were no significant growth differences between the types of regions of the EU15 in the second sub-period.

Of course, this is a very crude model that 'explains' only a small part of the variation in regional per-capita income. Nonetheless, these estimates confirm the results of the descriptive analyses presented in sections 3.1 to 3.4, in particular regarding the disappearance of the second peak at the lower tail of the density function, the higher density around the average and the stretching out of the upper tail.

Table 4
Cross-sectional regression results (OLS) - growth of per capita income (EU15, EU12, EU27)

	Dep. var.: $lny_{it} - lny_{it-1}$					
	EU27		EU15		EU12	
	1995 - 2002					
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
ln y_{t-1}	-0.060***	-3.760	-0.171***	-6.060	0.069	1.180
Large metro	0.042**	2.210	0.037**	2.010	0.128**	2.500
Small metro	0.010	0.460	0.042	1.800	-0.040	-0.780
Intermediate	-0.005	-0.270	0.003	0.190	-0.171	-1.190
Intercept	0.063	0.870	-0.397***	-3.300	0.702**	2.340
N	241		188		53	
R^2	0.078		0.180		0.200	
	2002 - 2009					
ln y_{t-1}	-0.215***	-14.510	-0.029	-1.220	-0.158***	-3.360
Large metro	0.073***	4.280	0.011	0.770	0.160***	3.280
Small metro	0.029	1.400	-0.022	-1.180	0.061	1.310
Intermediate	0.009	0.530	-0.004	-0.340	-0.050	-0.380
Intercept	-0.732***	-11.710	-0.010	-0.110	-0.435*	-1.930
N	241		188		53	
R^2	0.494		0.020		0.283	

Notes: Reference category are rural regions for settlement-type effects. For both periods we estimate the model for EU12, EU15 and EU27 (Denmark, Cyprus and French overseas regions excluded due to data restrictions). Robust t statistics in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%;

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However, findings change substantially as soon as national effects are considered (see Table A1 in the Annex). Country-dummy variables capture the net effects of a number of factors at the national level such as (1) country-specific shocks and macro-conditions, (2) national institutions e.g., education, infrastructures and policies, (3) national and subnational networks, (4) country-specific preferences, cultures and behaviours and (5) country-specific impacts of EU structural policies. Most of the estimated coefficients of the country-dummy variables are highly significant and plausible in light of the growth performance of European nations since 1995. With national effects accounted for, convergence disappears completely. This means that the decrease in regional inequalities within the EU27 is solely due to convergence between countries, not between regions within countries (see also section 3.3).

In the next step we include the structural variables relating to technology, knowledge, innovation and economic sectors in the regressions. The estimated coefficients for the first three variables have all the expected positive sign and are significant, if not in each

sub-period.[14] The size of the production sector had a negative impact on regional per-capita income in the first sub-period and a positive impact in the second sub-period, but in both cases the coefficients are only weakly significant.

The estimation results in Table 5 indicate that until 2002 regions with a higher production intensity showed less income growth in comparison to regions with a lower production intensity. However, in the second period this effect is removed and higher production intensity was favorable for regional income growth.

With the inclusion of the structural variables, some convergence reappears in the estimates and the growth advantage for large metropolitan areas disappears. As the results of the descriptive analysis would suggest, the relatively strong income growth of the large metropolitan areas is greatly due to the concentration of technology and knowledge there. Controlling for these factors separately eliminates the growth effect for large metropolitan areas (see also the results of a regression for the level of per-capita income in Table A2).

Table 5

Cross-sectional regression results (OLS) with country dummies - growth of per capita income (EU27)

	Dep. var.: $lny_{it} - lny_{it-1}$			
	1995 - 2002		2002 - 2009	
	Coeff.	t-value	Coeff.	t-value
ln y_{t-1}	-0.052**	-1.990	-0.024	-0.930
Large metro area	0.007	0.530	0.005	0.400
Small metro area	-0.014	-1.050	-0.006	-0.480
Intermediate region	-0.002	-0.130	0.008	0.700
HITEC	0.034**	2.080	0.010	0.710
KIS	0.080*	1.720	0.194***	4.280
PAT	0.014**	2.440	0.003	0.560
PROD	-0.046*	-1.760	0.040*	1.730
Intercept	0.164	1.230	0.263	2.150
N	226		226	
R^2	0.780		0.873	

Notes: Country-dummies were included in the model, but the estimated coefficients are not shown in this table. Reference categories are Italy for country effects and rural regions for settlement-type effects. We estimate the model for EU27 (Denmark, Cyprus, French overseas regions and 15 other regions from various EU countries excluded due to data restrictions). Robust t statistics in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%;

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[14] There is some correlation between the three variables representing technology, knowledge and innovation, so that identification could be difficult.

A much discussed issue in the analysis of regional income and growth are spatial spillovers. If firms and workers in one region are affected by activities in neighbouring regions, the estimates might be biased. The potential relevance of this problem depends on the definition of regions. With our concept of widely defined regions based on NUTS2, the bulk of spillovers is likely to be internal. A stylised fact of empirical research in this field is that externalities are subject to a rapid decay with distance. Most studies identify ranges of well below 100 kilometres (e.g. Rosenthal, Strange 2003 and 2008; Henderson 2003; Duranton, Overman 2005; Graham 2008) and only a few find evidence for somewhat more extensive externalities (Rodriguez-Pose, Crescenzi 2008).

4   Conclusions

In the present study, we explore four general socio-economic trends in their regional dimension - the shift towards services, the shift towards technology and knowledge-intensive activities, the rise in labour market participation and the renewed tendency towards urbanisation – and analyse how economic disparities between EU regions change in the course of these processes. Virtually all of these tendencies point at a persistent or even increasing spatial concentration of economic activities. The spatial hierarchy in terms of income, technology, knowledge-intensity and innovation, with large metropolitan areas at the top and rural regions at the bottom, is not levelling out, in some respects it is even getting stronger.

Overall, the economic inequalities between the regions of the EU27 have decreased from 1995 to 2009, in particular in the second half of that period. But this is not due to an underlying general process of convergence, rather it is the result of catching up of poor member states, whereas regional disparities *within* most of the EU countries are not changing, or even increasing. The regional pattern of the EU is determined by two countervailing trends: convergence and agglomeration. In contrast to the predictions of many popular augurs and some regional economists, the widespread and ever increasing use of the internet as a means of communication and data transfer does not lead to the dispersion of economic activities and the dissolution of urban agglomerations.

While the regions of the new member states are catching up in terms of income and productivity, the wide gap between the EU12 and the EU15 regarding technology, knowledge-intensity and innovation is hardly narrowing. Therefore, it might take very long for the EU12 countries to approach the development level of the old member states.

Due to data availability, our analysis ends with the year 2009. This could be problematic with regard to the validity of the results, because the various countries and regions of the EU have been struck very differently by the deep economic crisis in 2008/2009. Some of our estimates for the second sub-period from 2002 to 2009 are certainly affected by this asymmetric shock, but overall, we can be confident that our combination of descriptive and regression analyses provides reliable information on the territorial dynamics within the European Union.

