Regional Disparities and Growth in the European Union: Economic Integration, Convergence and Skill-Specific Employment

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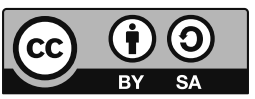

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Contents

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Hamburg, Juni 2012
Friso Schlitte

Chapter 1 Review of Relevant Studies

1 Introduction

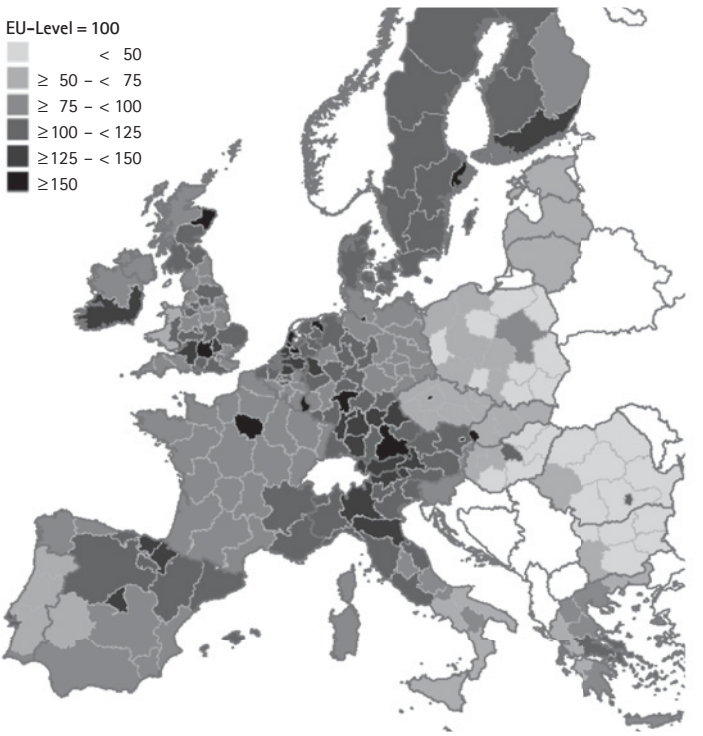
One of the basic objectives of the European Union is economic convergence among its countries and regions, i.e. a reduction of existing differences in income and employment. This goal has come into the focus of attention for policy-makers and scientists since the southern enlargement in the 1980s, gaining even more in relevance through the eastward enlargement rounds in 2004 and 2007. The explanation behind is related to the (statistically) increased economic disparities in the EU which followed the accession of member states with relatively low income levels. In 2004, the year of the first eastward enlargement round, average GDP per capita, measured in Purchasing Power Standards (PPS), in the old member states is twice as high as the average income level in the acceding countries. Three years later income levels of the two last acceding countries, Bulgaria and Romania, reach only a bit more than one third of the EU-15 average.[1]

The EU is marked by substantial income inequalities on the national level and even more remarkable disparities between EU regions. Figure 1 displays per capita incomes of NUTS-2 level regions relative to the EU average income level in 2008. Regional GDP per capita (measured in purchasing power parities) ranges from 28 percent of the EU level in the poorest region, Severozapaden in Bulgaria, to 343 percent in Inner London, the richest region in the EU. Most of the low-income regions are situated in the southern periphery or Eastern Europe. Most noticeable, around 85 percent of the regions in the new member states have income levels below 75 percent of the EU average. In order to overcome these disparities, for the current funding period from 2007 to 2013, the EU established structural and cohesion funds of € 347 billion representing slightly more than one third of its total budget. Around 80 percent (€ 282.8 billion) of the funds for EU regional policy is transferred to regions with low income levels.[2]

1 The figures are based on data provided by Eurostat.

2 This refers to regions exhibiting GDP levels below 75 % of the EU average. Furthermore, some regions, slightly exceeding this threshold due to the statistical decrease of the EU average after the eastward enlargement, still benefit on a "phasing-out" basis.

Figure 1: Regional GDP per Capita Levels (PPS) as Percentage of the EU Average, 2008



Source: Eurostat 2011.

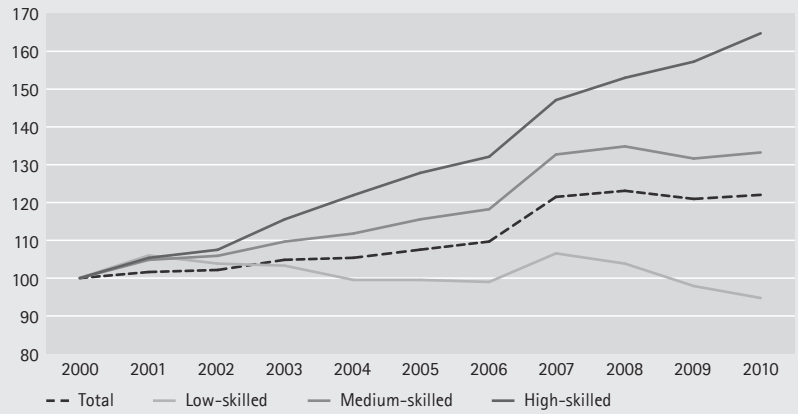
EU cohesion policy is strongly interlaced with the European Employment Strategy, which aims at creating more and better jobs. The European Social Fund, one of the EU structural funds, provides € 75 billion for promoting employment growth in EU regions.[3] Pursuing the goals of economic convergence and the enhancement of regional competitiveness and employment, EU regional policy focuses in particular on the improvement of the skills and the adaptability of workers. One of the main rationales to do so is that the employment prospects for skilled workers are significantly better than for unskilled workers. Around 82 percent the university graduates aged between 15 and 64 years in the EU currently have a job. By contrast in the same age group the employment rate of people with secondary education is about 69 percent and only 46 percent of the workers without professional education are currently employed.[4] Furthermore, it is widely believed that a skilled

3 The funds are assigned to regions eligible for the "Convergence" objective as well as to other regions within the budget for the "Regional Competitiveness and Employment" objective of EU regional policy for the period 2007 to 2013.

4 The figures are based on data provided by Eurostat.

work force increases the regional competitiveness and is a fundamental factor for economic growth (e.g. Lucas 1988).

Figure 2: Employment Growth by Skill Levels* in the EU, in Percent, 2000 to 2010



Notes: * Skill-levels according to ISCED 1997 with low-skilled = level 0–2, medium-skilled = level 3–4 and high-skilled = level 5–6.

Source: Eurostat 2011, own calculations.

However, regarding the employment growth by different qualification levels reveals that the development of the EU labour market is characterised by even rising inequalities between different qualification groups (see Figure 2). Between 2000 and 2010, the number of low-skilled workers (ISCED level 0-2) has shrunk by about five percent. At the same time the number of high-skilled employees (ISCED level 5–6) has increased by roughly two thirds. Thus, the employment prospects for low-skilled persons in the EU do not improve.

As the skill levels tend to be higher in relatively prosperous regions this may thwart the EU policy goal of a catching-up of relatively poor regions. According to the fourth report on economic and social cohesion published by the European Commission (2007) the EU labour force is marked by pronounced disparities in skill levels not only between countries but also, even more severely, between regions. Furthermore, regional levels of human capital correlate with regional income levels, i.e. education levels tend to be lower in economically lagging regions. The report also states that education levels in lagging regions do not improve, but the gap to other regions rather widens.

The increased policy concerns with regional disparities in the course of the EU enlargement and the ongoing internationalisation of the markets have strongly coincided with regained interest in regional economic sciences. The fundamental issue of regional economics are spatial imbalances in the distribution of economic

activities. The concern about regional economic disparities has drawn the attention of many economists from different main-line fields, such as economic growth, labour economics, economics of migration or industrial economics. New developments in economic theory revived arguments contradicting the neoclassical convergence hypothesis that were first established by Myrdal (1957). The arguments for persisting regional economic disparities concern the existence of market imperfections, such as the heterogeneity and immobility of production factors, monopolistic structures and limitations in the diffusion of information and knowledge in space and time. By the end of the 1980s these arguments were first integrated in formal model frameworks, i.e. endogenous growth theory (Romer 1986, 1990) and New Economic Geography (Krugman 1991a, 1991b). In particular, the latter has spured the regained interest in economic research on the spatial distribution of economic activities and corresponding issues in regional economics, also beyond the realms of the New Economic Geography itself. Armstrong and Taylor (2001) state, that likewise national economies, regional economies[5] are aggregations of individuals and institutions, and therefore, similar in behaviour. Moreover, large regions are sometimes bigger than small countries. However, certain characteristics of regional economies are distinctive from the features of a national economy. In particular, trade and migration between regions within a country are far less concerned by legal, political, cultural or other barriers that exist between countries. Accordingly, the mobility of production factors, goods and services as well as the interaction of politics and institutions are more pronounced within than between countries. The spatial heterogeneity of the regional economies within countries requires economic analysis at the regional level and provides are large potential for investigating economic behaviour (see Armstrong and Taylor 2001). Despite, the increased interest of economic research on regional disparities since the end of the 1980s, the results of regional economic studies are still not very conclusive about various problems concerning regional disparities so far. This leaves a lot to explore for further studies in regional economics in order to shed more light to the problems of why regional disparities persist and what factors drive convergence or divergence.

Against this background, the present chapter provides a survey of empirical studies analysing from different angles aspects regarding the development of regional economic disparities and growth in the EU. In a more refined manner, the chapter examines two groups of studies. The first group of studies deals with a potential decline or deepening of regional disparities in the course of the

5 A region may be defined differently, for example varying by functions or the level of aggregation. In this context the concept of a region refers to any spatial sub-unit of a country.

proceeding economic integration in Europe. The research topics of the second group of studies are centred on questions concerning patterns and determinants of regional disparities in skill-specific employment growth. In particular, the chapter outlines studies investigating the effects of local human capital and the level of skill-segregation on regional employment growth by different skill levels.

Investigating the development of regional disparities and the speed of convergence in the light of EU enlargement appears of utmost importance since it reflects the high priority of economic and social cohesion given by EU policy. Several empirical findings indicate that the catching-up of poor EU countries might go hand in hand with rising regional imbalances within these countries (e.g. de la Fuente and Vives 1995; Quah 1996; Tondl 2001), which may thwart the efforts of EU regional policy. Furthermore, the process of European integration and enlargement has always been accompanied by concerns about the implications of economic integration for regional disparities in the EU. The enlargement is supposed to profoundly affect the location of economic activities in Europe. The integration of the new member states from Central and Eastern Europe might have diverse effects on various EU regions, depending on their location and specialisation. However, relatively little is known about the spatial impact of economic integration on growth and convergence, yet.

Another gap of the current research in regional sciences refers to the lack of information on the determinants of regional employment growth by different skill levels. As the individual employment prospects shrink with decreasing skill-level, information on the determinants for employment growth by different skill levels is of particular importance for regional policies designed to promote employment at the lower bound of the skill distribution. Due to skill-biased technological and organisational changes (e.g. Acemoglu 1998, 2002; Lindbeck and Snower 1996; Spitz-Oener 2006) and increasing international specialisation on skill specific production (e.g. Wood 1994, 2002) the demand for low skills is generally decreasing in in highly developed countries. Hence, the problem of relatively poor job opportunities for low-skilled workers on EU labour markets is not likely to cease – even with rising skill level in the EU work force. In particular, in the light of the relatively low skill levels in economically lagging regions information on the determinants for regional, low-skilled employment growth is essential for EU cohesion policy.

The structure of the present chapter is as follows: Section 2 subsequently outlines in more detail the studies dealing with regional growth, convergence and the effects of economic integration. Section 3 provides an overview of studies that are concerned with regional disparities in skill-specific employment growth and their potential determinants. Finally, some concluding remarks are made in Section 4.

2 Regional Convergence and Economic Integration

2.1 Regional Convergence: Theoretical Considerations

The issue of convergence is frequently analysed within the framework of traditional, neoclassical and endogenous growth theory. Moreover, New Economic Geography (NEG) models might be used to investigate the effects of economic integration on regional disparities. The implications of these theoretical approaches with respect to the development of regional disparities differ considerably. Whereas neoclassical growth theory predicts convergence, NEG and endogenous growth theory both provide no clear-cut conclusions in this respect. Whether convergence or divergence of regional per capita income emerges depends crucially on the specific assumptions of the models. Fundamental differences between these theories also exist as to the effects of integration on convergence. According to neoclassical growth models, trade and factor mobility foster convergence processes. Within this traditional framework, the marginal productivity of production factors, i.e. of labour and capital, is assumed to be higher in regions where the respective factor is scarce. Typically in poorer regions labour is relatively abundant, but there is a relatively low endowment of capital. Increasing the mobility of capital and labour would, thus lead to faster convergence of factor proportions and incomes between regions. Moreover, trade results in specialisation in production using intensively the factors that are relatively abundant. Furthermore, new technologies and knowledge can be transferred to less developed regions via trade and factor mobility – in particular foreign direct investment. Therefore, trade and factor mobility are regarded as important channels for convergence.[6]

In contrast to traditional, neoclassical growth theory, economic integration may have diverse effects in NEG models and endogenous growth theory. In the NEG framework, the development of spatial economic disparities depends on the relative strengths of the opposing forces that either drive or thwart economic agglomeration. While the locational advantages of a large home market and other positive externalities in central places foster agglomeration, lower prices of immobile factors in peripheral areas may work against it. Thus, on the one hand, declining barriers to trade and factor mobility can promote movements away from less prosperous peripheral regions to exploit positive externalities in agglomeration areas. On the other hand integration can encourage firms and workers to move to the periphery in order to benefit from low factor costs. According to NEG models (e.g. Krugman 1991a) divergence processes dominate in the beginning of

6 See for example Barro and Sala-i-Martin (1995) and Tondl (2001) for more details.

an integration process, when costs for transportation and other transaction costs, caused for example by legislative or cultural differences, are still relatively high. When integration has advanced and transaction costs have reached a relatively low level, the spatial distribution of economic activities may become more decentralised resulting in lower disparities in income levels between centre and periphery. Thus, depending on the stage of integration, a further reduction of impediments to trade and factor mobility might initiate convergence or divergence in NEG models.[7]

Finally, the impact of trade on the one hand and factor mobility on the other hand can differ in endogenous growth models. In general, factor mobility will reinforce the existing trend that marks the development of disparities among closed economies. If disparities are declining, the convergence of per capita income will be sustained by the movements of factors between open economies. However, if divergence takes place among the closed economies, factor mobility will reinforce the widening of disparities. By contrast trade may work against income disparities that are due to different regional levels of the innovative ability. As a means of dissemination of knowledge and new technology trade may support innovative activities in less advanced regions, resulting in convergence of per capita income levels. However, this effect depends crucially on the spatial scale of the diffusion of knowledge and technology. If they are globally available or spread fast in space, convergence should occur. If, however, knowledge spillovers cease over distance, as for example found by Audretsch and Feldmann (2003), spatial disparities may persist or even reinforce.[8]

2.2 Concepts of Convergence

The development of disparities in the EU and the speed of convergence is frequently analysed by applying the concept of β-convergence. β-convergence is based on the traditional neoclassical growth model and postulates that poor economies grow faster than rich economies. If regions differ only in their initial income level and their capital endowment per worker, they will converge to the same steady-state level of per capita income. This is referred to as absolute convergence. However, endogenous growth theory and NEG provide arguments for the possibility of persisting or even widening regional economic disparities. This is reflected by the concept of conditional convergence. Conditional convergence allows for differences in the regional steady-states. If regions are marked by different steady states, i.e. because of differences in technology, geographic location, economic structures or

7 See for example Puga (1999) for more details.

8 See for example Bröcker (2002) for more details.

qualification of the work force, they will not converge towards the same income level. Persisting spatial disparities or even a widening of absolute inequality is then possible.