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Annex

Figure A1
Shift to services in selected EU countries
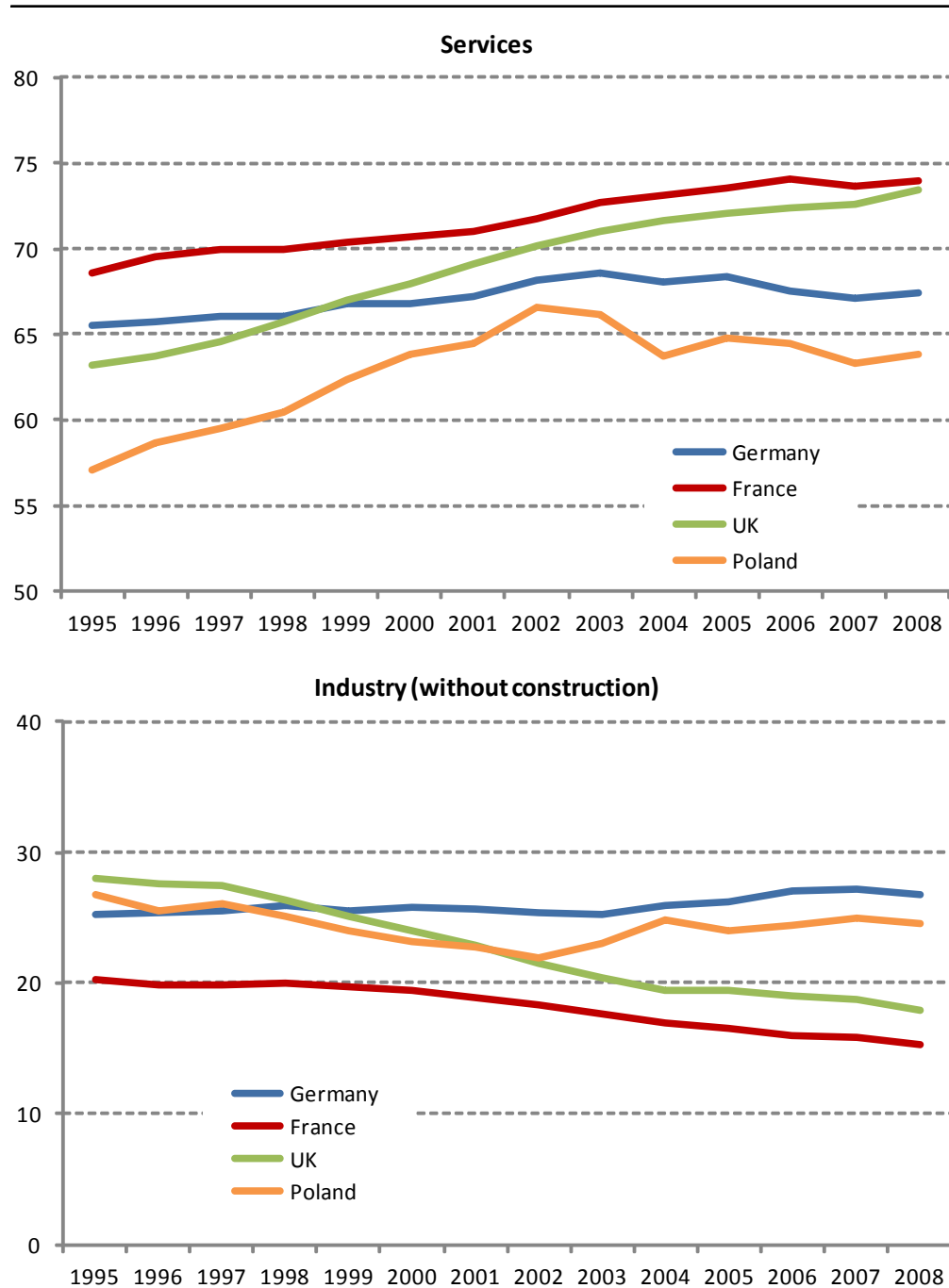
Percentages of total Gross Value Added

Services
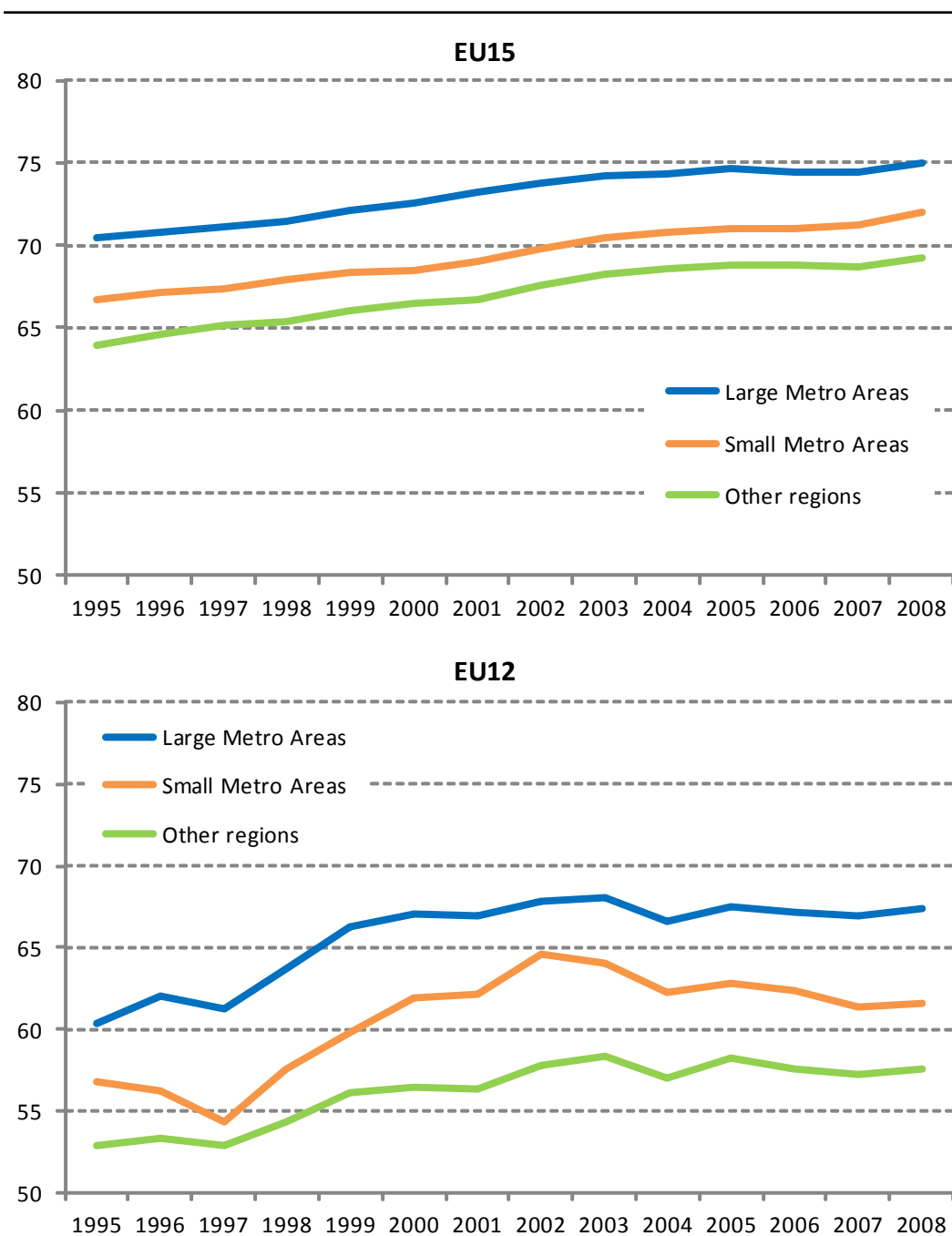

Industry (without construction)

Due to data restrictions Denmark and Cyprus are not covered by this chart.

Unweighted averages across regions.

Sources: Eurostat Regio database; own calculations.

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Figure A2
Shift to services by type of region

Percentages of total Gross Value Added

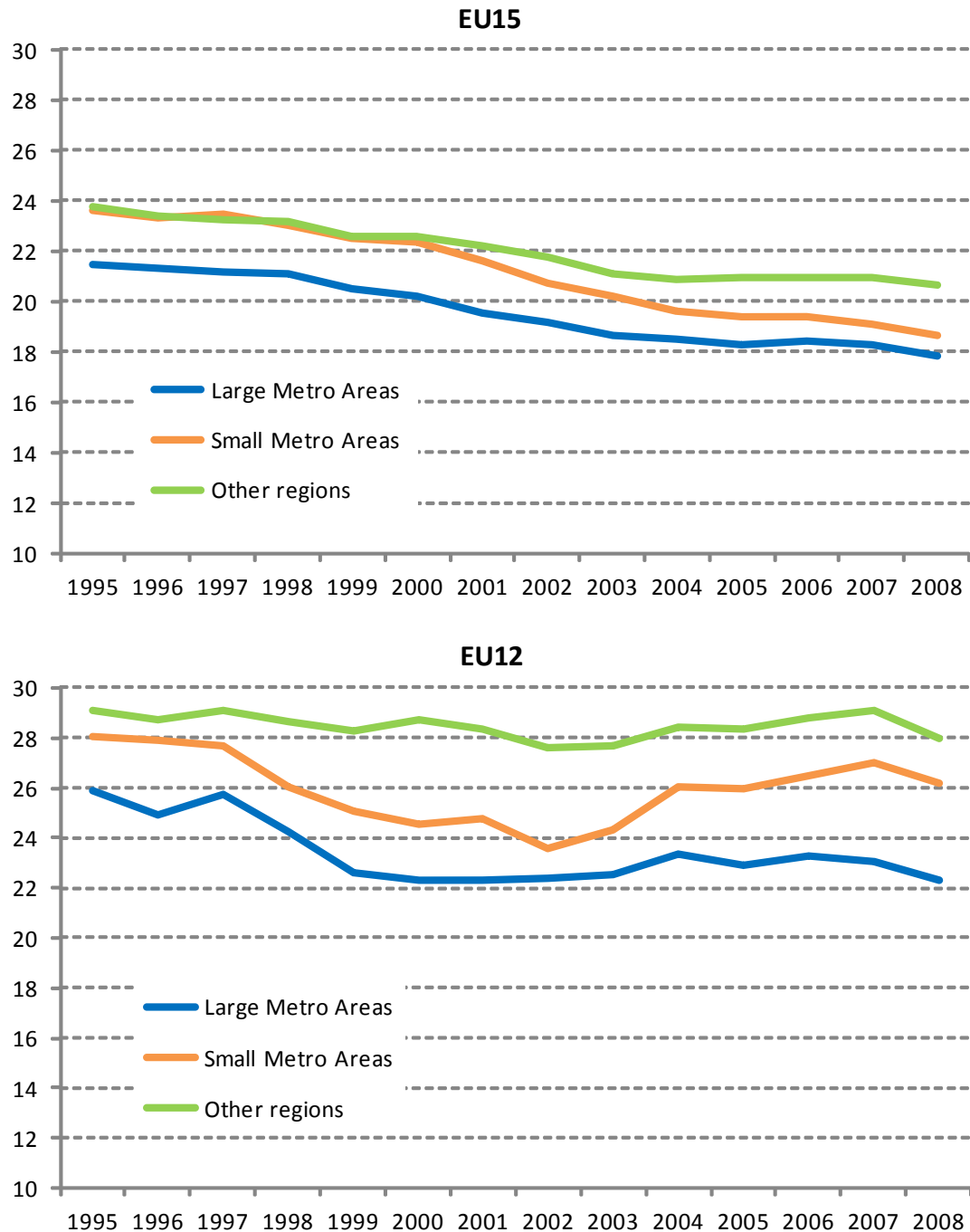Due to data restrictions Denmark and Cyprus are not covered by this chart.

Unweighted averages across regions.

Sources: Eurostat Regio database; own calculations.

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Figure A3
Share of industry by type of region

Percentages of total Gross Value Added

EU15

EU12

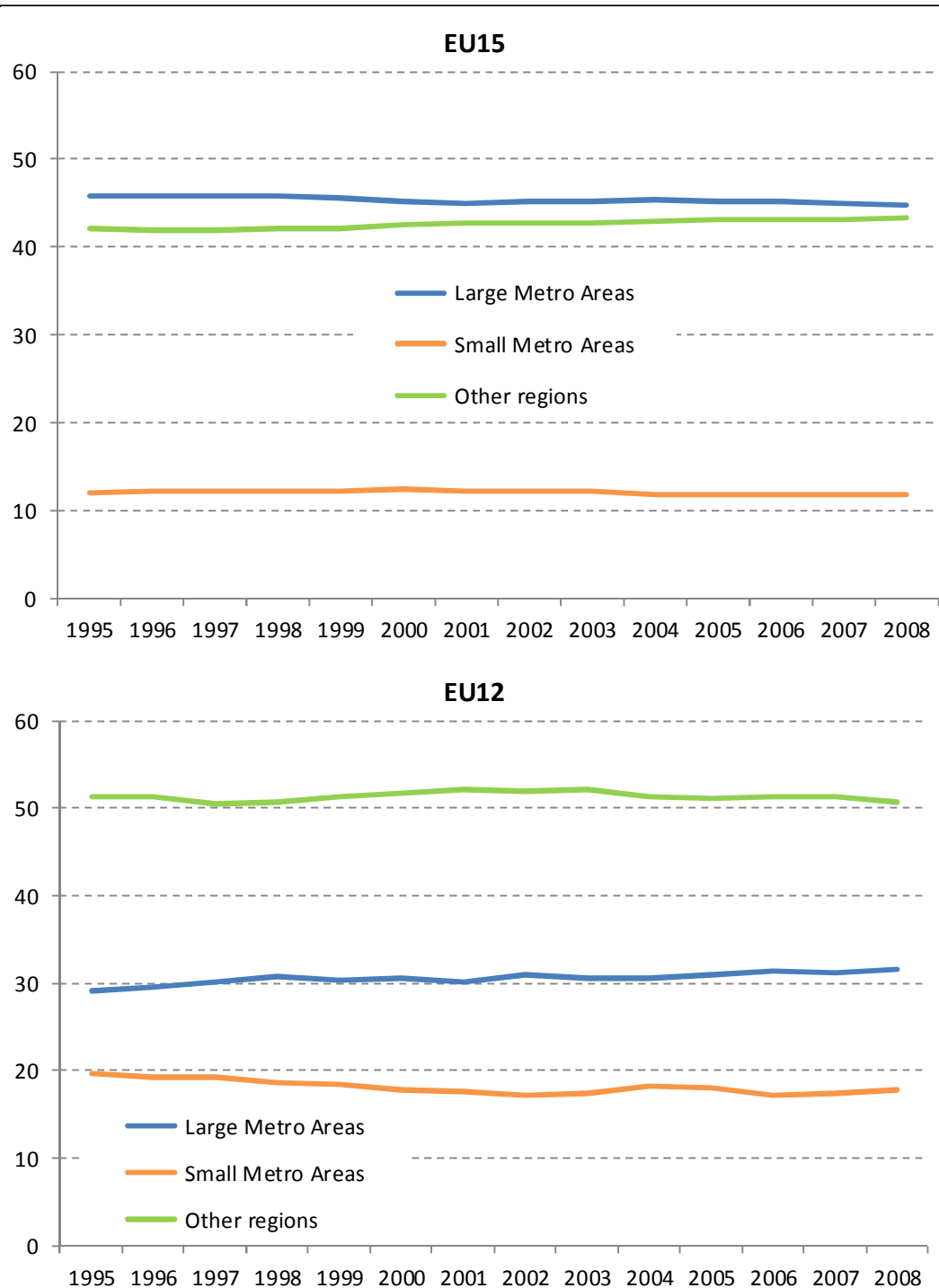Due to data restrictions Denmark and Cyprus are not covered by this chart.

Unweighted averages across regions.

Sources: Eurostat Regio database; own calculations.

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Figure A4
Share of types of regions in total industrial Gross Value Added
Percentages

EU15

EU12

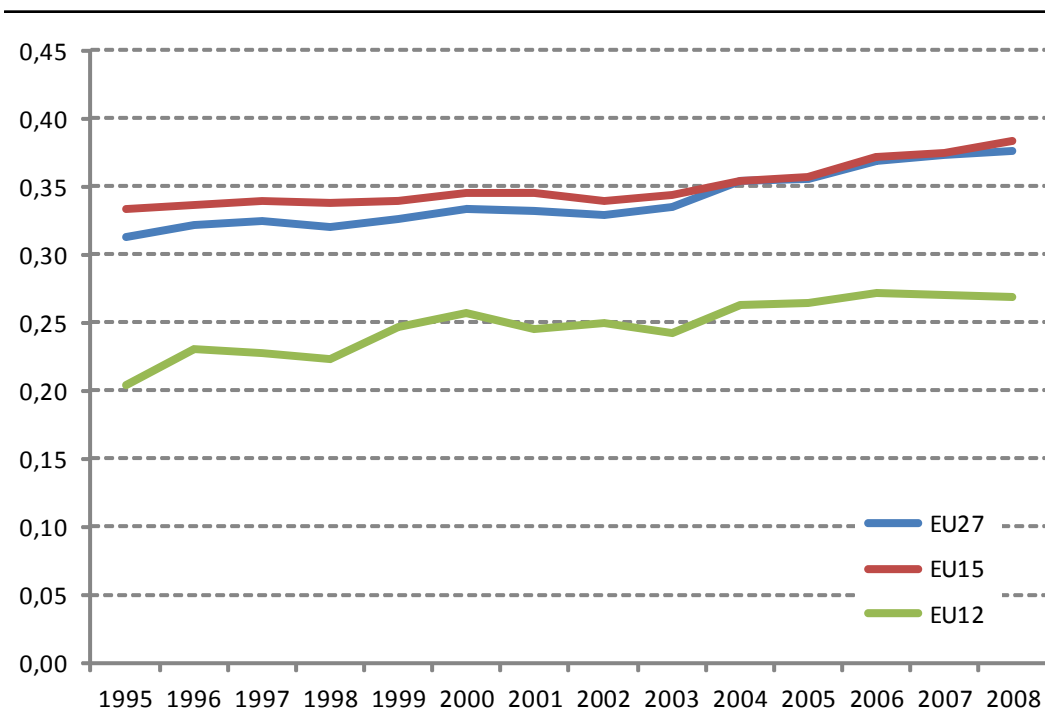Due to data restrictions Denmark and Cyprus are not covered by this chart.

Sources: Eurostat Regio database; own calculations.

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Figure A5
Regional variation of the share of industry in total GVA

Coefficient of variation across regions

Due to data restrictions Denmark and Cyprus are not covered by this chart.