In contrast to the concept of β-convergence, σ-convergence refers to a reduction in the variation of regional income levels over time. A problem associated with the concept of β-convergence is that it does not necessarily imply σ-convergence. Hence, a negative correlation between initial income levels and subsequent growth rates does not prove a declining level of inequality. Friedman (1992) and Quah (1993) have identified this flaw in the concept of β-convergence and have, both, independently referred to Galton's fallacy, a term which was frequently used in convergence studies thereafter. Galton's fallacy can be described as the delusion that the tendency of extreme values in a population to converge towards the population mean implies a reduction of the population's variance.[9] Nevertheless, in contrast to the concept of σ-convergence the application of a formal β-convergence analysis allows to control for various effects on the convergence process.[10] It is, however, advisable to substantiate the results obtained from β-convergence regressions by additional analysis of the development of regional income dispersion over time.

In the 1990s the emerging interest in the issue of regional convergence has led to several empirical investigations in this matter (e.g. Barro and Sala-i-Martin 1995; Armstrong 1995; Rey and Montouri 1999). In their seminal analysis Barro and Sala-i-Martin (1995) observe regional convergence among various cross-sections over long-term periods. For different cross-sections of regions they find annual absolute convergence rates β that are close to 2 percent, a rate that is frequently found in convergence studies. At this speed the so-called half-life amounts to 35 years, i.e. it takes about a third of a century for half of the initial income inequalities to vanish. However, they find varying rates of convergence when analysing different periods of time separately. Their results show that the speed of convergence over shorter time periods may deviate significantly from the long-run average. For the case of 90 regions in eight Western European countries between 1950 and 1990 their findings show for example that the speed of absolute convergence has been particularly strong before the mid-1970s. Thereafter absolute convergence has been slowing down significantly. This was confirmed later for example by Armstrong (1995), Cuadrado Roura (2001) and Giannetti (2002). The latter even find tendencies for divergence between the middle of the 1970s and the middle of the 1980s.

9 See for example Bliss (1999) for more details.

10 See for example Barro and Sala-i-Martin (1995) or Bröcker (1998) for more details.

With respect to EU policy aiming at regional equality, absolute convergence is the appropriate concept to test for the economic catching-up of regions with relatively low income levels towards the richer regions in the EU. However, considering the structural heterogeneity of regions in Europe, regional per capita incomes are likely to converge towards different steady-state levels. In this case the concept of conditional convergence, allowing different steady-state income levels is to be tested. Different studies point to the existence of conditional convergence. A method frequently applied to test conditional convergence is based on the concept of club convergence, in which steady states are allowed to differ across groups of relatively homogenous economies (e.g. Quah 1996). Bräuninger and Niebuhr (2008) as well as Geppert et al. (2008) show for example that highly agglomerated regions show higher steady state levels than less densely populated areas. Furthermore, several studies on regional growth and convergence have stressed the crucial role played by national characteristics, such as differences in national policies, legislation, tax systems, etc. (e.g. Armstrong 1995; Cuadrado Roura 2001).

2.3 Spatial Autocorrelation

Another methodological issue that has emerged only quite recently in the regional growth and convergence literature is the one of spatial autocorrelation. Regions surrounded by rich neighbours, for example, have usually better chances for development than regions situated in a relatively poor neighbourhood. Therefore, regions cannot be regarded as isolated entities when convergence processes are analysed. Ignoring such spatial interdependencies may lead to biased and inefficient estimates for the rate of convergence. There are two forms of spatial autocorrelation. The so-called substantive form, that is if regional growth rates are autocorrelated through spatial spillovers, leads to biasedness. When only the error term is spatially autocorrelated, the so-called nuisance dependence, tests for the significance of the estimates are unreliable.[11] Although the economic development of a region is likely to be influenced by neighbouring regions, most early convergence studies assumed growth rates to be independent across regions, which may have distorted some of the findings. Ertur and Le Gallo (2003) for example show for Western Europe that there is a persistent spatial concentration of high and low regional income levels, respectively. Likewise Egger and Pfaffermayr (2005) state that the convergence process in Western Europe is significantly affected by spatial interdependencies among

11 See for example Anselin (1988) for more details.

regional growth processes. While the role of spatial interaction was generally ignored in convergence studies for a long time, a growing number of convergence studies using spatial econometric techniques has been emerging since the end of the 1990s (see Abreu et al. 2005). Meanwhile, several convergence analyses have given evidence of the importance of regional spillovers on growth and convergence processes confirming that regional development is affected by spatial interactions (e.g. Rey and Montouri 1999; Le Gallo et al. 2003; Niebuhr 2001; Fingleton 2004; López-Bazo et al. 2004).

2.4 Regional Disparities in the Enlarged EU

So far a great number of studies on income convergence for different time-periods and cross-sections of Western European regions have been conducted since the beginning of the 1990s (e.g. Barro and Sala-i-Martin 1995; Armstrong 1995; Tondl 2001; Cuadrado Roura 2001; Baumont et al. 2003; Arbia and Piras 2005; Meliciani and Peracchi 2006). By contrast, empirical evidence on regional convergence in the enlarged EU is still relatively scarce. This is mainly due to the lack of reliable GDP data for Central and Eastern European countries before the mid-1990s. In the 2000s, some studies have examined the issue of regional convergence in the light of the eastern enlargement of the EU (e.g. Fischer and Stirböck 2004; Niebuhr and Schlitte 2004; Feldkircher 2006; Tondl and Vuksic 2007; Paas and Schlitte 2008).

Tondl and Vuksic (2007) analyse the factors that make East European regions catch up. According to their findings foreign direct investments have been crucial for regional growth in Eastern European countries. Especially, capital regions and border areas have been most successful in attracting direct investments from abroad. Against their expectations, the authors did not find evidence for the importance of high regional education levels for regional growth processes in the regions of the acceding countries. Fischer and Stirböck (2004) investigate absolute and conditional convergence among NUTS-2 level regions in the enlarged EU. They identify two convergence clubs: one consisting of poorer regions in the new member states and the southern periphery of Western Europe, and the other consisting of the relatively rich Central and Northern European regions of the EU-15. Niebuhr and Schlitte (2004) as well as Feldkircher (2006) investigate regional convergence in the enlarged conducting absolute and conditional convergence regressions. Rather than identifying clubs of convergence they control for country-specific effects. In other words, in their conditional convergence analyses regions are allowed to converge towards country-specific steady-state income levels. Both analyses

find a general catching-up of the new member states, but also strong evidence for national effects on regional growth in the enlarged EU hinting at persisting or even increasing within-country disparities.

Overall, the issue of regional convergence has been the subject of a large body of empirical research since the beginning of the 1990s. However, despite the great interest in this matter, information on regional convergence in the enlarged EU is still relatively scarce. Owing to data restrictions, previous empirical research on regional convergence in Europe focused on EU-15 regions. The analysis in Chapter 2 aims at providing more distinct information on regional convergence processes in the enlarged EU. It focuses, in particular on the development of between- and within-country disparities. In contrast to previous studies, the investigation is conducted at a comparatively low level of regional aggregation comprising 861 (mainly NUTS-3 level) regions. The estimated rate of absolute convergence in the EU-25 is close to the rate of 2 percent, a rate that is frequently found in other convergence studies. However, according to the results presented in Chapter 2 the convergence process is driven mainly by country-specific effects. Furthermore, the catching-up is accompanied by regional divergence processes within the individual new-member-state countries. Thus, the analysis demonstrates that there may be a trade-off between convergence on the national level and regional within-country convergence in the new member states which may impede the European Commission in its pursuit of the objective of economic and social cohesion.

2.5 Economic Integration and Convergence

Closely related to the regional growth and convergence discussion in the course of EU enlargement is a strand of literature that considers the spatial pattern of integration effects released by the eastern enlargement of the EU. Within the NEG framework Krugman (1993) and Krugman and Venables (1990) investigate the implications of integration for the spatial structure of economic activity in Europe. Integration affects the balance of centripetal and centrifugal forces through its effect on transport costs and, thus, might alter the spatial distribution of economic activities. The domestic market becomes less important, possibly resulting in a reallocation of resources from previous centres to new locations (see Fujita et al. 1999). Market size considerations based on NEG models suggest that central regions, such as those along a common border of integrating countries, might realise above-average integration benefits because they achieve above-average increases of their market potential. The relative geographical position of these regions is altered dramatically by integration, changing from a peripheral

one on a national scale to a central one in the common market. Midelfart et al. (2003) argue that market access improvements benefit firms located in the centre of the European Union rather than those in the periphery. The relative disadvantage of peripheral regions should therefore increase. However, most NEG models do not allow the drawing of precise conclusions, as integration might not be sufficient to destabilise the existing spatial distribution of economic activity. Moreover, integration might work to the advantage of either central locations or peripheral areas.

Overall, theoretical analysis does not give clear-cut results regarding the effects of enlargement on regional disparities in the EU-27 so far. The literature has not yet reached a consensus on the question of whether integration leads to convergence or increasing disparities within countries that open up to trade. Thus, empirical analysis must shed some light on this issue. However, thus far empirical research on integration effects tends to focus on the EU-wide impact on growth and country effects (e.g. Baldwin et al. 1997; Breuss 2001). Only a few studies explicitly consider its effect at the regional level. Bröcker (1998), Brülhart et al. (2004) and Pfaffermayr et al. (2004) provide quantitative estimates of regional effects in Europe caused by the economic integration of the Central and East European countries.

In order to fill in this gap of missing empirical evidence the analysis in Chapter 3 offers empirical evidence on the spatial effects of EU enlargement, the development of regional disparities, and the interaction of both. It provides a link between regional growth and convergence studies on the one hand, and the empirical research dealing with integration effects on the spatial pattern of economic activities on the other hand. The results show that regions in the new member states realise significant increases in market potential through increased trade integration with the EU-15 market, whereas market potential changes in the EU-15 are more or less negligible. Therefore, reduced border impediments between old and new EU member states should promote the catching-up of the new member states towards the EU-15. However, accounting for neoclassical catching-up mechanisms and country-specific growth factors, the change in market potential has hardly any effect on per capita income growth in the enlarged EU. Overall, it can be concluded that centripetal forces driving agglomeration prevail at the subnational level in the early stages of economic integration within the enlarged EU market.

3 Skill-Specific Employment Growth and the Effects of Local Human Capital and Skill Segregation

3.1 Changes in the Demand for High and Low Skills

Labour markets in many industrialised countries are marked by rising inequalities between different qualification groups (e.g. Nickell and Bell 1995). While high-skilled employment is steadily increasing, employment in the low-skilled segment is subject to a continuous decline in most industrialised countries. On the one hand, this can be explained by an increasingly skilled labour force, in particular due to the educational expansion in the 1960s and 1970s. On the other hand, it can be argued that the labour demand for low skills is declining. The decreasing demand for low skills is often explained by an increasing international competition promoting specialisation in human-capital intensive industries (e.g. Wood 1994, 2002) and skill-biased technological and organisational changes (e.g. Acemoglu 1998, 2002; Lindbeck and Snower 1996; Spitz-Oener 2006). In other words, low-skilled jobs are relocated more easily abroad to other, low-wage regions, and the substitution elasticity with respect to new technology and production processes is relatively high for low-skilled labour. However, recent studies (e.g. Autor et al. 2003) suggest that low-skilled labour might be less affected by decreasing demand than some types of medium-skilled labour. In particular, highly standardised medium-skill occupations, such as book- and record-keeping, can be more easily substituted by technology than less standardised low-skill jobs, such as cleaning or gardening. Manning (2004) and Goos and Manning (2007) for example, find that some jobs belonging to the latter type are among the fastest growing occupations in the UK. Similar results are obtained by Spitz-Oener (2006) for Germany.

In general, technological and organisational changes as well as the international competition of factor prices affect all regions within a country simultaneously. However, despite similar institutions and the same macroeconomic environment, the development of skill specific employment varies substantially across regions within highly developed countries. For the case of Germany Fromhold-Eisebith and Schrattenecker (2006) show for example that low-skilled employment growth in West Germany is subject to substantial disparities across regions. Despite the general decline, there are regions that still experience an increase in low-skilled employment. Although the regional determinants for low-skilled employment growth may be very different than the influence factors of high-skilled employment growth, there is a lack of both, theoretical and empirical studies adequately explaining these differences. However, different strands of literature such as

studies dealing with the spatial division of labour and regional specialisation or human capital externalities provide some indication for regional disparities in skill-specific employment dynamics.

3.2 Product Life-Cycles and Functional Specialisation

One explanation for regional disparities in the qualification specific demand for labour can be derived from the hypothesis of product life cycles. The different life cycles may vary in their skill requirements for production influencing the choice of location for production (e.g. Vernon 1966). At the beginning of the life cycle, the phase in which the innovation of the product takes place, production demands a relatively high level of skills. Later, in the phase of mass production, the process of production comprises mainly simple task performed by less skilled workers. Duranton and Puga (2001) apply the idea of product life cycles in their contribution to the discussion on the role spatial specialisation and diversification for regional innovation and growth. According to their model the most fruitful ground for product innovation are big, diversified cities, while small and medium sized cities tend to provide specialisation advantages that benefit mass production. In line with this discussion Duranton and Puga (2005) argue that sectoral specialisation passes more and more into a functional specialisation of regions. For metropolitan areas in the United States they observe that the firms' headquarters and business related services concentrate in large cities, while the plant production tends to be located in smaller metropolitan areas. To sum up, different product life cycles, each requiring specific skills and the division of firms' locations by functions influences the spatial structure of the economy. The spatial effects refer in particular to differences in the degree of agglomeration of regions.

3.3 Local Human Capital Externalities and Skill Complementarities

Alternatively, skill-specific inequalities across regional labour markets may be explained by the effects from local human capital. Firstly, human capital externalities can arise through knowledge spillovers, generated by formal and informal interaction between people (e.g. Lucas 1988). According to Audretsch and Feldmann (2003) for example a significant part of knowledge transfers decreases rapidly in space. Due to their spatial dimension, knowledge spillovers may be one explanation for the persisting economic disparities between regions. Secondly, Acemoglu (1996) shows theoretically that, also in absence of knowledge spillovers, there may be pecuniary human capital externalities that arise due to labour market pooling and asymmetric information between employer and employee. Furthermore,

another possible explanation for a positive impact of local human capital on the productivity of less skilled workers is a complementary relation between different skills in the production process. According to simple supply and demand side considerations, the relative supply of imperfectly substitutable production factors determines their marginal productivity. Hence, if high-skilled workers are locally abundant, less skilled workers are relatively scarce, which brings them higher pay than identically skilled workers in a less skilled region (e. g. Moretti 2004a; Südekum 2008).