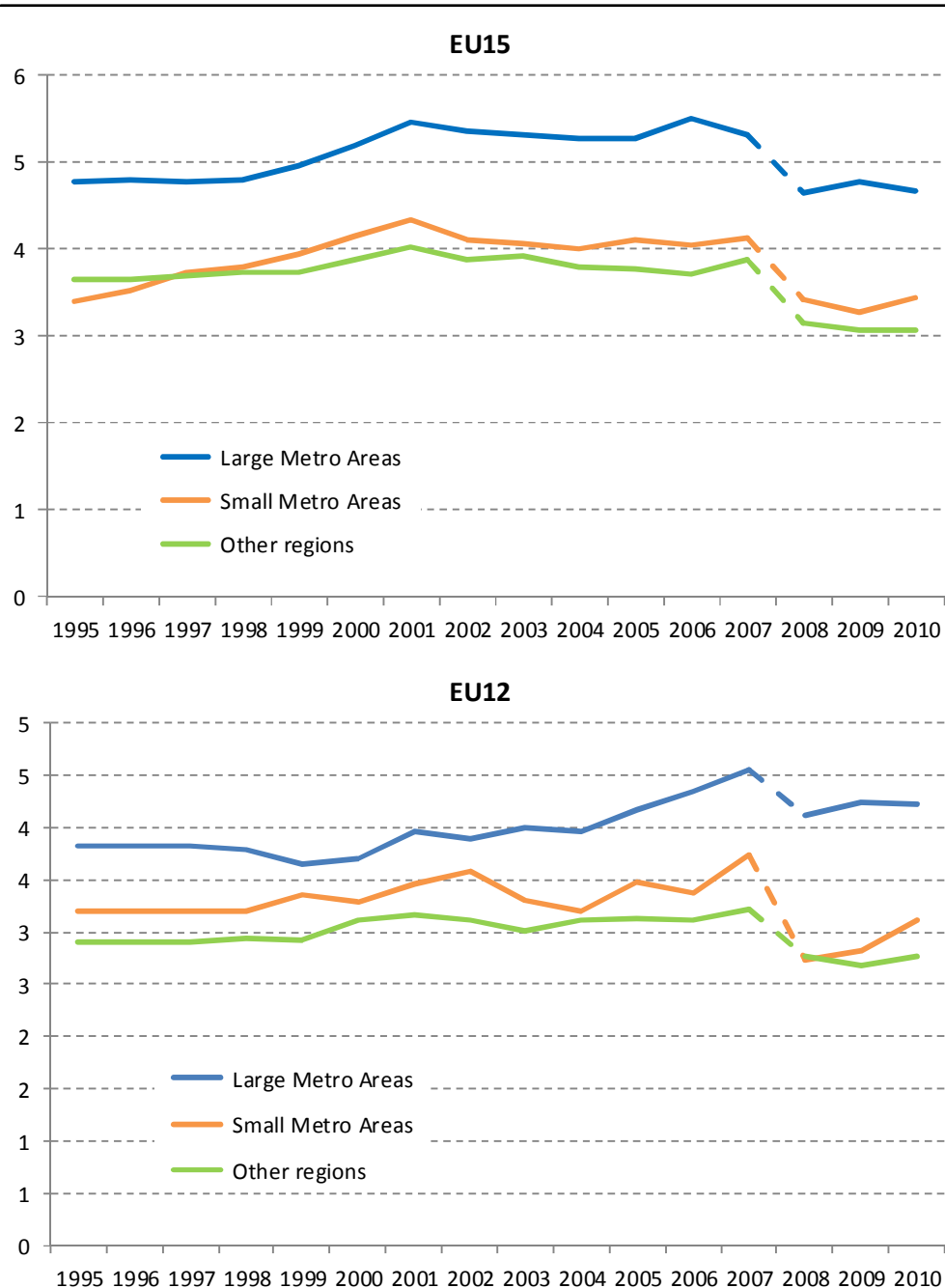Industry = Mining, Manufacturing, Energy and water supply.

Sources: Eurostat Regio database; own calculations.

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Figure A6
Share of high-tech industries and technology-based services by type of region

Percentages of total employment

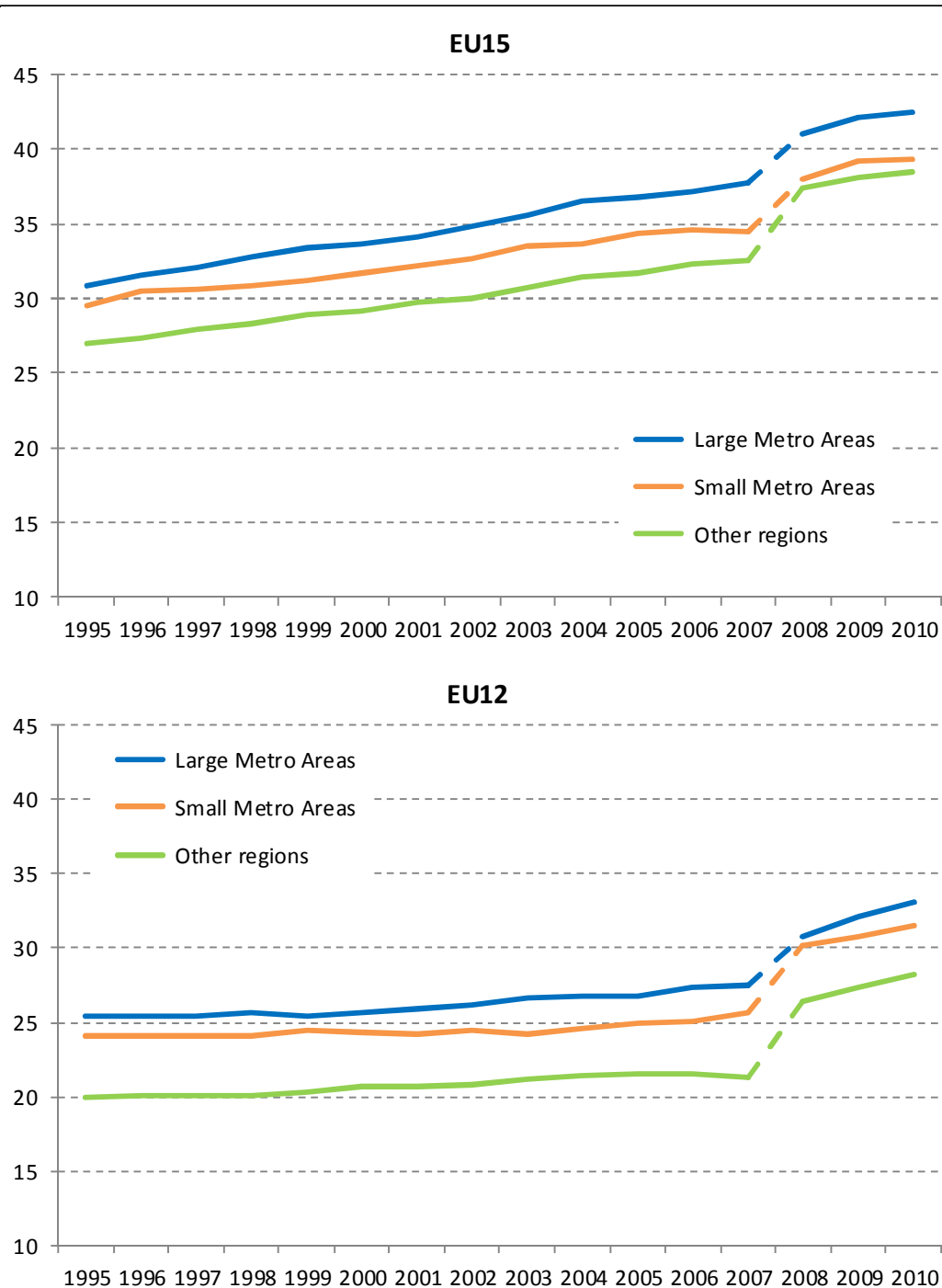Due to data restrictions Denmark and Cyprus are not covered by this chart.

Unweighted averages across regions.

Sources: Eurostat Regio database; own calculations.

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Figure A7
Share of knowledge-intensive services by type of region

Percentages of total employment

Due to data restrictions Denmark and Cyprus are not covered by this chart.

Unweighted averages across regions.

Sources: Eurostat Regio database; own calculations.

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Figure A8
Human resources in science and technology by type of region

Percentages of total employment

Due to data restrictions Denmark and Cyprus are not covered by this chart.
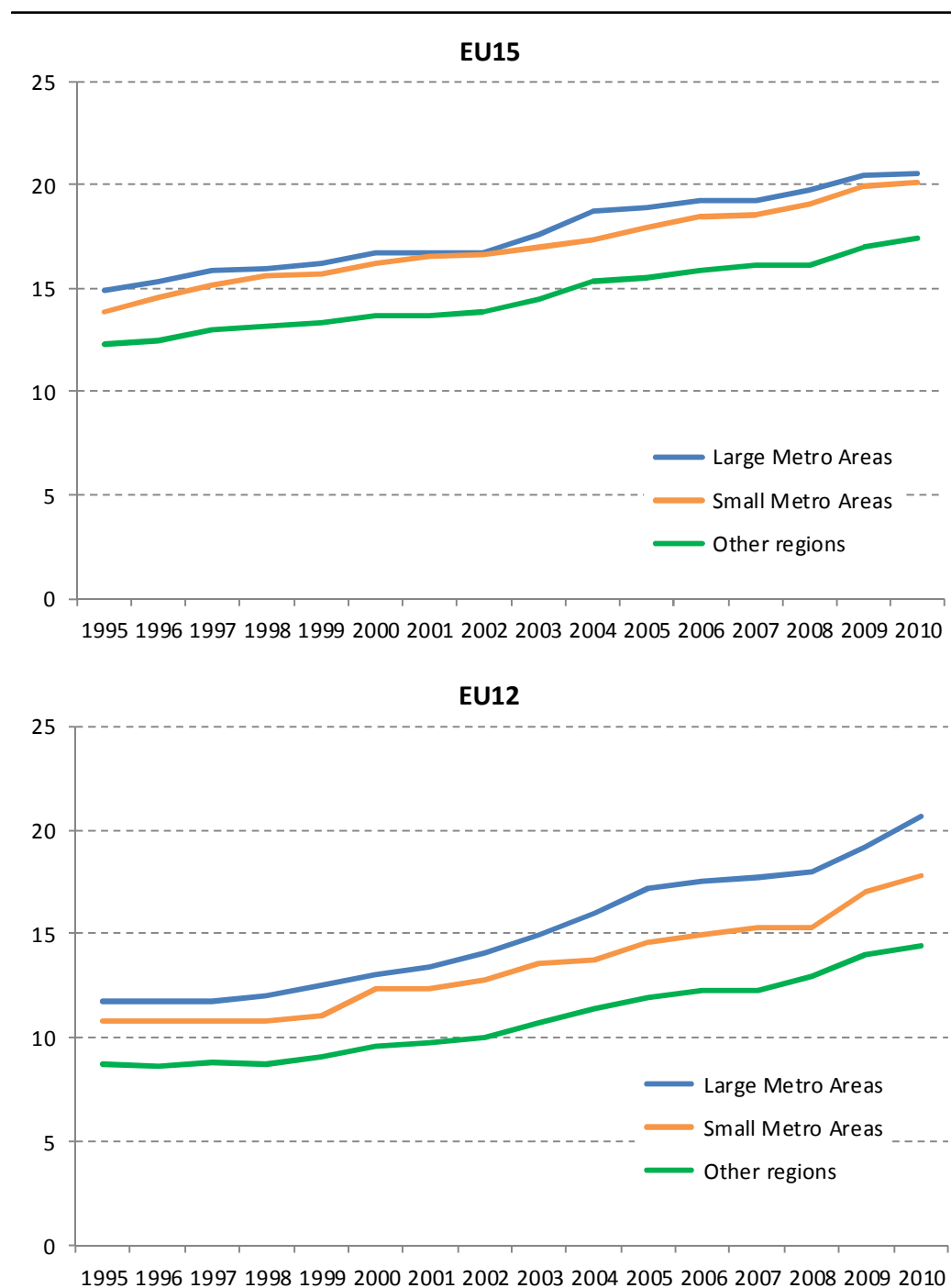
Unweighted averages across regions.

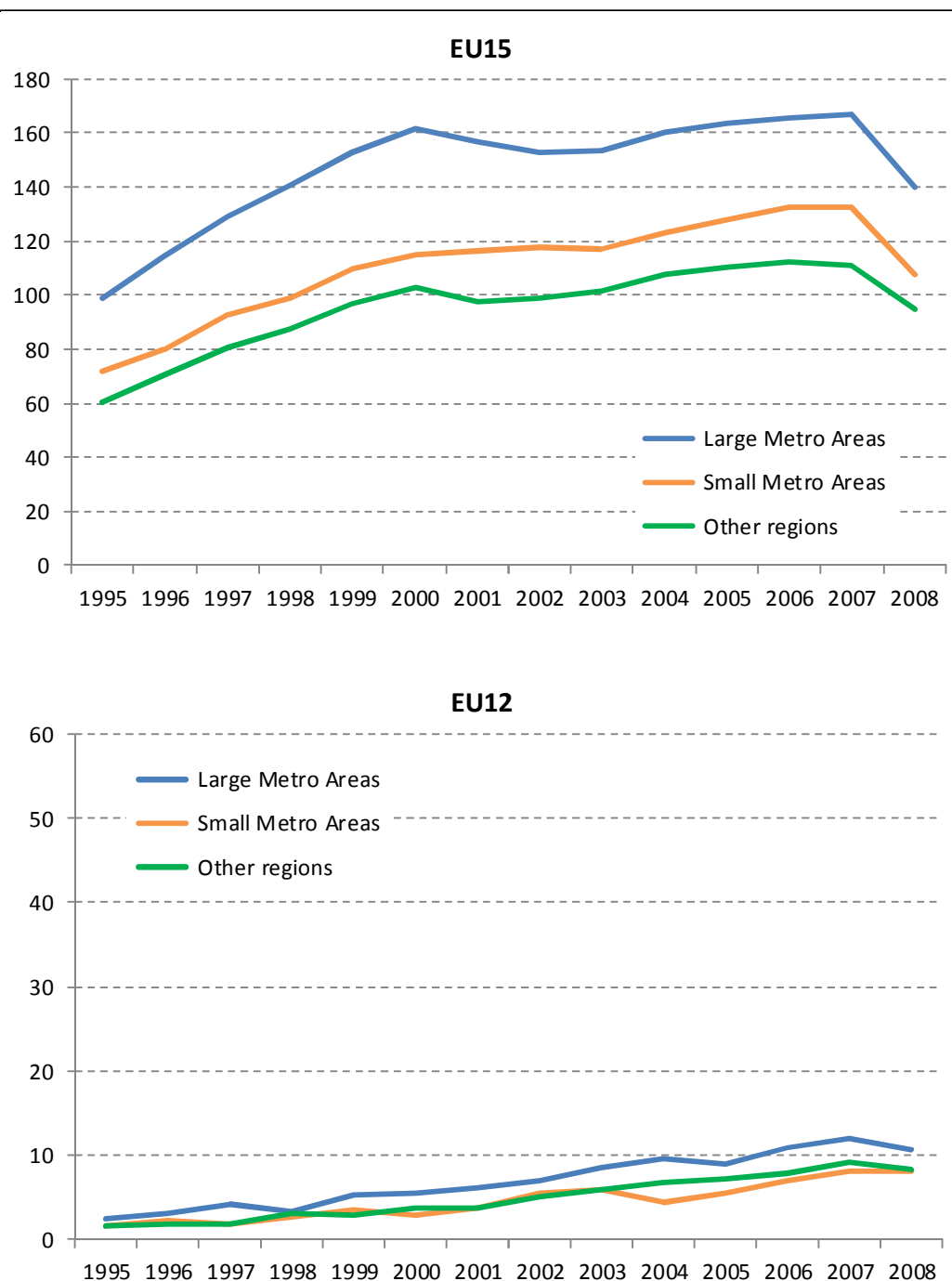Sources: Eurostat Regio database; own calculations.

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Figure A9
Patent applications to the European Patent Office by type of region

Number of patents per 1 million inhabitants

EU15

EU12

Due to data restrictions Denmark and Cyprus are not covered by this chart.

Unweighted averages across regions.

Sources: Eurostat Regio database; own calculations.

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Figure A10
Employment rate by type of region

Age group 25-64

Due to data restrictions Denmark and Cyprus are not covered by this chart.