Though human capital externalities are supposed to affect productivity level and not directly employment, it can be argued that changes in skill specific productivity levels have an impact on the growth of jobs for the different skill types. This is in line for example with Südekum (2006, 2008) establishing a link between skill-specific productivity and employment growth. In particular, if wages are sticky moving downwards at the lower end of the income distribution a relative productivity decline of low-skilled labour should translate into decreasing low-skilled employment. This is frequently supposed to be the case in Continental European labour markets, which leads many economists to believe that increasing unemployment rates in Continental Europe can be traced back to the same causes – i.e. rising disparities in the skill-specific productivity levels – as the increasing wage inequalities in Anglo-Saxon countries (e.g. Krugman 1994; Freeman 1995).

Both, pecuniary externalities and knowledge spillovers may affect the productivity in different (high and low) skill levels. The possible effect of knowledge spillovers from high-skilled to low-skilled workers is modelled for example by Jovanovic and Rob (1989) and Glaeser (1999). In both models spatial proximity between more- and less-skilled workers increases the chances for the low-skilled to learn from the high-skilled workers. Acemoglu (1996) shows theoretically that the wage level of less skilled workers may be positively affected by pecuniary human capital externalities arising irrespectively of the existence of knowledge transfers. This result is based on the assumption that human capital and physical capital are complements. Due to asymmetric information between firms and individual workers, an employer cannot precisely assess the individual skill levels of potential workers beforehand. Investments in production technology, however, are made before staffing. As a consequence, firms adapt their production technology to the qualifications available on the labour market. If the share of skilled workers is high, firms tend to invest more in production technology. Hence, new and modern production technologies that are initially implemented to exploit complementarities with human capital can raise the productivity of less skilled workers as well.

There are several empirical studies investigating the effects of human capital externalities on local productivity levels. Most of these analyses estimate the effects

of local high-skilled employment on qualification specific wages.[12] Some studies, such as Rauch (1993), find significantly positive effects on wages. According to Moretti (2004a), both, spillovers and skill complementarities, are relevant for skill-specific wage levels. In contrast, the results obtained by Acemoglu and Angrist (2000) or Ciccone and Peri (2006) suggest that the impact of local human capital is rather weak. According to Moretti (2004a), however, applying different measures for human capital may yield different estimated effects on the local economy. He finds that college education actually increases productivity levels, while average schooling might rather be effective in terms of non-market externalities. Duranton (2006) argues that this might be the reason for the lack of evidence for knowledge spillovers in the study from Acemoglu and Angrist (2000) as they have used compulsory state schooling laws as instruments for the level of schooling. This argument could also hold for Ciccone and Peri (2006) who also apply average schooling levels as a measure for the stock of local human capital.

3.4 Skill-Specific Employment Growth

There are numerous studies investigating regional disparities and the determinants of overall employment growth. In urban economics literature the local skill composition has been found to be a major cause for regional variations in employment growth. Several authors find a positive correlation between the initial level of human capital and subsequent city employment growth (e.g. Glaeser et al. 1995; Simon 1998; Simon and Nardelli 2002; Glaeser and Saiz 2004; Shapiro 2006). Besides the existence of localised human capital externalities Shapiro (2006) offers two more explanations for a positive correlation between a city's skill level and employment growth. Firstly, employment growth may be caused by unobserved city characteristics that correlate with skills, such as specialisation in skill-intensive and dynamic industries. Secondly, skilled cities may generate consumption amenities, as for example good schools, cultural activities, a friendly environment, etc. that attract migration of skilled workers. Thus, regional employment growth is likely to be linked to region-specific location factors. There are several studies providing information on different location factors that may be responsible for regional disparities in employment growth in different countries, such as the regional structure of economic sectors, skills, the firm-sizes or the wage level (e.g. Blien et al. 2003; Blien et al. 2006; Südekum et al. 2006; Fuchs 2011 (all Germany); Combes 2000; Combes et al. 2004 (both France); Shearmur and Polèse 2007 (Canada)).

12 A more detailed overview of studies dealing with the effects of local human capital on skill-specific wages is provided for example by Moretti (2004b), Duranton (2006) or Halfdanarson et al. (2008).

While there are several empirical studies dealing with the regional disparities of overall employment growth, corresponding evidence for different skill levels is rare. Südekum (2006, 2008) estimates the effect of the share of high-skilled employment on qualification-specific employment growth in West German regions. He finds that the percentage of workers with tertiary education has a positive effect on low- and medium-skilled employment growth, but not on the employment growth of the high-skilled. Südekum concludes because of the latter result that skill complementarities are more important than knowledge spillovers. As another exception Cordes (2008) investigates the determinants of employment growth in different occupational groups across West German regions. His findings point to existing complementarities between occupational groups. These findings are in line with Poelhekke (2009) who analyses the effects of different skill groups on regional overall employment in Germany. According to his results the interaction of different skill groups may enhance local productivity and overall employment growth.

3.5 Workplace Segregation by Skill

One aspect of the qualification specific changes on the labour market that has not received much attention up to now is the segregation by skill in the production process. The qualification-related structural change affects the internal skill structure of employment at the firm level. However, the changes in the skill composition within firms do not merely reflect the general shift to increasing shares of high-skilled workers in overall employment. In contrast, more and more firms tend to employ predominantly one specific type of qualification. Some companies, such as fast-food or supermarket chains, recruit mainly low-skilled labour, while others tend to employ primarily high-skilled workers, as for instance software or high-tech producers. As a consequence, employees tend to work more often with similarly qualified co-workers and share less frequently a common workplace with differently skilled colleagues. There are several empirical studies documenting the increase in the levels of skill segregation in highly developed economies. Davis and Haltiwanger (1991) as well as Kremer and Maskin (1996) analyse the wage structure within and between firms in the U.S. manufacturing sector. Both studies find that the variance of wages between firms has increased more profoundly than wage disparities within firms. It can be concluded that the degree of skill segregation between workplaces has increased. Investigating the qualification structure at the firm level, Kramarz et al. (1996) provide evidence for increasing segregation by skill among French firms. They show that it is more likely to find low-skilled employees at the same workplace in 1992 than in 1986.

The same is shown for high-skilled employees. Likewise Stephan (2001), Gerlach et al. (2002) and Tsertsvadze (2005) find evidence for increasing skill segregation in Germany.

Different theoretical models from Kremer and Maskin (1996), Acemoglu (1999) and Duranton (2004) provide a link between the level of skill segregation and increasing wage inequalities between qualification groups. While skill segregation may raise the productivity among skilled workers, it may negatively impact the productivity level at the lower end of the skill distribution. Although the mechanisms differ substantially, the models have a few characteristics in common: skill segregation in highly developed countries is closely related to the proceeding internationalisation of labour markets, technological and organisational changes as well as the skill structure in the labour supply. The models suggest that skill segregation may lead to rising wage differentials across skill groups and also to absolute wage losses among less skilled employees which may translate into changes in skill specific employment prospects. Therefore, the models offer skill segregation as a reasonable explanation for the development of qualification-specific wage levels, as documented for example by Katz and Murphy (1992) for the U.S. labour market. Furthermore, the models identify the level and the variety of skills in the labour force available to firms as key determinants for the level of skill segregation.

Since production technologies and skill structures are characterised by pronounced regional disparities, there are likely significant differences in the levels of skill segregation between regions. Since skill segregation may impact on the productivity of low-skilled workers, information on differences in regional levels of skill segregation and their determinants However, there is a lack of studies investigating the phenomenon of skill segregation on the regional level so far. The analysis in Chapter 4 provides first empirical evidence on regional differences in the level of skill segregation and their determinants applying cross sectional time-series data for Germany. The findings of the analysis reveal that, though growing in almost all regions under consideration, the level of skill segregation is marked by pronounced regional disparities. The analysis identifies the local endowment with human capital to be an important determinant for the regional level of skill segregation. Besides the local stock of human capital within a region, also the skill supply in neighbouring regions significantly affects the level of skill segregation. Following the theoretical models from Acemoglu (1999) and Duranton (2004), it can be argued that firms adapt their production processes and technology to the skills available. In the case of a high level of human capital firms tend to specialise their production with respect to skills.

The issues of skill segregation and the local productivity effects of human capital are likely to be closely connected. For instance, workplace segregation

by skill may prevent knowledge transfers or other types of human capital externalities to benefit less skilled employees. Moreover, if firms tend to create more and more qualification-specific jobs, this should reduce the degree of substitutability between skills. Hence, there is a likely link between the existence of localised human capital externalities, skill complementarities and segregation by qualification level. Although the theoretical results point to such a possible influence of skill segregation on qualification-specific productivity, corresponding empirical evidence has been lacking thus far. Following the argument that changes in productivity levels affect employment growth because of sticky wages, it can be assumed that skill segregation affects employment growth, especially at the lower bound of the skill distribution. This is in line with Duranton (2004) who concludes that increasing levels of skill segregation may spur unemployment of the least skilled by decreasing the productivity levels in that skill group.

However, empirical evidence on the possible effects of skill segregation on the employment prospects of low-skilled persons has been completely lacking thus far. Chapter 5 provides first empirical results on the impacts of segregation on the development of skill-specific employment, focusing in particular on the employment prospects for workers without formal vocational education. Furthermore, the analysis adds to the empirical evidence of local human capital effects on employment growth by different skill levels. Investigating the effects of the local skill structure and the level of skill segregation on regional employment growth in Germany, it relates the issue of skill segregation to recent research on human capital externalities and skill complementarities. The results show that the local endowment of human capital is an important determinant for skill-specific employment growth in West German regions. While it does not foster further accumulation of human capital it has a positive impact on less skilled employment, in particular on workers without formal vocational education. This indicates the existence of skill complementarities. The results, however, are not conclusive on that point. Although a rising stock of local human capital tends to have a positive effect on regional labour markets in general, the low-skilled might benefit to a lesser extent, because they tend to work in firms with relatively less modern and less complex production technologies decreasing their productivity and employment prospects. The findings reveal that high regional levels of skill segregation have a significant negative impact on low-skilled employment growth. Thus, regarding the high unemployment rates of low-skilled workers in most developed countries, workplace segregation by skill is an important issue for further regional labour market research and policy.

4 Summary and Outlook

The present survey addresses two different types of studies that are relevant for policies concerned with regional disparities and growth in the EU or individual member states. The first type of studies regards regional growth and a potential decline or deepening of regional income disparities in the course of a proceeding economic integration in Europe. The second group of studies deals with skill-specific labour market disparities, focusing in particular on the increasing inequalities between the employment prospects for high-skilled and low-skilled persons.

The existing evidence on the issue of regional convergence in the EU shows that the catching-up of poor EU countries might go hand in hand with rising regional imbalances within these countries. The existing empirical evidence indicates a possible trade-off between convergence on the national level and a deepening of regional within-country disparities in the new member states, which may impede the European Commission in reaching its objective of economic and social cohesion. However, there is still a limited amount of studies examining the issue of regional convergence in the light of the eastern enlargement and there is a lack of conclusive evidence on the development of regional economic disparities within countries, in particular the new member states. Furthermore, the enlargement is supposed to profoundly affect the location of economic activities in Europe. The integration of the new member states from Central and Eastern Europe might have diverse effects on various EU regions, depending on their location and specialisation. However, relatively little is known about the spatial impact of economic integration on growth and convergence, yet. The analyses in Chapter 2 and Chapter 3 shall provide a deepening understanding of the spatial development of economic activities in the course of economic integration. The study presented in Chapter 2 analyses regional convergence processes in the enlarged EU focussing in particular on the development of between- and within-country disparities. Chapter 3 concentrates on the effects of economic integration on regional growth and convergence via changes in regional market access.

The second group of studies addresses the issue of regional labour market disparities in skill-specific employment growth and its determinants. One gap in the current research in regional sciences refers to the lack of information on the determinants of regional employment by different skill levels. In order to assess the potentials and weaknesses of regional labour markets, local policy makers need detailed information on the factors determining the labour market development at the local level. Since the low-skilled are less frequently employed and hit more often by unemployment than medium- or high-skilled workers, information on the local labour market conditions for the low-skilled is of particular interest. As

the demand for low skills is generally decreasing in industrialised countries, the problem of relatively poor job opportunities for low-skilled workers on EU labour markets is not likely to cease – even with rising skill level in the EU work force. In particular, in the light of the relatively low skill levels in economically lagging regions information on the determinants for regional, low-skilled employment growth is essential for EU cohesion policy.

These gaps in the current empirical research are addressed in Chapter 4 and Chapter 5. In the centre of the investigation are the local level of human capital and the regional level of skill segregation in the production process. Despite the indication of theoretical results that skill segregation may be relevant in particular for the employment prospects of low-skilled workers this issue has not received much attention in empirical studies until now. In a first approach, this lack is addressed in Chapter 4, which provides new evidence on the regional development of skill segregation and its determinants. By contrast, the regional skill level is frequently regarded as a central determinant for economic growth and is a key variable targeted by EU regional policy. However, the effects of the regional skill structure on employment growth in different qualification levels has been rarely explored so far. Chapter 5 complements the analysis of Chapter 4 by exploring for the first time the impact on skill segregation and local human capital on regional employment growth in different skill groups.

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Chapter 2 Regional Income Inequality and Convergence Processes in the EU-25[1]

TIIU PAAS[2] AND FRISO SCHLITTE[3]

Abstract: This chapter deals with the development of disparities in regional per capita GDP and convergence processes in the enlarged EU. A cross-section of 861 regions is analysed for the period from 1995 to 2003. Firstly, we apply Theil's index of inequality in order to show the development of between- and within-country disparities. Secondly, we conduct a formal β-convergence analysis, taking into account the effects of spatial dependence and controlling for national effects. The analyses show that poorer regions mainly situated in the European periphery have tended to grow faster than the relatively rich regions in the centre of Europe. However, the convergence process has been driven mainly by national factors. In the course of this process, regional disparities within the new member countries have actually increased. Furthermore, we find that spatial growth spillovers lose relevance when crossing a national border. Thus, border impediments still matter for the intensity of economic cross-border integration in the EU.

1 Introduction

EU eastward enlargement obliges EU policy to deal with a considerably increased range of income disparities within the EU. Considering the community's objective of enhancing economic and social cohesion (Article 2 of the Treaty on European Union), this constitutes a challenging task. Cohesion policy, the second largest item in the EU budget, has to be adjusted to this change in the scale of disparities. Information on the development of regional disparities and the speed of convergence is therefore of utmost importance for EU policy.

The issue of regional convergence has been the subject of a large body of empirical research since the beginning of the 1990s. Despite the great interest in this matter, information on regional convergence in the enlarged EU is still relatively scarce. Owing to data restrictions, previous empirical research on regional convergence in Europe focused on EU-15 regions. This chapter aims at providing more distinct information on regional convergence processes in the enlarged EU. Special attention

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2 Institute of Economics, University of Tartu, Estonia.