Employment rate 25-64 = persons employed aged between 25 and 64 / population
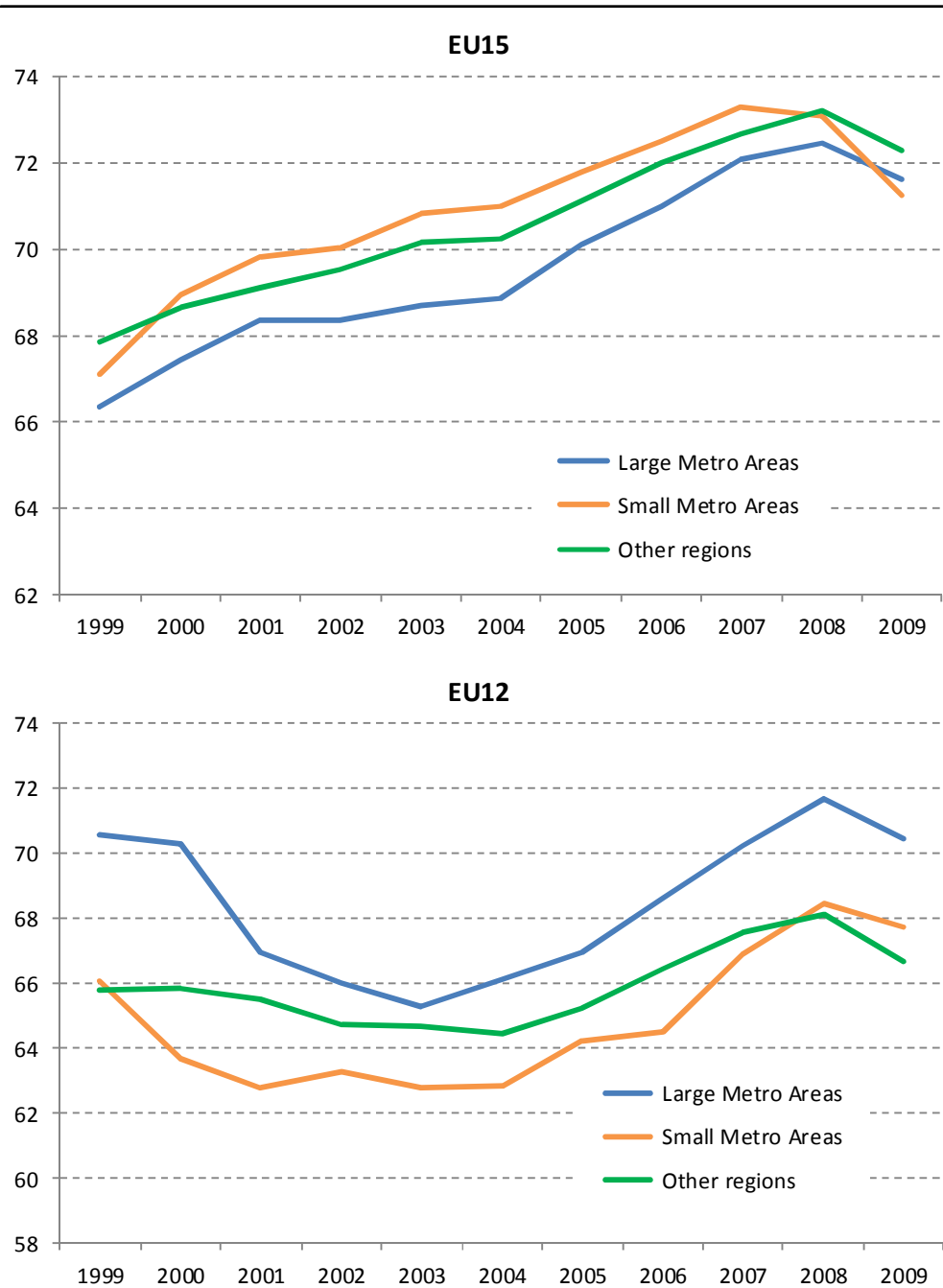
aged between 25 and 64.

Unweighted averages across regions.

Sources: Eurostat Regio database; own calculations.

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Figure A11
Participation rate by type of region

Age group 25-64

EU15

EU12
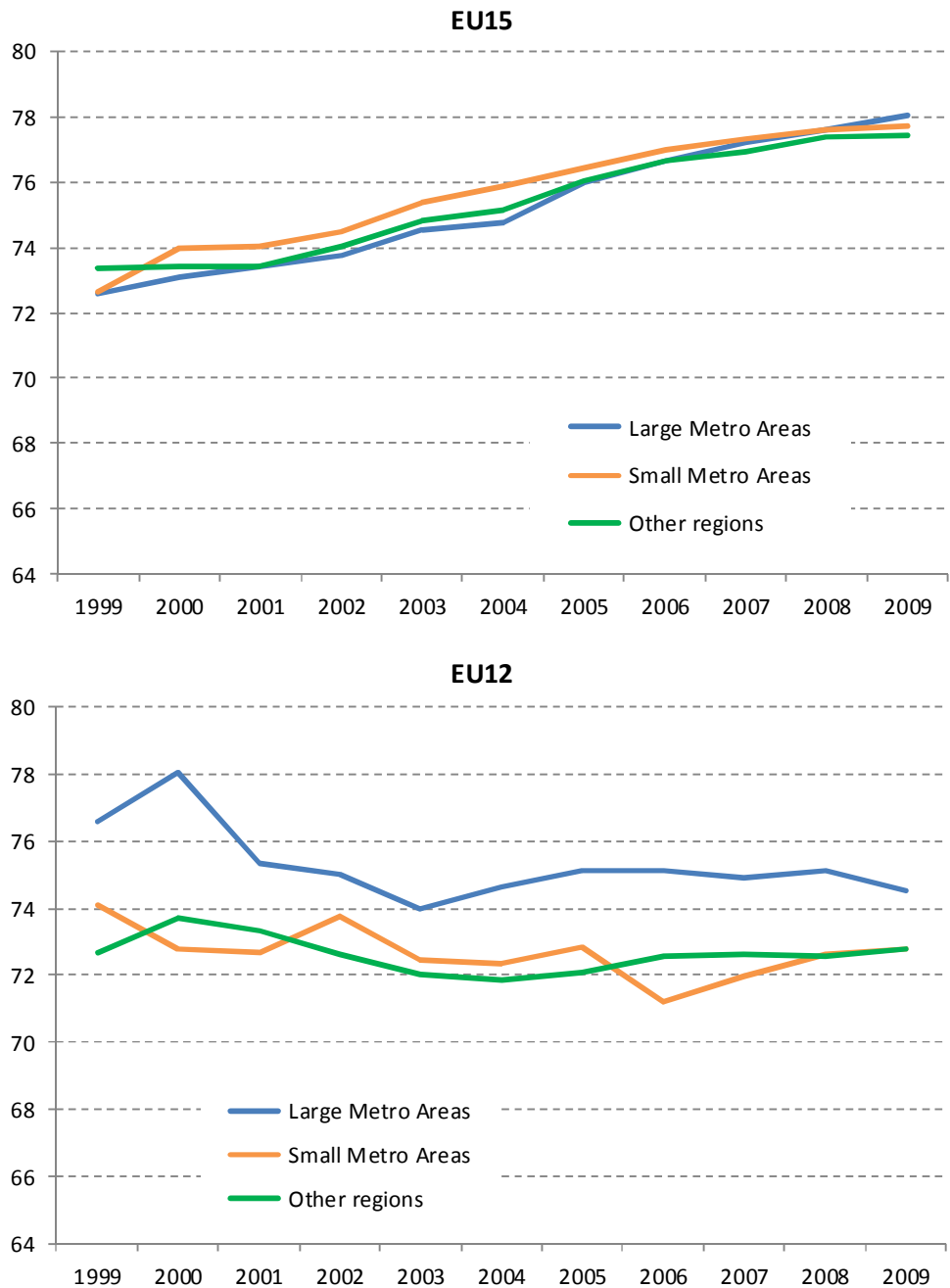
Due to data restrictions Denmark and Cyprus are not covered by this chart.

Participation rate 25-64 = persons employed aged between 25 and 64 + unemployed persons

aged 25 and more / population aged between 25 and 64.

Unweighted averages across regions.

Sources: Eurostat Regio database; own calculations.

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Figure A12
Regional disparities in income and productivity for selected countries (I)

Coefficient of variation across regions

Germany

France

Sources: Eurostat Regio database; own calculations.

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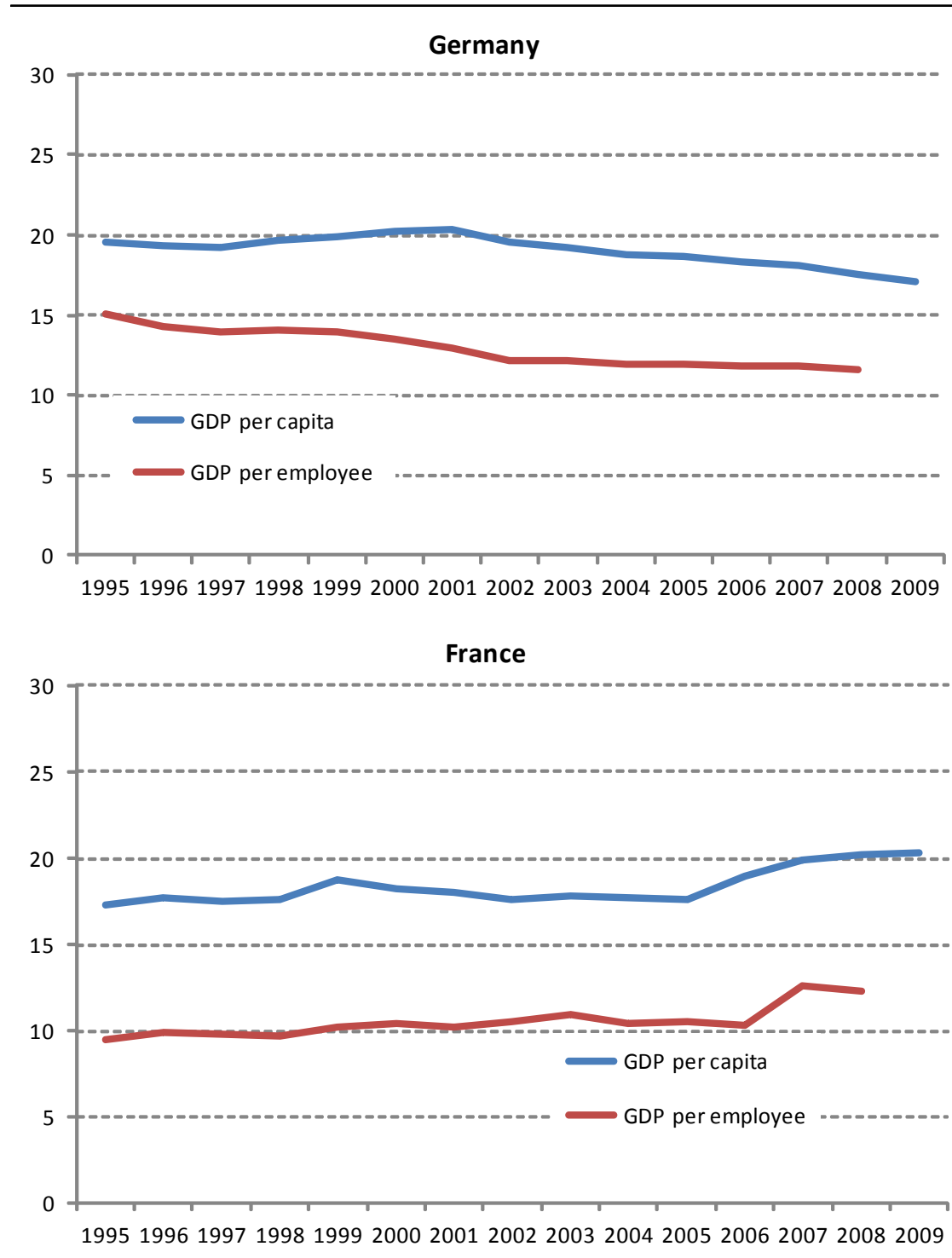
Figure A13
Regional disparities in income and productivity for selected countries (II)

Coefficient of variation across regions

United Kingdom

Legend:
— GDP per capita
— GDP per employee

Poland

Legend:
— GDP per capita
— GDP per employee

Sources: Eurostat Regio database; own calculations.

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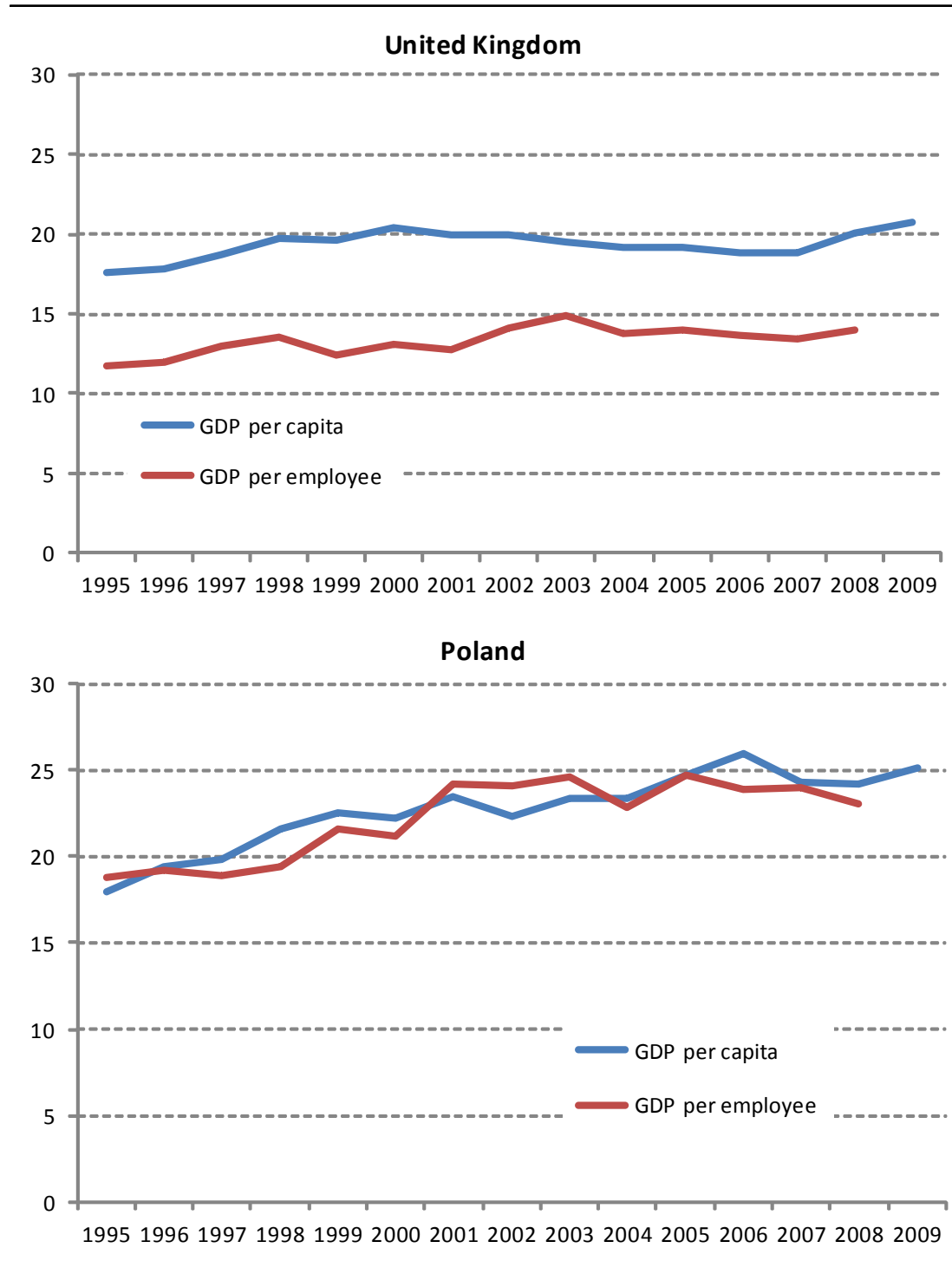
Figure A14
Estimated density functions for EU15 regions