3 Hamburg Institute of International Economics (HWWI), Germany, and Institute for Employment Research (IAB), Germany.

is paid to differences in regional growth processes between the EU-15 and the new member states (NMS), and to the role of national effects and the development of regional within-country disparities. Regional convergence and income inequality will be analysed for the period between 1995 and 2003 at a comparatively low level of regional aggregation comprising 861 regions of the EU-25. Firstly, reference will be made to the development of regional disparities by applying Theil's Index of Inequality, which allows overall inequality to be decomposed into between-country and within-country components. Secondly, a formal convergence analysis will be conducted by applying the well-known concept of β-convergence. Since spatial dependence has been found to be influential on regional growth in the recent convergence literature, spatial econometric techniques will be applied in order to control for such effects in our data set.

The chapter consists of six main sections. In the next section we set out empirical and theoretical considerations which are relevant to our analysis. Section 3 describes the dataset and discusses the regional system subject to analysis. Recent developments of regional income disparities are explored in Section 4, followed by a β-convergence analysis in Section 5. Finally, our conclusions are presented in Section 6.

2 Theoretical and Empirical Considerations

The concept of β-convergence is based on the traditional neoclassical growth model and postulates that relatively poor economies grow faster than relatively rich ones. If regions differ only in their initial income levels and capital endowment per worker, they converge towards an identical level of per capita income. This is referred to as absolute β-convergence. By contrast, conditional convergence exhibits spatial heterogeneity in growth factors which gives rise to different growth paths. In the case of conditional convergence, where regions are marked, for example, by differences in technology, economic structures or skill level of the labour force, regions converge towards different steady-state income levels.

Numerous studies on regional convergence in Europe have been conducted since the beginning of the 1990s (e.g. Barro and Sala-i-Martin 1995; Armstrong 1995; Tondl 2001; Cuadrado Roura 2001; Baumont et al. 2003; Arbia and Piras 2005; Meliciani and Peracchi 2006). Since regional convergence is a long-run phenomenon, convergence studies usually observe longer time spans of 15 years or more. Analyses observing regional convergence over a couple of decades have found varying rates of convergence over time, showing that the speed of convergence over shorter periods may deviate significantly from the long-run average (e.g. Barro and Sala-i-Martin 1995; Armstrong 1995; Cuadrado Roura 2001). However, a long-run convergence

analysis covering the enlarged EU is not feasible at present. Owing to the change in accounting conventions and the fundamental change in modes of production in Central and Eastern European (CEE) countries during transition to market economies, income data for before the mid-1990s cannot be reasonably interpreted (Fischer and Stirböck 2004). As a consequence, empirical analysis on regional convergence in the enlarged EU is able to show recent developments, but it cannot identify long-term trends. However, although the explanatory capacity for long-run developments is limited, we believe that analysing the period after 1995 may yield important insights into recent tendencies in the development of income disparities in the enlarged EU.

Absolute convergence is the appropriate concept to be used with respect to EU policy, which aims at regional equity. However, considering the variety of regions in Europe, including large structural differences, conditional convergence may be more realistic. In this chapter, absolute and conditional convergence models will be estimated. A method frequently applied to test conditional convergence is based on the concept of club convergence, in which steady states are allowed to differ across groups of relatively homogenous economies (e.g. Quah 1996). Analysing regional convergence in the enlarged EU, Fischer and Stirböck (2004) identify two convergence clubs: one consisting of poorer regions in the NMS and the southern periphery of Western Europe, and the other consisting of the relatively rich Central and Northern European regions of the EU-15. Feldkircher (2006) as well as Niebuhr and Schlitte (2004) find strong evidence for country-specific effects on regional growth in the enlarged EU. The crucial role played by national characteristics, such as differences in national policies, legislation, tax systems, etc. has been stressed by several studies on regional growth and convergence (e.g. Armstrong 1995; Cuadrado Roura 2001). Besides testing the absolute convergence hypothesis, we test for conditional convergence, allowing regions to converge towards country-specific steady-state income levels.[4] We therefore test the regional convergence that takes place within the individual member states.

Although the economic development of a region is likely to be influenced by neighbouring regions, most convergence studies of the 1990s assumed growth rates to be independent across regions. Since the end of the 1990s, various convergence studies have found evidence of serious model misspecifications if spatial interdependencies of regional growth are ignored (see Abreu et al. 2005). Therefore, the convergence estimation in this chapter will take account of spatial autocorrelation by applying the Spatial Error Model (SEM) and the Spatial Lag Model (SLM) suggested by Anselin (1988).

4 We are aware that a control for national effects does not capture spatial heterogeneity comprehensively. For example, being an agglomerative or a rural area indubitably influences the economic development of a region (see Bräuninger and Niebuhr 2005).

A specific problem associated with β-convergence is that it does not necessarily imply a reduction in the variation of regional income levels over time (see Barro and Sala-i-Martin 1995). Hence, a negative correlation between initial income levels and subsequent growth rates does not prove a declining level of inequality. However, β-convergence is a frequently used concept because it makes it possible to control for various effects on the convergence process. Nevertheless, it can be useful to explore the data on the development of regional income disparities while conducting a formal β-convergence analysis. Therefore, the concept of σ-convergence is frequently applied in the convergence literature. σ-convergence takes place if the dispersion of income levels decreases over time (Barro and Sala-i-Martin 1995). We apply Theil's index of inequality (Theil 1967) because it makes it possible to decompose overall inequality into within-country and between-country components, which is very useful for the purpose of analysing the development of regional within-country disparities in the context of the general catching-up process taking place in the enlarged EU. Theil's inequality measure is derived from information theory and can be associated with the strand of literature dealing with inequality (see Cowell 1995).

3 Dataset and Regional System

When conducting regional convergence analysis, it should be borne in mind that the level of regional aggregation chosen may affect the outcome. Applying the same analysis on different spatial scales may yield different results (Arbia 2006). Except for very few studies employing relatively low levels of spatial aggregation (e.g. Niebuhr 2001; Arbia et al. 2005; Petrakos and Artelaris 2006), regional disparities and convergence processes in Europe have to date been analysed at the NUTS-2 level or higher levels of regional aggregation.[5] This can be explained by the improved data availability at higher levels of regional aggregation for observations in Western Europe. In principle, however, the choice of the level of spatial aggregation is somewhat arbitrary. On the one hand, using large spatial units of observation hides spatial heterogeneity and spatial interaction, which may be present within the regions observed. On the other hand, a very low level of regional aggregation increases the danger of slicing functional regions into parts. In the latter case, economic activities within a homogenous, functional region may be wrongly detected as spatial autocorrelation (see also Ertur and Le Gallo 2003).

5 NUTS (Nomenclature of Statistical Territorial Units) are spatial units used by EUROSTAT. While spatial units in NUTS-0 are countries, the level of spatial aggregation decreases with the levels 1, 2 and 3.

This analysis is conducted at a relatively low level of regional aggregation for two reasons. Firstly, as suggested by Bräuninger and Niebuhr (2005), there may be economic spillover effects which cannot be observed in a sample of NUTS-2 regions owing to their short range. Secondly, many of the NUTS-2 regions are relatively large and comprise very heterogeneous areas, such as highly agglomerated and very rural regions. The Baltic States, where the NUTS-2 level equals the county-level, are good examples of diverse regional structures within NUTS-2 regions. Our cross-section consists basically of NUTS-3 level regions of the EU-25. Only in the case of Germany do we use 97 so-called planning regions ("Raumordnungsregionen-ROR") which comprise several NUTS-3 regions.[6] Overall, we analyse 861 regions, of which 739 belong to the EU-15 and 122 to the NMS.[7]

To measure income, we use GDP per capita data adjusted for purchasing power standards (PPS), taken from the Eurostat database.[8] Data in PPS are adjusted for differences in national price levels, but not for differing price levels within countries. Although there are considerable regional within-country differences in price levels, we believe that data in PPS provide a better approximation of regional wealth than do data in euros. Furthermore, GDP in PPS is used to determine the eligibility of regions for support from the EU structural funds in the range of Objective 1. GDP data are collected in the place of residence. When small regional units are used, the commuting of workers between their place of residence and place of work may pose a problem for the analysis. However, convergence analyses are typically conducted with GDP data. For example, using GDP per employee data may attenuate the commuting problem, but it creates another one: productivity can be detached from actual regional growth. During structural changes in particular, decreasing employment may lead to increasing GDP per employee.

4 Development of Regional Disparities in the EU

4.1 Spatial Distribution of Income Levels and Growth

Figure 1 displays regional per capita incomes relative to the EU-25 average income level in 1995. The spatial distribution of regional income levels in the EU-25 shows a centre-periphery structure. Most of the relatively rich regions were situated along

6 German NUTS-3 regions are relatively small and very numerous compared to other European NUTS-3 regions. The inclusion of 439 German NUTS-3 regions would have significantly increased the influence of German regions in the analysis.

7 See more detailed information on the cross-section in the appendix.

8 It should be noted that Eurostat warns against using PPS-adjusted GDP values to calculate growth rates. However, we do not analyse the dynamics of single countries or regions, but the relative development of income levels between countries and regions.

the so-called "blue banana", which ranges from Southern England to Northern Italy. In the EU-15, regions with income levels below 75 percent of the EU-25 average can be found mainly in the southern periphery. Most noticeable, however, is an east-west gradient. In 1995, slightly more than two thirds of all regions in the NMS had income levels below 50 percent of the EU-25 average. Only the five capital regions – Prague (126 %), Bratislava (95 %), Ljubljana[9] (94 %), Budapest (89 %) and Warsaw (89 %), as well as Cyprus (82 %) – had income levels above 75 percent.

However, the spatial pattern of per capita growth between 1995 and 2003 is more dynamic in the periphery, indicating a general catching-up process (see Figure 2). Most regions in Spain, Greece, Ireland, Finland and in the NMS experienced growth rates above the average EU-25 growth rate. Relatively few regions within the "blue banana", mainly in the London area and in the Netherlands, displayed above average per capita growth.

Strikingly, a closer look at regional growth rates in the NMS reveals particularly strong dynamics in the relatively rich agglomerations – mainly the capital regions and their peripheries. The capital cities – Warsaw (139 %), Prague (138 %), Budapest (122 %), Bratislava (116 %) and Ljubljana (109 %) – clearly achieved above average income levels in 2003. This suggests that the general catching-up of the NMS may have been accompanied by increasing regional within-country disparities in the NMS.

4.2 Between- and Within-Country Inequality

This section explores the issue of differences in the development of overall regional inequality in the EU and the development of regional inequalities within the individual member states. To this end, we divide regional inequality into within-country and between-country disparities using the population-weighted version of Theil's index of inequality.[10]

$$T_{total} = \sum_i \left(\frac{N_i}{N} \right) \ln \left(\frac{N_i / N}{Y_i / Y} \right) \qquad (1)$$

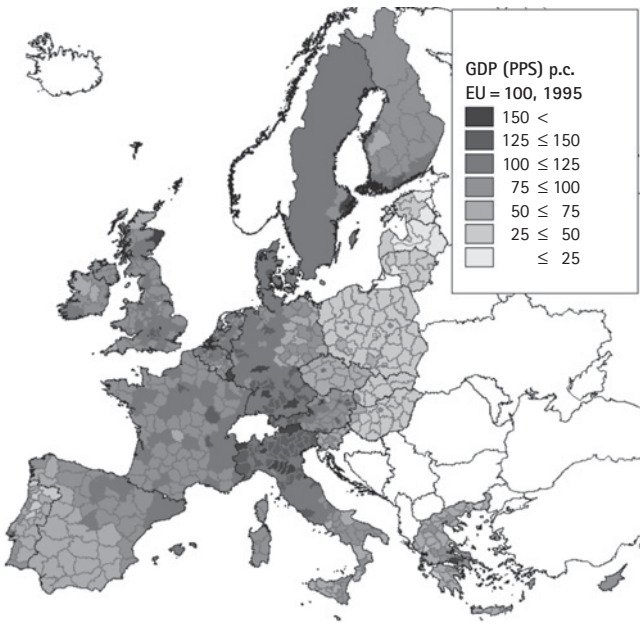
where

N – population in all regions,
N_i – population in region i,
Y – total GDP in all regions,
Y_i – total GDP in region i,

9 The actual name of the region is Osrednjeslovenska. It comprises Ljubljana and surrounding regions.

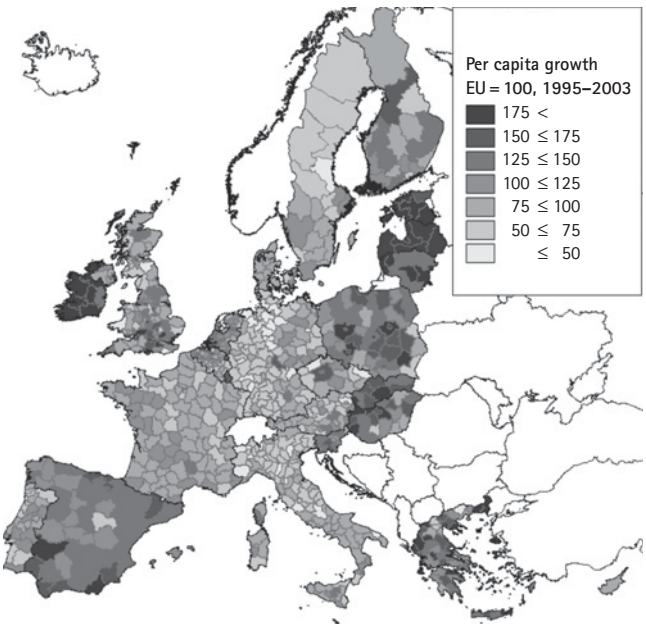
10 The population-weighted version of Theil's index is also called Theil's second measure. Theil's second measure is supposed to be more appropriate for measurement of inequality in wealth and it is more sensitive to changes at the bottom of the income distribution than the income weighted first measure (see Duro 2003).

Figure 1: Regional Income Levels Relative to the EU-25 Average



Source: Eurostat 2007, own calculations.

Figure 2: Regional per Capita Growth Relative to the EU-25 Average



Source: Eurostat 2007, own calculations.

Theil's index relates the regional income shares of the total sample population's income Y_i/Y to regional population shares of the total sample population N_i/N. When population shares equal the respective income shares in all regions, incomes are distributed completely evenly; hence Theil's index equals zero. The properties of Theil's index make it possible to break down total inequality in such a way that the weighted sum of the components matches the index for overall inequality. The left-hand term on the right-hand side of Equation (2) expresses the between-country component $T_{between}$. It equals the expression in Equation (1), except that observational units are countries instead of regions. The within-country component T_{within} is given by the right-hand term on the right-hand side of the equation. This contains the population-weighted sum of indices for regional inequality within each country.

$$T_{total} = \sum_j \left(\frac{N_j}{N}\right) \ln\left(\frac{N_j/N}{Y_j/Y}\right) + \sum_j \left(N_j/N\right)^* \sum_i \left(\frac{N_i}{N_j}\right) \ln\left(\frac{N_i/N_j}{Y_i/Y_j}\right) = T_{between} + T_{within} \qquad (2)$$

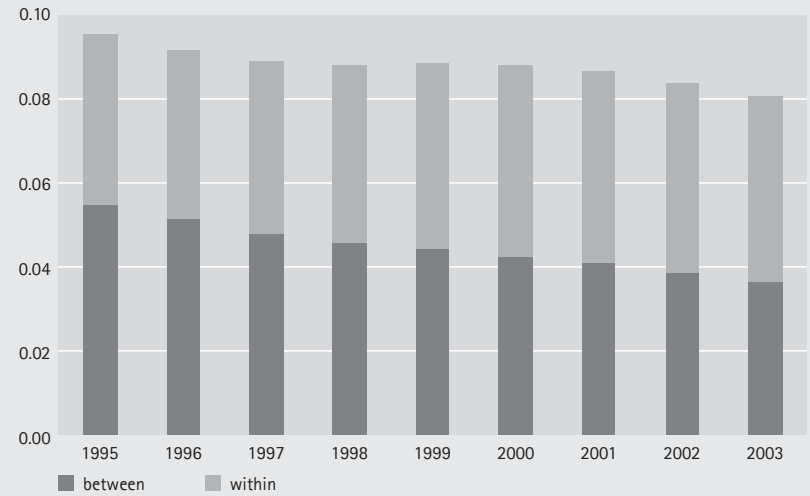
where

N_j – population in country j,
Y_j – total GDP in country j,

Figure 3 displays the development of income inequality in the EU-25 from 1995 to 2003. It shows that both inequality between countries and inequality within countries are very pronounced. Furthermore, this period is marked by a continuous decline in total income inequality. However, the reduction in overall inequality was driven exclusively by the between-country component. At the same time, the size of within-country inequality slightly increased.

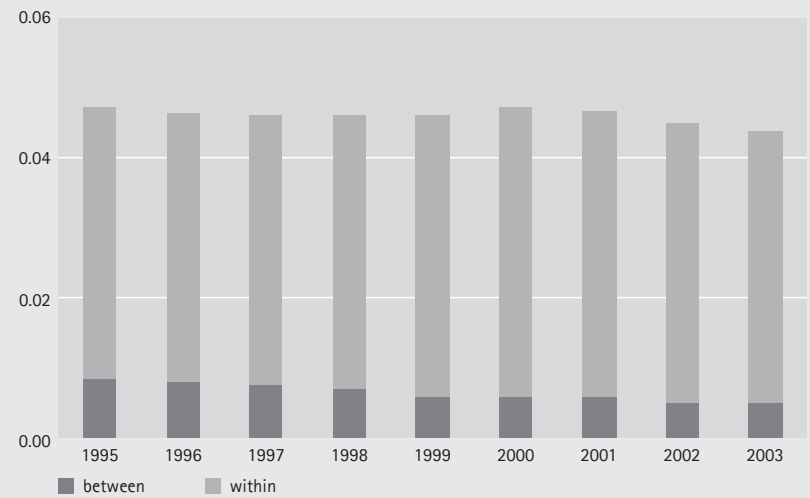
Regarding income inequality separately in the EU-15 and the NMS, disparities between countries are shown to be less important than disparities within countries (see Figures 4 and 5). Hence, within the EU-15 and the NMS, differences in per capita income across countries are much less important. This means that the magnitude of the between-country component in the EU-25 is mainly due to differences in income levels between old and new member states. However, Theil's index shows distinctly different developments in income inequality between the EU-15 and the NMS. The EU-15 experienced a small decrease in inequality between countries, while the level of within-country disparities remained relatively constant. In the NMS, by contrast, decreasing between-country inequality was accompanied by a significant increase in within-country inequality, leading to an overall increase in income disparities.

Figure 3: Inequality Within and Between Countries of the EU-25



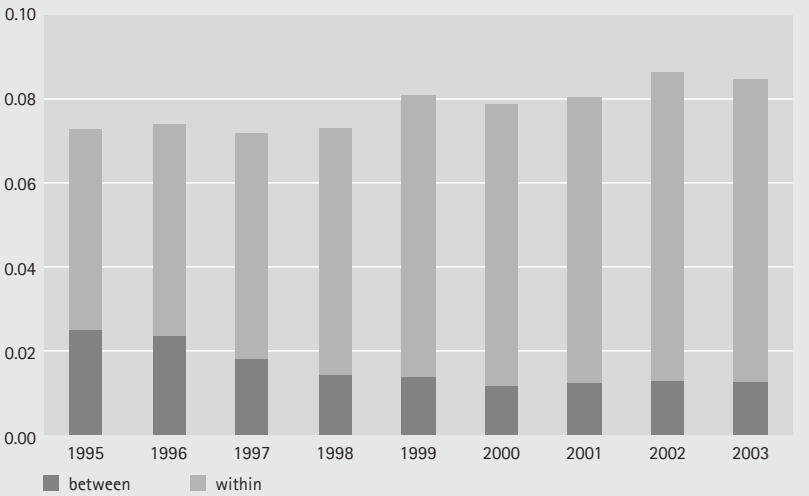
Source: Eurostat 2007; own calculations.

Figure 4: Inequality Within and Between Countries of the EU-15



Source: Eurostat 2007; own calculations.

Figure 5: Inequality Within and Between Countries of the NMS



Source: Eurostat 2007; own calculations.

Overall, the analysis shows that decreasing disparities in the EU between 1995 and 2003 were mainly a national phenomenon. Equalising processes on the country-level were accompanied by an increase in regional inequality within the individual NMS. These findings are consistent with those of Lammers (2002) and Tondl and Vuksic (2003), who conclude that there are metropolitan regions in the NMS which are driving national growth rates upwards. In particular, economically dynamic capital regions are responsible for a large share of national products while other regions lag behind.

5 Estimation

5.1 β-Convergence

β-convergence is defined as a negative relationship between initial income levels and subsequent growth rates. In order to test for regional β-convergence, we used the common cross-sectional OLS approach with per capita income growth as the dependent variable and the initial income level as the explanatory variable. In a second estimation dummy variables for countries were applied in order to account for country-specific effects. Therefore, we tested for absolute and conditional convergence. Since convergence patterns are supposed to differ between the EU-15 and the NMS, separate models for both country groups will be estimated.

$$\ln\left(\frac{y_{i0+T}}{y_{i0}}\right) = \alpha_0 + \alpha_1 \ln(y_{i0}) + \sum_{j=1}^{N} \alpha_{2j} c_{ji} + \varepsilon_i \quad (3)$$

where

y_{i0} – initial GDP per capita in region i,
T – number of years in observation period,
c_{ij} = 1 if region i belongs to country j, otherwise d_{ij} = 0,
α_0, α_1 and α_{2j} – parameters to be estimated,
ε_i – normally and independently distributed error term.

When the estimated coefficient α_1 is negative, poor economies tend to grow faster than rich ones. The annual rate of convergence β can be obtained from the equation $\beta = -\ln(1-\alpha_1)/T$, where T denotes the number of years between the initial and the final year of observation. Another common indicator used to characterise the speed of convergence is the so-called half-life τ, which can be obtained from the expression: $\tau = \ln(2)/\beta$. The half-life shows the time necessary for half of the initial income inequalities to vanish. When interpreting these indicators, however, one has to take into consideration that β-convergence does not necessarily imply σ-convergence. Both measures, the speed of convergence and the half-life my overestimate the intensity of the convergence process.

5.2 Spatial Dependence

Spatial dependence can be taken into account by applying a spatial weight matrix W, which is supposed to capture spatial structure and the intensity of spatial dependence. The specification of the matrix may influence the regression results. However, there are various ways to specify a spatial weight matrix. Because there is usually no a priori information about the exact nature of spatial dependence, the choice of the design of the spatial weight is somewhat arbitrary (see Niebuhr 2001; Ertur and Le Gallo 2003). A commonly used approach is based on the concept of binary contiguity, where the elements of the matrix w_{ij} = 1 if region i and region j share a common border or are within a certain distance range to each other, and w_{ij} = 0 otherwise (e.g. Rey and Montouri 1999). We used a distance-based weight matrix W where distance is the squared inverse of the great-circle distance between the geographic centres of the regions. Furthermore, we implemented a critical distance cut-off above which spatial interaction is assumed to be zero. The functional form of the squared inverse of distances can be interpreted as reflecting a gravity function (see Le Gallo et al. 2003). Furthermore, the distance matrix is row-standardized, so that it is relative and not absolute distance that matters.

$$W = \begin{cases} w_{ij} = 0 & \text{if } i = j \\ w_{ij} = 1/d_{ij}^2 & \text{if } d_{ij} \leq D \\ w_{ij} = 0 & \text{if } d_{ij} > D \end{cases} \quad (4)$$

where

$w_{i,j}$ – spatial weight for interaction between regions i and j;
d – distance between geographical centres of regions i and j;
D – critical distance cut-off.

According to Anselin (2001), spatial autocorrelation[11] can be defined as a spatial clustering of similar parameter values. If similar parameter values – high or low – are spatially clustered there is a positive spatial autocorrelation present in the data. Conversely, a spatial proximity of dissimilar values indicates a negative spatial autocorrelation.

As a measure of the spatial clustering of income levels and growth in the EU, we used Moran's I-statistic:

$$I_t = \frac{N \sum_{i=1}^{N} \sum_{j=1}^{N} x_{i,t} x_{j,t} w_{i,j}}{N_b \sum_{i=1}^{N} x_{i,t}^2} \quad (5)$$

where
$x_{i,t}$ – variable in question in region i and in year t (in deviations from the mean);
N – number of regions;
N_b – sum of all weights (since we use row-standardised weights N_b is equal to N).

When Moran's I is positive and significant, there is a tendency towards a spatial clustering of similar parameter values in the sample. We used Moran's I-statistic to check for the spatial autocorrelation of regional growth rates and income levels. Table 2 shows the coefficient I using the weight matrix W. Different critical distance cut-offs were applied in order to check for sensitivity to changes in the spatial weight.

The results in Table 1 show that there is strong evidence for spatial dependence among the regions in the EU. The coefficient I is highest with a cut-off distance of a hundred kilometres and decreases with increasing cut-off distances. However, the significance of the results (standardised z-values) increases up to a critical cut-

11 The terms 'spatial autocorrelation' and 'spatial dependence' are used as synonyms, although we acknowledge that the terms are not exactly identical in meaning.

off distance of 500 km and decreases thereafter. This leads to the conclusion that regional interaction over distances of more than 500 km are not relevant in terms of spatial autocorrelation. Therefore, a critical cut-off distance of 500 km will be used in the following analysis.

Table 1: Moran's I-test for Spatial Autocorrelation (Randomisation Assumption)

Critical distance cut-off (km)	Moran coefficient I (Standardised z-value)		
	$\ln\left(\frac{y_{i2003}}{y_{i1995}}\right)$	$\ln(y_{i1995})$	$\ln(y_{i2003})$
100	0.54** (21.27)	0.75** (29.77)	0.67** (26.71)
200	0.51** (29.35)	0.74** (42.43)	0.66** (37.49)
300	0.48** (31.63)	0.72** (47.34)	0.63** (41.77)
400	0.45** (32.44)	0.70** (49.72)	0.61** (43.82)
500	0.44** (32.77)	0.68** (50.80)	0.60** (44.80)
600	0.42** (32.67)	0.65** (50.74)	0.58** (44.78)
700	0.41** (32.60)	0.63** (50.55)	0.56** (44.65)
800	0.40** (32.37)	0.62** (50.12)	0.55** (44.33)
900	0.39** (32.09)	0.60** (49.64)	0.53** (43.94)
1000	0.38** (31.82)	0.59** (49.13)	0.52** (43.54)
2000	0.34** (30.27)	0.52** (46.38)	0.47** (41.33)

Notes: ** significant at the 0.01 level.

Spatial autocorrelation can appear in two different forms: the substantive form and the nuisance form (see Anselin 1988). Ignoring the substantive form of spatial autocorrelation, which results from direct regional interaction, may lead to biased and inefficient estimates. The nuisance form of spatial dependence is restricted to the error term. It stems from measurement errors, such as a wrongly specified regional system which does not adequately reflect the spatial structure of economic activities. Ignoring nuisance dependence may lead to inefficient estimates.

Anselin (1988) suggests two different model specifications in order to deal with the respective forms of spatial dependence. Both models are estimated with the maximum likelihood (ML-)method. In the spatial error model (SEM), spatial dependence is restricted to the error term. Hence, on average, per capita income growth is explained adequately by the convergence hypothesis. Therefore, the SEM is an appropriate model specification for the nuisance form of spatial dependence:

$$\ln\left(\frac{y_{i0+T}}{y_{i0}}\right) = \alpha_0 + \alpha_1 \ln(y_{i0}) + \sum_{j=1}^{N} \alpha_{2j} c_{ji} + \varepsilon_i, \text{ with } \varepsilon_i = \lambda \left[W \cdot \varepsilon\right]_i + u_i \quad (6)$$

where

λ – spatial autocorrelation coefficient,
$[W \cdot \varepsilon]_i$ – the i-th element of the vector of the weighted errors of other regions,
c_{ij} = 1 if region i belongs to country j, otherwise d_{ij} = 0,
ε_i and u_i – normally and independently distributed error terms.

The spatial lag model (SLM) is suitable when spatial dependence is of the substantive form, where regional growth is directly affected by the growth rates in surrounding regions. Growth spillovers from neighbouring regions are incorporated through the inclusion of a spatially lagged dependent variable on the right-hand side of the equation:

$$\ln\left(\frac{y_{i0+T}}{y_{i0}}\right) = \alpha_0 + \rho \left[W \cdot \ln\left(\frac{y_{0+T}}{y_0}\right)\right]_i + \alpha_1 \ln(y_{i0}) + \sum_{j=1}^{N} \alpha_{2j} c_{ji} + \varepsilon_i \quad (7)$$

where

ρ – the spatial autocorrelation coefficient,

$\left[W \cdot \ln\left(\frac{y_{0+T}}{y_0}\right)\right]_i$ – the i-th element of the vector of weighted growth rates of other regions.

5.3 Estimation Results

The results of OLS estimation ignoring spatial dependence are presented in Table 2. The EU-25 experienced a significant regional convergence of income levels at an average rate of 2 percent p.a. Given the accuracy of β-convergence, such a convergence rate, which is frequently found in the literature (e.g. Barro and Sala-i-Martin 1995), implies a half-life of 35 years. Regional convergence was somewhat weaker within the EU-15 and clearly less pronounced within the NMS. The respective half-lives are 38 years in the EU-15 and 50 years in the NMS.