EU15-relative per-capita income in 1995, 2002 and 2009

kernel = epanechnikov, bandwidth = 0.0750

Figure A15
Estimated density functions for EU12 regions

EU12-relative per-capita income in 1995, 2002 and 2009

Kernel density estimate

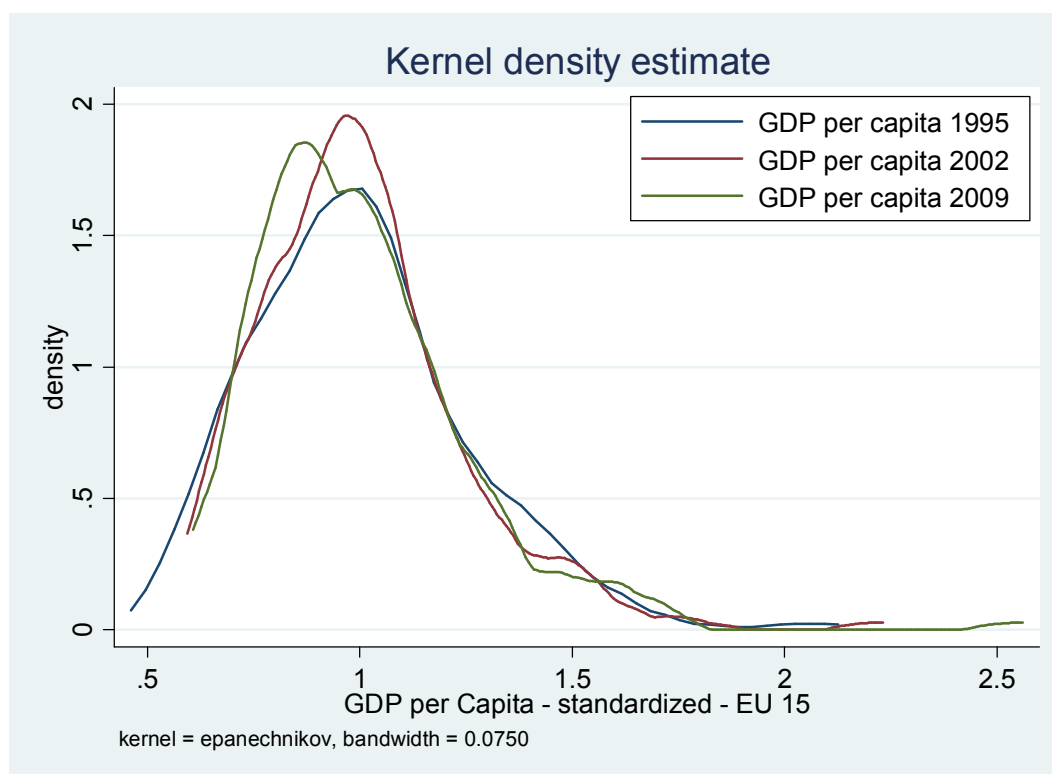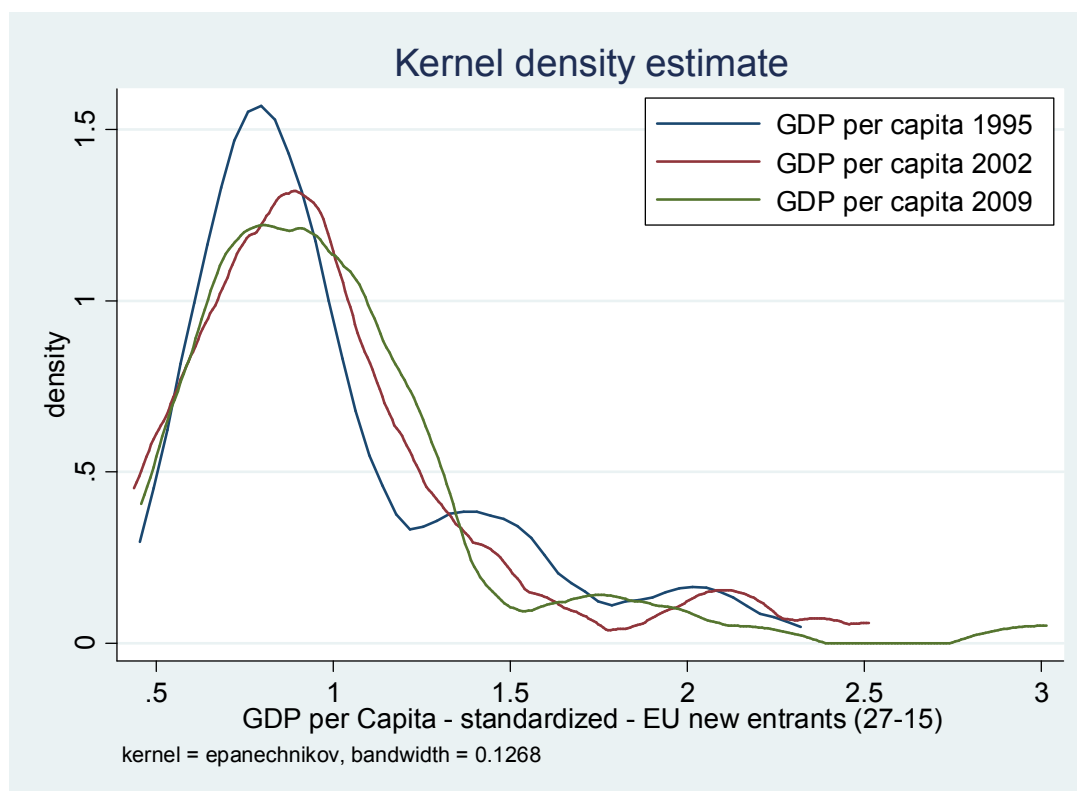kernel = epanechnikov, bandwidth = 0.1268

Table A1

Cross sectional regression results (OLS) with country dummies – growth of per-capita income (EU27)

	Dep. var.: $lny_{it} - lny_{it-1}$			
	1995 - 2002		2002 - 2009	
	Coeff.	t-value	Coeff.	t-value
ln y_{t-1}	-0.013	-0.500	0.009	0.440
Large metro areas	0.058***	4.300	0.016	1.310
Small metro areas	0.015	0.950	-0.005	-0.400
Intermediate regions	0.025*	1.790	0.004	0.330
Belgium	0.049*	1.870	0.004	0.170
Germany West	-0.052**	-2.560	0.049***	2.830
Germany East	-0.001	-0.030	0.124***	4.810
Spain	0.165***	7.260	0.089***	4.710
Finland	0.148***	4.430	0.071**	2.450
France	0.083***	4.050	-0.033*	-1.840
Greece	0.143***	5.690	0.039*	1.870
Ireland	0.357***	7.180	-0.017	-0.390
Luxemburg	0.156**	2.180	0.156**	2.510
Netherlands	0.135***	5.500	0.043**	1.980
Portugal	0.174***	5.590	0.067***	2.640
Sweden	0.043	1.540	0.023	0.960
United Kingdom	0.098***	4.990	-0.047***	-2.820
Austria	0.040	1.420	0.059**	2.420
Latvia	0.361***	4.780	0.288***	4.680
Lithuania	0.303***	4.080	0.281***	4.600
Poland	0.155***	4.320	0.280***	10.330
Slovakia	0.226***	5.420	0.349***	10.430
Slovenia	0.197***	3.900	0.121***	2.830
Czech Republic	-0.005	-0.160	0.217***	8.010
Hungary	0.192***	5.220	0.074**	2.560
Bulgaria	0.015	0.330	0.296***	7.760
Romania	-0.075*	-1.740	0.501***	13.570
Estonia	0.372***	5.060	0.309***	5.120
Malta	-0.031	-0.440	0.087	1.470
Intercept	0.179	1.610	0.112	1.310
N	241		241	
R^2	0.680		0.840	

Reference categories are Italy for country effects and rural regions for settlement-type effects. We estimate the model for EU 27 for both periods (Denmark, Cyprus and French overseas regions excluded due to data restrictions). Robust t statistics in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%;

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Table A2

Cross sectional regression results (OLS) with country dummies – level of per-capita income (EU27)

	Dep. Var.: lny_{it}					
	1995		2002		2009	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Large metro	0.029	0.810	0.047	1.220	0.075***	2.010
Small metro	0.050	1.430	0.017	0.450	0.035	0.960
Intermediate	-0.056	-1.620	-0.023	-0.660	-0.011	-0.320
HITEC	0.159***	3.540	0.150***	3.390	0.183***	4.820
KIS	0.275**	2.370	0.305**	2.360	0.198	1.510
PAT	0.073***	4.730	0.081***	5.550	0.090***	5.400
PROD	0.062	0.840	-0.029	-0.390	-0.034	-0.520
Intercept	-3.296***	-12.730	-3.262***	-12.490	-3.269	-14.220
N	226		226		236	
R^2	0.919		0.908		0.858	

Notes: Country-dummies were included in the model, but the estimated coefficients are not shown in this table. Reference categories are Italy for country effects and rural regions for settlement-type effects (Denmark only for 2009, Cyprus, French overseas regions and some regions from various EU countries excluded due to data restrictions). Robust t statistics in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%.

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ABOUT NEUJOBS

"Creating and adapting jobs in Europe in the context of a socio-ecological transition"

NEUJOBS is a research project financed by the European Commission under the 7th Framework Programme. Its objective is to analyse likely future developments in the European labour market(s), in view of four major transitions that will impact employment - particularly certain sectors of the labour force and the economy - and European societies in general. What are these transitions? The first is the **socio-ecological transition:** a comprehensive change in the patterns of social organisation and culture, production and consumption that will drive humanity beyond the current industrial model towards a more sustainable future. The second is the **societal transition,** produced by a combination of population ageing, low fertility rates, changing family structures, urbanisation and growing female employment. The third transition concerns **new territorial dynamics** and the balance between agglomeration and dispersion forces. The fourth is **a skills (upgrading)** transition and and its likely consequences for employment and (in)equality.

Research Areas

NEUJOBS consists of 23 work packages organised in six groups:

- o **Group 1** provides a conceptualisation of the **socio-ecological transition** that constitutes the basis for the other work-packages.
- o **Group 2** considers in detail the main drivers for change and the resulting relevant policies. Regarding the drivers we analyse the discourse on **job quality**, **education**al needs, changes in the organisation of production and in the employment structure. Regarding relevant policies, research in this group assesses the impact of changes in **family composition**, the effect of **labour relations** and the issue of financing transition in an era of budget constraints. The regional dimension is taken into account, also in relation to **migration** flows.
- o **Group 3** models economic and employment development on the basis of the inputs provided in the previous work packages.
- o **Group 4** examines possible employment trends in key sectors of the economy in the light of the transition processes: energy, health care and goods/services for the **ageing** population, **care services**, housing and transport.
- o **Group 5** focuses on impact groups, namely those vital for employment growth in the EU: **women**, the **elderly**, immigrants and **Roma**.
- o **Group 6** is composed of transversal work packages: implications NEUJOBS findings for EU policy-making, dissemination, management and coordination.

For more information, visit: www.neujobs.eu

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