When national effects are taken into account, the estimated convergence rates decrease substantially. There is no significant convergence process on-going within the countries of the EU-25, and the speed of within-country convergence in the EU-15 halves relative to the absolute convergence model. The rate of within-country convergence in the NMS even changes sign. Regional per capita incomes within the countries of the NMS actually diverge at a rate of 1.5 percent p.a. Hence,

within individual NMS, richer regions tend to grow faster. Overall, the catching-up process in the EU-25 is predominantly a national phenomenon. Niebuhr and Schlitte (2004) have obtained similar results when testing regional within-country convergence at the NUTS-2 level.

The results of Moran's I-test in Table 2 show significant spatial autocorrelation in the residuals of all OLS estimations. Though commonly used, Moran's I is not very reliable and does not provide information about the form of spatial dependence (Anselin 1992). In order to identify the form of spatial autocorrelation, Lagrange Multiplier (LM-)tests are applied. According to the decision rule by Anselin and Florax (1995), spatial dependence is of the nuisance form if the LM-test for spatial error dependence (LM_{err}) is more significant than the test for spatial lag dependence (LM_{lag}) nd the robust version of the LM_{err} – which is robust against the presence of spatial lag dependence – is significant. Conversely, the opposite indicates that the substantive form of spatial autocorrelation is present in the data.

Table 2: OLS Estimation Results

	EU-25	EU-15	EU-10	EU-25	EU-15	EU-10
Country dummies		no			yes	
No. of regions	861	739	122	861	739	122
Intercept	1.583** (17.04)	1.473** (8.84)	1.258** (3.98)	0.553** (4.34)	0.876** (6.09)	–0.646 (–1.60)
α_1	–0.130** (–13.36)	–0.119** (–6.88)	–0.092* (–2.52)	–0.020 (–1.14)	–0.058** (–3.89)	0.112** (2.58)
$R^2_{adj.}$	0.20	0.09	0.06	0.48	0.37	0.36
AIC	–1371.4	–1230.1	–151.1	–1721.3	–1483.3	–190.2
Convergence speed	2.0**	1.8**	1.4*	0.3	0.9**	–1.5**
Half-life	35	38	50	240	81	-
Jarque-Bera	389.54**	429.96**	9.50**	496.48**	540.82**	3.96
Moran's I	21.68**	21.79**	6.12**	9.32**	14.15**	4.34**
LM_{Error}	451.90**	454.81**	30.25**	51.16**	149.60**	7.21**
Robust LM_{Error}	40.45**	10.46**	6.64**	9.90**	18.06**	0.08
LM_{Lag}	440.45**	473.91**	25.95**	41.26**	131.61**	9.03**
Robust LM_{Lag}	29.01**	29.56**	2.33	0.01	0.07	1.91

Notes: ** significant at the 0.01 level. * significant at the 0.05 level. Standard errors reported in parentheses.

In the case of absolute convergence, the LM-tests show a preference for spatial lag dependence in the EU-15 and spatial error dependence in the NMS. When national

effects are considered, the results clearly indicate spatial error dependence in the EU-15, while there is no clear result for the NMS. Overall, the LM-tests do not provide a clear and consistent preference for either the substantive or the nuisance form. Furthermore, LM-tests may be unreliable in the presence of non-normality (see Anselin 1992). The Jarque-Bera test detects non-normality in almost all models. Seeing these potential problems, both the SEM and the SLM were tested in all cases (see Tables 3 and 4).

Table 3: SLM Estimation Results

	EU-25	EU-15	NMS	EU-25	EU-15	NMS
Country dummies		**no**			**yes**	
Number of regions	861	739	122	861	739	122
Intercept	0.485** (5.72)	0.509** (4.31)	0.346 (1.35)	0.343** (2.82)	0.548** (4.24)	–0.541** (–1.60)
α_1	–0.043** (–5.23)	–0.046** (–3.87)	–0.019 (–0.69)	–0.014 (–1.14)	–0.042** (–3.23)	0.101** (2.89)
ρ	0.780** (21.28)	0.782** (20.15)	0.604** (6.05)	0.410** (6.52)	0.535** (8.78)	0.508** (4.02)
AIC	–1640.1	–1473.2	–174.9	–1755.0	–1558.2	–197.8
Convergence speed	0.6**	0.7**	0.3	0.2	0.6**	–1.4**
Half-life	110	103	253	344	113	-
LM-test	0.00	2.08	8.99**	7.68**	0.29	1.10

Notes: ** significant at the 0.01 level. * significant at the 0.05 level. Standard errors reported in parentheses.

The spatial lag coefficient ρ in the SLM as well as the spatial error coefficient λ in the SEM are highly significant. Furthermore, the Akaike Information Criterion (AIC) shows improved model-fits in all cases, indicating that regions are affected in their development by their neighbourhood.[12] Applying SEM and SLM estimations without control for country-specific effects yielded very low convergence rates. In both spatial specifications, the estimated rate of convergence is 0.6 percent in the EU-25 and 0.7 percent in the EU-15. These rates imply half-lives of more than a hundred years. In both models, there was no significant convergence in the NMS. In the case of the NMS, LM-tests pointed to the nuisance form of spatial dependence. Considering the EU-25 and the EU-15 cases, LM-tests do not provide a clear-cut conclusion as to which of the two models is more suitable. However, compared with

12 The R^2 in ML-estimations is only a pseudo measure and therefore not suitable for comparison with OLS. Hence the AIC is used instead (see Anselin et al.1995).

the convergence speed in the spatial models, OLS estimates seem to be biased. This leads to the conclusion that the substantive form of spatial autocorrelation is present in the data.[13]

When country dummies were included, the estimations yielded results very similar to those of the conditional OLS estimations. There was a very slow process of conditional convergence taking place in the EU-15, while income levels in individual NMS diverged. Also, the model fits did not vary remarkably from OLS models. This indicates that OLS estimates are not seriously biased when national effects are taken into account. As a consequence, spatial lag dependence seems to be captured sufficiently by the employment of country dummies. Hence, national macroeconomic factors appear to be more influential on regional growth than spatial spillovers. Put differently: spatial spillovers seem to stop at national borders. Similar results have been found by Bräuninger and Niebuhr (2005) and Geppert et al. (2005) for NUTS-2 regions in Western Europe and by Feldkircher (2006) for NUTS-2 regions in the enlarged EU.

Table 4: SEM Estimation Results

	EU-25	EU-15	NMS	EU-25	EU-15	NMS
Country dummies		**non**			**yes**	
Number of regions	861	739	122	861	739	122
Intercept	0.781** (6.30)	0.752** (4.87)	0.268 (0.97)	0.518** (4.01)	0.766** (5.30)	−0.311 (−0.98)
α_1	−0.041** (−3.62)	−0.045** (−2.77)	0.013 (0.42)	−0.017 (−1.30)	−0.048** (−3.22)	0.076* (2.35)
λ	0.840** (26.01)	0.809** (21.21)	0.830** (12.37)	0.495** (7.75)	0.592** (9.79)	0.540** (4.17)
AIC	−1636.1	−1467.4	−185.5	−1764.8	−1568.7	−199.0
Convergence speed	0.6**	0.7**	−0.2	0.2	0.7**	−1.0*
Half-life	116	105	-	283	99	-
LM-test	0.03	1.48	0.89	0.02	5.33*	2.74

Notes: ** significant at the 0.01 level. * significant at the 0.05 level. Standard errors reported in parentheses.

13 It should be noted that a direct comparison of β-coefficients between the SLM and OLS models is not quite correct because the estimated speed of convergence in the SLM also takes indirect and induced effects into account (see Abreu et al. 2005 or Pace and Le Sage 2006).

6 Conclusions

Examination of regional income levels of NUTS-3 regions across the enlarged EU reveals significant regional disparities in both the EU-15 and the NMS. There is a core-periphery structure with relatively high income levels in the centre of the EU and relatively low income levels in peripheral regions. Furthermore, the spatial structure of income levels in the EU is marked by an east-west gradient, with comparatively low income levels in the NMS. However, regional growth rates tend to be higher in the periphery, especially in the NMS, indicating a catching-up process. Inequality analysis by means of Theil's inequality index has shown a decrease in total income inequality in the EU. This development, however, is mainly due to diminishing income disparities at the country level. While the level of within-country inequality in the EU-15 remains relatively constant, the NMS experience a significant increase in regional within-country inequality.

These findings have been confirmed by formal β-convergence analysis. OLS estimation results show a significant absolute convergence at an annual rate of 2 percent between 1995 and 2003. At the same time, catching-up processes were somewhat less pronounced in the EU-15 and the NMS. However, on taking national effects into account, the general convergence process was shown to be driven mainly by country-specific effects, i.e. national policies, legislation, tax systems etc. This is particularly the case of the NMS, where institutional changes in the course of market liberalisation have been large compared with Western Europe. When regions are allowed to converge towards country-specific steady-state levels of per capita income, the convergence rate across regions in the NMS becomes negative. Hence, in the course of general catching-up by the NMS, regional within-country disparities in the NMS have increased. Considering spatial dependence in the convergence estimations shows that regions cannot be regarded as isolated entities in absolute convergence processes. Both spatial lag dependence and spatial error dependence matter. However, in the conditional convergence models, the effects of spatial spillovers are sufficiently captured by country dummies. This demonstrates that national macroeconomic factors exert a greater influence on regional growth than spatial interaction. In other words, spatial growth spillovers seem to stop at national borders, which indicates that border impediments still matter for the intensity of economic cross-border integration in the EU.

Given the short length of the period observed, these results cannot be taken as an indications for long-run development. It is possible, for example, that forces driving regional inequality in the individual NMS will cease in the long run. However,

the analysis has shown that there may be a trade-off between convergence on the national level and regional within-country convergence in the NMS which may impede the European Commission in its pursuit of the objective of economic and social cohesion.

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Appendix

Table A1: The Regional Cross-Section

	Number of regions	Classification
EU-25	861	NUTS-3/ROR
EU-15	739	NUTS-3/ROR
Belgium	43	NUTS-3
Denmark	15	NUTS-3
Germany	97	ROR
Finland	20	NUTS-3
France*	96	NUTS-3
Greece	51	NUTS-3
Ireland	8	NUTS-3
Italy	103	NUTS-3
Luxembourg	1	NUTS-3
Netherlands	40	NUTS-3
Austria	35	NUTS-3
Portugal**	28	NUTS-3
Spain***	48	NUTS-3
Sweden	21	NUTS-3
United Kingdom	133	NUTS-3
EU-10	122	NUTS-3
Estonia	5	NUTS-3
Latvia	6	NUTS-3
Lithuania	10	NUTS-3
Malta	1	NUTS-2
Poland	45	NUTS-3
Slovakia	8	NUTS-3
Slovenia	12	NUTS-3
Czech Republic	14	NUTS-3
Hungary	20	NUTS-3
Cyprus	1	NUTS-3

Notes: * French overseas departments Guadeloupe, Martinique, French Guyana and La Reunion. ** Excluding Acores and Madeira. *** Excluding Canary islands as well as Ceuta and Mellila.

NUTS – Nomenclature of Statistical Territorial Units of EUROSTAT; ROR – Raumordnungsregionen (Planning Regions) of the Bundesamt für Bauwesen und Raumordnung.

Chapter 3 EU Enlargement and Convergence – Does Market Access Matter?[1]

ANNEKATRIN NIEBUHR[2] AND FRISO SCHLITTE[3]

Abstract: Economic integration in Europe has been accompanied by concerns about the effect of integration on regional disparities in the European Union. This chapter investigates the effects of the most recent EU enlargement on convergence among countries and regions in the EU-27. Departing from a new economic geography framework, we focus on integration effects caused by changes in market access, released by a reduction of trade impediments. Special attention is paid to the catching-up process of the new member states (NMS) and the development of regional disparities within the East European countries. From 1995 to 2004, the EU integration process was marked by an economic catching-up of the NMS. At the same time, regional within-country disparities in the NMS have been increasing. Our simulation analysis shows that trade integration has a strong effect on market potentials in East European regions. Comparatively strong changes in market access are supposed to foster the East European catching-up at the national and regional levels. However, accounting for these integration effects does not significantly alter the findings of our convergence analysis.

1 Introduction

The process of European integration and enlargement has always been accompanied by concerns about the implications of economic integration for regional disparities in the European Union. EU enlargement is supposed to profoundly affect the location of economic activities in Europe. The integration of the new member states (NMS) from Central and Eastern Europe might have diverse effects on various EU regions, depending on their location and specialization. Economic convergence is one of the EU Commission's basic objectives. With the European Union's eastward enlargement, income disparities (statistically) increased considerably (see European Commission 2004). Cohesion policy, the second-largest item in the EU budget, has to be adjusted to this change in the scale of disparities. Information on the speed of

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2 Institute for Employment Research (IAB), Germany, and Department of Economics, Christian-Albrechts-Universität zu Kiel, Germany.

3 Hamburg Institute of International Economics (HWWI), Germany, and Institute for Employment Research (IAB), Germany.

convergence and the effect of integration on the convergence process is therefore of utmost importance for EU policy.

This analysis links two strands of literature dealing with EU enlargement. The first group of studies considers the spatial pattern of integration effects released by the eastward enlargement of the European Union. The empirical literature on integration effects tends to focus on the EU-wide impact on growth and country effects (e.g., Baldwin et al. 1997; Breuss 2001). Only a few studies explicitly consider its effect at the regional level. Bröcker (1998), Brülhart et al. (2004), and Pfaffermayr et al. (2004) provide quantitative estimates of regional effects in Europe caused by the economic integration of the Central and East European countries. The second group of studies deals with a potential decline or deepening of regional disparities in the course of a proceeding economic integration in Europe. Recent empirical studies have examined the consequences of the last enlargement round for convergence. Tondl and Vuksic (2007) analyze the factors that make East European regions catch up. Feldkircher (2006), Paas and Schlitte (2008), and Fischer and Stirböck (2004) investigate regional convergence in the enlarged European Union.

This chapter offers empirical evidence on the spatial effects of EU enlargement, the development of regional disparities, and the interaction of both. The study deals with the effects of the eastward enlargement on the spatial distribution of economic activity and differences in regional per capita income in the EU-27[4] through its effect on market access. We investigate whether changes in market access released by declining impediments to cross-border trade support the catching-up of lagging regions or tend to work against convergence. We pay special attention to the NMS catching-up process and the development of regional disparities within the East European countries. Evidence provided by Quah (1996) as well as De la Fuente and Vives (1995) suggests that the catching-up of poor EU countries might go hand in hand with rising regional imbalances within these countries. As the analysis is restricted to integration effects arising from changes in market access, we do not offer a comprehensive investigation of the spatial effect of integration and its consequences for cohesion. Effects emerging from differences in specialization and factor mobility are not considered, though they are likely to be important.

We apply a new economic geography (NEG) model, which allows us to examine why market access might be decisive with respect to spatial integration effects and regional disparities. Only some models allow the consideration of disparities both between and within countries. We use a wage equation derived from the NEG framework to estimate the distance decay of demand linkages in the European

4 Malta and Cyprus, though members of the EU, are not included in the empirical investigation.

Union. This information is used to calculate changes in market access caused by a reduction of border impediments. The basic idea of the analysis is that the changes in the market potentials of EU regions, in turn, affect regional per capita income. To investigate the effect of changing market access on regional disparities, we carry out a convergence analysis and extend the corresponding regression model by our accessibility measure.

We find that regions in the NMS realize significant increases in market potential through increased trade integration with the EU-15 market, whereas market potential changes in the EU-15 are more or less negligible. Therefore, reduced border impediments between old and new EU member states should promote the catching-up of the NMS to the EU-15. However, accounting for neoclassical catching-up mechanisms and country-specific growth factors, the change in market potential has hardly any effect on per capita income growth in the European Union. Furthermore, we find that national macroeconomic differences seem to influence regional growth rates more than spatial spillovers. Accounting for national effects reveals that the catching-up of the NMS is accompanied by regional divergence processes within the individual NMS countries. Overall, this indicates that centripetal forces driving agglomeration prevail at the subnational level in the early stages of economic integration within the enlarged EU market.

2 Theory

NEG models offer a perfect theoretical framework for our analysis because they consider both the spatial effects of integration and the development of regional disparities. Based on corresponding approaches, Krugman (1993) and Krugman and Venables (1990) investigate the implications of integration for the spatial structure of economic activity in Europe. Integration affects the balance of centripetal and centrifugal forces through its effect on transport costs and, thus, might alter the spatial distribution of economic activities. The domestic market becomes less important, possibly resulting in a reallocation of resources from previous centers to new locations (see Fujita et al. 1999). Market size considerations based on NEG models suggest that central regions, such as those along a common border of integrating countries, might realize above-average integration benefits because they achieve above-average increases of their market potential. The relative geographical position of these regions is altered dramatically by integration, changing from a peripheral one on a national scale to a central one in the common market. Midelfart et al. (2003) argue that market access improvements benefit firms located in the center of the European Union rather than those in the periphery. The relative disadvantage of peripheral regions should therefore increase. However,

most NEG models do not allow the drawing of precise conclusions, as integration might not be sufficient to destabilize the existing spatial distribution of economic activity. Moreover, integration might work to the advantage of either central locations or peripheral areas.

As we are interested in the catching-up process at the national level as well as in regional convergence within the member states, the theoretical model should allow us to distinguish these processes on different spatial scales. In most NEG models, however, this is not possible. The few exceptions comprise studies by Krugman and Livas Elizondo (1996), Monfort and Nicolini (2000), and Paluzie (2001) that extend the standard two-region NEG model to three or even four regions. Both Monfort and Nicolini (2000) and Paluzie (2001) show that integration might lead to increasing disparities in the integrating countries. By contrast, in Krugman and Livas Elizondo (1996), declining barriers to trade foster dispersion in the country opening to trade.[5] The following section discusses the corresponding effects in more detail based on a similar model by Crozet and Koenig-Soubeyran (2004).

2.1 A Two-Country, Three-Region NEG Model

To investigate the effect of integration on the development of disparities within the acceding countries, we apply a two-country, three-region model proposed by Crozet and Koenig-Soubeyran (2004). As the model largely aligns with the usual NEG setup, we keep the description of the theoretical framework brief. In the model, there are three regions in two countries, the domestic country and the foreign economy (0). The domestic country has two regions, denoted (1) and (2). The regional economies consist of a monopolistically competitive industry and a perfectly competitive agricultural sector. Goods are traded among all regions.

The tastes of all consumers are described by a Cobb–Douglas utility function:

$$U = C_M^{\mu} C_A^{1-\mu} \quad \text{with } 0 < \mu < 1 \tag{1}$$

where μ is the share of expenditures on manufactured goods, C_A is the quantity of the agricultural product consumed and C_M is a composite of symmetric product varieties given by:

$$C_M = \left[\sum_{k=1}^{K} c_k^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \tag{2}$$

5 A similar analysis by Behrens et al. (2007) suggests that integration will promote regional dispersion if intra-national transport costs are relatively high. Their results point to the importance of transport and infrastructure policies in this context.

The parameter σ is the constant elasticity of substitution between any pair of varieties, and K is the number of varieties. Consumers have a love for variety. With increasing σ, the substitutability among varieties rises; thus, the desire to spread consumption over manufactured goods declines. Utility is maximized subject to the budget constraint:

$$Y = C_A p_A + \sum_{k=1}^{K} c_k p_k \tag{3}$$

where Y is income, and p_A and p_k are prices of the agricultural product and the variety k of the manufactured commodity, respectively.

Manufactured goods are traded among regions, incurring iceberg transaction costs – that is, a fraction of any product shipped melts away and only a part $(1/T_{ij})$ arrives at its destination. The price of the varieties produced in i and sold in j, $(p_i T_{ij})$, therefore, consists of the mill price and transaction costs.[6] Transaction costs differ across regions. The approach differentiates between cross-border transaction costs (T_{01}, T_{02}) and internal transaction costs (T_{12}), which apply to interregional domestic trade.

Utility maximization results in the following demand function for manufactured goods:[7]

$$c_{ij} = \frac{(p_i T_{ij})^{-\sigma}}{P_j^{1-\sigma}} \mu Y_j ; \; i, j = 1, 2, 3 \tag{4}$$

where c_{ij} is demand in region j for manufactured goods produced in region i. P_j is the price index for manufactured goods in region j, p_i is the mill price of varieties produced in i and T_{ij} are transaction costs which include distance related transport costs as well as trade barriers.

Crozet and Koenig-Soubeyran (2004) model two factors of production: mobile human capital H and immobile labor L. In agriculture, only labor is used as an input, whereas the manufacturing sector uses only human capital.[8] There are increasing returns in the production of each individual variety of manufactured goods due to fixed costs. Each manufacturing firm has the same production function, in which human capital enters as input. Total costs are given by:

$$h = \eta - \theta q \tag{5}$$

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6 In contrast, trade of the agricultural product is assumed to incur no trade costs.

7 We omit the variety subscript k because of the symmetry of all varieties produced in region i.

8 By choice of units, the price of the agricultural product pA equals the wage of farm labor wA. Moreover, wA = 1, since the agricultural product serves as a numéraire.

where q is output, η is fixed costs and θ is marginal costs per additional unit produced.

The price of a variety produced in i is given by a mark-up on marginal costs:

$$p_i = \left(\frac{\sigma}{\sigma - 1}\right) w_{iH}\theta \tag{6}$$

Because of increasing returns, each variety is only produced by one firm in one region. Thus, regions do not produce the same set of products, but produce differentiated bundles of manufactured goods. The number of corresponding varieties is proportional to the human capital of the region. If human capital increases due to immigration, the number of supplied manufactured goods rises. There is no international factor mobility. However, human capital is mobile between domestic regions. Human capital owners migrate to the region that offers the highest real wage, $\omega_{iH} = w_{iH}/P_i^{\mu}$ – that is, the nominal wage deflated by the price index. Thus, two factors determine the mobility of human capital. Human capital owners migrate toward regions characterized by a relatively low price index for manufactured goods and a comparatively high remuneration of human capital. Depending on the interaction of centripetal and centrifugal forces, a real wage differential may either induce more human capital to move to the high-wage region or lower the real wage in the destination region.

The effect of the geographic distribution of manufacturing and human capital on wages can be discussed based on the nominal wage equation that gives the short-term equilibrium level of the nominal wage in region i:

$$w_{iH} = \frac{1}{\theta}\left(\frac{\sigma - 1}{\sigma}\right)\left[\frac{\mu\theta}{\eta(\sigma - 1)}\left(\sum_{j=1}^{N} Y_j P_j^{\sigma - 1} T_{ij}^{1-\sigma}\right)\right]^{1/\sigma} \tag{7}$$

According to this equation, the nominal wage paid by manufacturing firms in region i increases with the number of nearby consumers – that is, the available purchasing power – and declines with the number of competitors in locations with low transaction costs to region i. The latter is appropriate because the price index $P_j^{\sigma-1}$ can be regarded as index for concentration of manufacturing firms. Backward and forward linkages might cause a spatial concentration of human capital and firms. A concentration of firms raises real wages in the corresponding region through a decline in the price index of manufacturing goods, as many varieties are produced locally. Rising real wages increase the attractiveness of the location for human capital (forward linkage) and result in in-migration, which increases the size of the market. Large markets, in turn, are attractive production sites for manufacturing, allowing firms to reward human capital with higher wages (backward linkage).

Thus, there is a mechanism of cumulative causation that might result in a spatial concentration of manufacturing and human capital. The distribution of firms and human capital across space depends on the relative strength of centripetal and centrifugal forces. The centrifugal force in our model is based on the exogenous location of agricultural workers and the desire of manufacturing producers to get away from competitors. The attractiveness of agglomeration for firms and human capital constitutes the centripetal force.

2.2 Effects of Integration

The effect of integration on regional disparities in the domestic country depends, among other things, on the assumptions regarding cross-border transport costs. In the following, two cases are considered: First, we assume that both domestic regions have the same access to the foreign market ($T_{01} = T_{02}$). In the second case, Region (2) – that is, a border region – has better access to the foreign market ($T_{01} > T_{02}$).

Economic integration gives rise to two opposed forces.[9] Due to integration, the significance of foreign demand and supply is raised in the domestic country. This decreases the strength of both centripetal and centrifugal forces. On the one hand, rising accessibility of the foreign market decreases the incentive to locate near domestic consumers for the domestic industry, as such consumers represent a smaller share of total purchasing power. Domestic agglomeration also is weakened by the increasing weight of foreign supply for domestic consumers. Hence, the strength of the centripetal force related to domestic purchasing power declines in the course of integration. On the other hand, integration results in increased competition by foreign firms. The presence of foreign supply reduces the need to locate away from domestic competitors, thereby reducing centrifugal forces. The simulations in Crozet and Koenig-Soubeyran (2004) suggest that the effect on the centrifugal force dominates – in other words, that the likely outcome of integration is agglomeration of manufacturing and human capital in one region.

Thus, the probability that domestic manufacturing concentrates in one region increases due to declining external trade costs. If we assume perfect symmetry of domestic regions ($T_{01} = T_{02}$), the corresponding location of industry is indeterminate. However, if a border region has better access to foreign demand ($T_{01} > T_{02}$), its attractiveness relative to the domestic nonborder region rises with trade liberalization. When tariffs are low, the advantage of favorable access to

9 We only consider the impact of trade liberalization and ignore effects resulting from free cross-border movement of labor and human capital.

the foreign market outweighs the negative effect arising from competition with foreign firms in the border region. According to Brülhart et al. (2004), in this case, a concentration of manufacturing in the nonborder region is only possible if a comparatively large number of manufacturing firms were located in the region before integration began. However, as Crozet and Koenig-Soubeyran (2004) show, the adverse effect of increased competition might dominate the effect of improved accessibility of foreign demand if tariffs remain at a high level. Economic activity is dispersed, with an above-average share of industry located in the nonborder region.[10]

2.3 Implications for EU Enlargement

Two-region NEG models do not allow us to draw clear-cut conclusions about the effect of integration on regional disparities in the enlarged European Union. Differences between prosperous old and poor new EU member states might decline after enlargement if the forces released by integration are strong enough to alter the current spatial structure of economic activities in Europe. However, the effect of integration on centripetal and centrifugal forces depends on various aspects; therefore, enlargement might as well result in increasing disparities among EU member states.

Regarding convergence within the NMS, the theoretical analyses suggest that, irrespective of differences in access to the foreign market, regional disparities in acceding countries might increase. However, whether centripetal or centrifugal forces dominate depends on the degree of integration – that is, the level of remaining barriers to trade. Moreover, we cannot derive clear-cut implications regarding winners and losers of enlargement based on the NEG model unless we assume differences in accessibility to the EU-15 market or differences in the starting positions of the regions in the NMS. There are some indications that border regions in the western part of the NMS, as well as prosperous agglomerated regions, might achieve above-average integration benefits. The pull effects toward the border regions in the west of the NMS are likely to be strong, especially if foreign demand is relatively large, as in the EU-15 market.

In sum, theoretical analyses do not give clear-cut results regarding the effects of enlargement on regional disparities in the EU-27. The literature has not yet reached a consensus on the question of whether integration leads to convergence or increasing disparities within countries that open up to trade. Empirical analysis

10 See Brülhart et al. (2004) and Niebuhr (2008) for detailed analyses of the impact of enlargement on European border regions.

must shed some light on this issue. We apply convergence regressions and simulation analyses to provide empirical evidence.

3 Methodology

3.1 Integration and Market Access

Our empirical analysis follows the intuition of Harris' (1954) seminal market-potential function. According to this function the demand for goods produced in region *i* is determined by the purchasing power in region *i* and the purchasing power in other surrounding regions weighted by transport costs. In other words proximity to demand increases a regions market potential. A theoretical foundation for the idea of the market potential function followed only much later in NEG models. The intuition of the market potential function resembles the nominal wage equation, which is crucial to the core NEG models. The nominal wage equation, as given by Equation (7), establishes a link between market access and the regional wage level, representing market potential. Thus, we might expect that changes in market access due to integration affect regional disparities in per capita income.[11]

We use the nominal wage equation to determine the distance decay of demand linkages in the European Union. The estimated distance decay parameter enters into the calculation of changes in regional market access. Because data on regional price indices are not available, Equation (7) cannot be estimated directly. Therefore, it is assumed that the price levels are identical in all regions. Consequently, the corresponding regression model given by Equation (8) does not test for the effect of strong competition in nearby regions, but only for the effects of available incomes. Thus, Equation (8) states that the regional wage level is affected by the weighted sum of purchasing power in all accessible regions. The weights of purchasing power decline with increasing distance between locations *i* and *j*. Wages are relatively high in locations close to high consumer demand (see Hanson 2005). Regional wages increase with purchasing power of neighboring regions and decline with rising transport costs to these locations.[12]

$$\log(w_i) = \gamma_0 + \gamma_1 \log\left(\sum_{j=1}^{J} Y_j e^{-\gamma_2 d_{ij}}\right) + \varepsilon_i \qquad (8)$$

11 See Hanson (2005), Brakman et al. (2002), Mion (2004) and Niebuhr (2006) for empirical evidence on the nominal wage equation.

12 We acknowledge the possibility that regional income Y_j might not be exogenous within the model.

with w_i as the nominal wage in region *i* and Y_j as income in region *j*. γ_2 is the distance decay parameter and d_{ij} is the distance (travel time) between the regions *i* and *j*.

We estimate the nominal wage equation for EU-15 regions, using gross domestic product (GDP) per capita instead of nominal wages as the dependent variable, to determine the dimension of the distance decay. However, Equation (8) represents only a very limited explanation of regional disparities. Local amenities or the sectoral composition of the regional economy are most likely additional factors that influence the spatial distribution of economic activities. To allow for such effects, and to check the robustness of the estimated relations between the regions' market access and economic activity, the regression model in Equation (8) is extended by different control variables comprising indicators for the sectoral composition of regional economies and the presence of local amenities (see Niebuhr 2006 for details).

Table 1 summarizes the results of the estimations based on cross-sectional data for 1995 and 2000. The coefficient γ_1 suggests that market access has a significant positive effect on per capita income in European regions. Second, the estimates of γ_2 indicate that the intensity of demand linkages halves over a range of roughly 180 minutes of travel time. Moreover, the distance decay as well as the effect of market access on regional per capita GDP is fairly stable over time. The estimated coefficients hardly differ between 1995 and 2000.[13]

Table 1: Regression Results for the Market Potential Function

	Dependent variable: Log (GDP per capita)	
	1995	2000
γ_0	6.54** (18.55)	6.57** (19.06)
γ_1	0.17** (10.28)	0.19** (11.05)
γ_2	0.0039** (4.61)	0.0040** (5.02)
Adj. R^2	0.86	0.87

Notes: *t*-statistics (in parentheses) are based upon White's heteroscedasticity-adjusted standard errors. The regression models include control variables, dummies for outlying regions, and some country-dummies. ** significant at the 0.01 level, * significant at the 0.05 level.

With the information on the distance decay, we calculate the market potential of region *i* in year *t* as follows:

13 All corresponding regression results are available from the authors upon request. For a detailed description of the regression approach and estimates see Niebuhr (2006, 2008).

$$MP_{it} = \sum_{j} Y_{jt} \cdot e^{-\gamma_2 (d_{ij} + b_{ijt})} \quad (9)$$

where Y_{jt} is income in region j in year t, and b_{ijt} are travel time equivalents of border impediments in year t.

We deal with the effects of EU enlargement and associated increases in regional market access on regional convergence processes in the European Union. Therefore, we focus on the effects of declining trade impediments between old and new EU member states as well as proceeding trade integration among the NMS. Despite the ongoing integration process within the EU-15 and its effect on the spatial structure of economic activity in Europe, we ignore integration effects in the old member states. Only the development of border impediments between EU-15 countries and former candidate countries and border effects among the NMS matter in our simulation analysis. Hence, border impediments b_{ijt} in Equation (9) are defined as follows:

$b_{ijt} = 0$, if i and j are both located in the same country or in different countries of the EU-15

$b_{ijt} > 0$, if i and j are located in different countries of which at least one country is a NMS

Regional market potential is determined by the purchasing power in surrounding regions weighted by the corresponding travel time. To isolate the effects from declining border impediments on regional market potentials, we ignore income growth in our simulation analysis.

The effect of trade integration on regional market potentials is modelled by manipulating interregional travel time data. The raw travel time data include waiting times at border crossings but do not account for tariffs or nontariff barriers, such as technical standards and legal systems. The simulation of economic integration is carried out in two steps. First, travel time equivalents of border impediments are added to raw travel time through a time penalty for crossing a national border. Second, ongoing economic integration is modelled by reducing the time penalties.

Our assumptions regarding the level and decline of border impediments are based on a literature survey of corresponding studies. There are only a few estimates of border impediments and their development in the enlarged European Union.[14] Based on such information, we presume that trade impediments between EU-15 countries and the NMS amount to a travel time equivalent of 450 minutes compared to intra-EU-15 trade. We assume that the accession of the NMS corresponds to a decline of this time penalty of between sixty and one hundred minutes. We

14 For a detailed description of corresponding empirical evidence see Niebuhr (2008).

consider the following scenarios differing by the intensity and development of border impediments between the EU-15 and the NMS:

1. Uniform reduction of border impediments by a travel time equivalent of sixty minutes
2. Asymmetric reduction of border impediments between the EU-15 and NMS as compared to integration among the NMS
   a. More intense integration between the EU-15 and the NMS as compared to integration among the NMS: reduction by one hundred minutes between the EU-15 and the NMS and by sixty minutes among the NMS
   b. Less intense integration between the EU-15 and the NMS as compared to integration among the NMS: reduction by sixty minutes between the EU-15 and the NMS and by one hundred minutes among the NMS.

The effect of declining border impediments on market access for a given regional purchasing power in t_0 is given by

$$\begin{aligned}\Delta MP^{BORDER}_{it_1-t_0} &= \left[logMP_{it_0^*} - logMP_{it_0}\right] \\ &= \left[\log\sum_j Y_{jt_0}\cdot e^{-\gamma_2(d_{ij}+b_{ijt_1})} - \log\sum_j Y_{jt_0}\cdot e^{-\gamma_2(d_{ij}+b_{ijt_0})}\right]\end{aligned} \tag{10}$$

where $(b_{ijt_1} - b_{ijt_0})$ corresponds to the reduction of border impediments in terms of travel time equivalents.

3.2 Integration and Convergence

We apply the well-known concept of β-convergence to analyze the speed of convergence across regions in the European Union (see Barro and Sala-í-Martin 1995). The concept of β-convergence is based on the traditional neoclassical growth model and postulates that poor economies grow faster than rich ones. If regions differ only in their initial income levels and their capital endowments per worker, they will converge to the same level of per capita income. This is referred to as absolute β-convergence. However, if regions are marked by different steady states – that is, differences in technology, economic structures, or qualification of the work force – they will not converge toward the same income level. This is the concept of conditional convergence. We estimate both absolute and conditional convergence across EU regions between 1995 and 2004. Previous empirical analyses have shown that national effects are important to regional convergence processes in Europe in that regional growth is determined by national macroeconomic factors (e.g., Armstrong 1995). Therefore, our conditional convergence model controls for

national effects with dummy variables for countries. Applying country dummies also allows distinguishing between regional within-country convergence and the catching-up process on the national level. We estimate the relation between initial income levels and growth using the following equation:

$$\ln\left(\frac{y_{it_1}}{y_{it_0}}\right) = \alpha - \beta \ln\left(y_{it_0}\right) + \sum_{k=2}^{21} \delta_k D_k + u_i \qquad (11)$$

The term on the left-hand side of Equation (11) is growth of per capita income from the base year t_0 to the year t_1. Initial per capita income in region i is given by y_{it_0} and u_i is a disturbance term. D_k represents a dummy variable for the respective country k when national effects are taken into account. The annual rate of convergence β can be obtained from expression (12):[15]

$$\beta^* = \frac{-\ln(1-\beta)}{t_1 - t_0} \qquad (12)$$

To investigate the effects of integration on regional convergence in the European Union, we include the percentage change of regional market potentials caused by a reduction of border impediments, $\Delta MP^{BORDER}_{it_1-t_0}$, into Equation (11):

$$\ln\left(\frac{y_{it_1}}{y_{it_0}}\right) = \alpha - \beta \ln\left(y_{it_0}\right) + \sum_{k=2}^{21} \delta_k D_k + \varphi \Delta MP^{BORDER}_{it_1-t_0} + u_i \qquad (13)$$

Applying this approach for the estimation of β-convergence assumes regional growth rates to be independent from one another. Since the end of the 1990s, various convergence studies have found evidence for spatial interdependencies of regional growth processes leading to specification errors in the classical β-convergence model (see Abreu et al. 2005). To control for spatial dependence, we apply spatial diagnostic tests and maximum-likelihood (ML) estimations, including a spatially lagged dependent variable on the right-hand side (a spatial lag model, or SLM) or an error term including a spatial lag (a spatial error model, or SEM), respectively, as Anselin (1988) suggests. Therefore, a spatial weights matrix W has to be applied, which is supposed to capture the structure of spatial dependence. To test for the sensitivity of the estimation results to changes of W, we apply alternative specifications of the weights matrix: the inverse and the squared inverse of travel time as well as a binary and higher-order contiguity matrix based on travel time using different distance cutoffs.[16]

15 The half-life, i.e. the time that it takes to halve the initial income gap between two regions, is given by $\log(2)/\beta = 0.69/\beta$.

16 See LeGallo et al. (2003) for a more detailed discussion about the functional form of spatial weights matrices.

Furthermore, as outlined in Chapters 1 and 2 β-convergence does not necessarily imply a reduction in the variation of regional income levels over time. Hence, a negative correlation between initial income levels and subsequent growth rates does not prove a declining level of inequality. However, β-convergence allows to control for various effects on the convergence process, i.e. the regional market access. Nevertheless, the analysis of β-convergence should be complemented by other concepts to confirm a reduction in the level of income variation. However, in this study we can refer to the results of corresponding analysis conducted in Chapter 2.

4 Data and Regional System

We analyze integration effects and convergence in the enlarged European Union across 802 regions, of which 643 are situated in the EU-15 and 159 in the NMS. The cross section consists predominantly of NUTS-3-level regions.[17] Regions in Switzerland and Norway are subject to the calculation of regional market potentials in the European Union but are not included in the cross-sectional convergence analyses.

To calculate regional market potentials in the European Union, we use inter-regional distances, measured by travel time in minutes between the centers of the regions. Border impediments – tariffs and nontariff barriers – are incorporated by means of a travel time equivalent in minutes, which is added to the actual travel time between regions situated in different countries. It is assumed that integration results in reduced border impediments. The assumption regarding border effects rests on information given in the corresponding literature.

Because the analysis regards exclusively changes in market access due to reduced border impediments – and not to income growth – the initial GDP levels of 1995 are not altered in the simulation analysis. The analysis of regional convergence is conducted for the time between 1995 and 2004, applying GDP per capita data. All income data are measured in purchasing powers standards (PPSs) and taken from the Eurostat database.[18]

17 Due to data restrictions NUTS-2 level regions (Poland and the UK) as well as functional regions comprising several NUTS-3 units (Germany) had to be applied. Regions of Latvia, Bulgaria and Romania could not be included in the regression analysis. Furthermore, the French overseas departments Guadeloupe, Martinique, French Guyana and La Reunion, the Portuguese Regions Acores and Madeira as well as the Spanish regions Canary Islands and Ceuta and Mellila are excluded from all analyses.

18 The data in PPS are adjusted for differences in national price levels.

5 Empirical Results

We present our empirical results in three parts. The first part shows the spatial structure of integration effects obtained in our simulation analysis. In the following two parts, we present regression results on the regional convergence pattern in the European Union and on the influence of integration effects on the speed of convergence.

5.1 Enlargement and Changes in Market Access

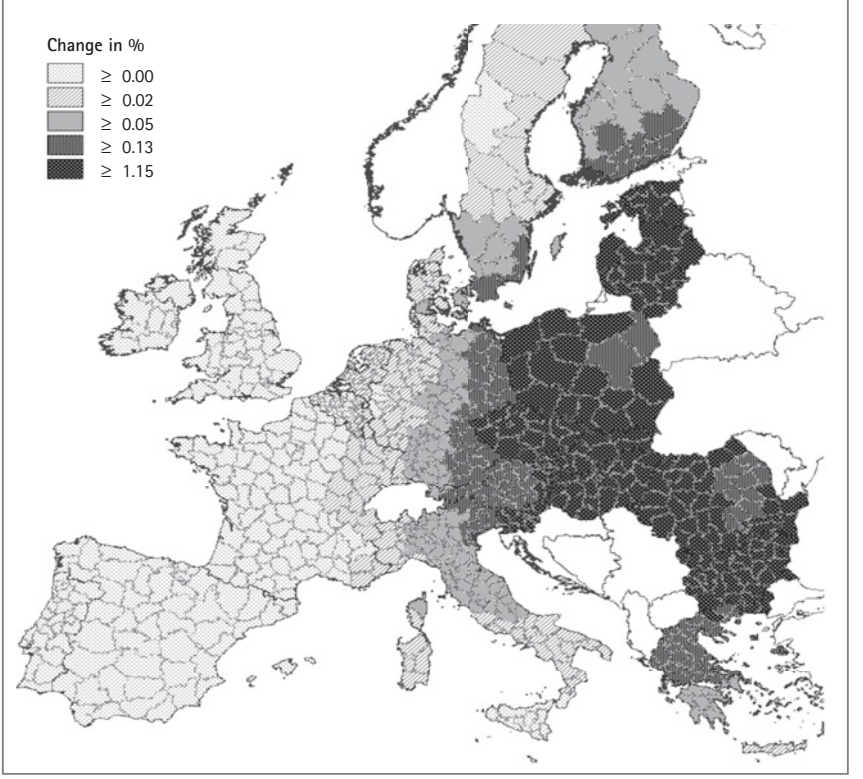
As outlined above, theoretical models allow for different outcomes from integration effects on the spatial distribution of economic activities. A likely result, however, is that integration effects are relatively strong in regions of the NMS that directly adjoin the EU-15 market, leading to above-average wage increases in these regions. By contrast, the effect of better market access to the NMS is likely to be small in the old member states. Analyzing enlargement effects on regional wage levels, Pfaffermayr et al. (2004) show a negligible effect on EU-15 regions bordering the NMS compared to considerable wage increases in NMS regions sharing a common border with an EU-15 state.

Figure 1 shows the percentage change of regional market potentials in the European Union based on Scenario 1. The spatial structure of integration effects is most notably characterized by an east-west gradient. Regional market potentials in the NMS increase to a much higher extent than do those in the old member states. Overall, the EU enlargement influences market access in the NMS much more than in the EU-15 regions. If growing market potentials positively affect regional wage levels, the regions in the NMS – in particular those near EU-15 countries – will profit in terms of higher per capita growth. Thus, it can be expected that declining barriers to cross-border trade and associated changes in market access should favor convergence between old and new member states.

Figure 2 presents a more differentiated pattern of integration effects on regional market access in the NMS. Some regions in the NMS profit much more from reduced border impediments than others in increasing market access. In the simulation analysis, changing market potentials in the NMS do not result only from a higher accessibility to the EU-15 market, but also from economic integration with the other NMS. However, the overall effect of the latter is relatively small, as purchasing power in most NMS regions is comparatively low. The largest effects can be observed in those NMS regions directly adjoining the markets of the wealthy regions in southern Germany, Austria, and northern Italy. According to our simulation results (Scenario 1), regional market potentials

increase by nearly 20 percent in Slovenian regions, by more than 13 percent in the western part of Slovakia, and up to 12 percent in the western regions of Hungary and the Czech Republic. Estonia benefits from increasing market access due to its proximity to Finland. In Latvia, where market potentials initially are very low and nearly every region is a border region, increased accessibility to neighbors exerts a relatively strong effect, despite the low purchasing power in surrounding regions (e.g., 10.5 percent in Latgale). By contrast, market potential growth in Poland, Bulgaria, and Romania, which is clearly below 4 percent in most of their regions, is relatively small. Most of these regions are remote from the EU-15 market. Also, the Polish regions bordering Eastern Germany and the regions in Bulgaria sharing a common border with the northern part of Greece do not realize large benefits, as initial purchasing power in these parts of the EU-15 is relatively low. Only in the Polish border region Zachodniopomorskie (4.5 percent) do the growth rates of market potential exceed the 4 percent level. Furthermore, the share of border regions in these countries is small compared to the other NMS. Therefore, integration effects in these regions are comparatively weak.

Figure 1: Market Potential Changes Due to Reduced EU Border Impediments (Scenario 1)



Market Potential Changes in the NMS Due to Reduced Border Impediments

Figure 2: Scenario 1

Figure 3: Scenario 2a

Figure 4: Scenario 2b

Comparing the results of Scenarios 2a and 2b (see Figures 3 and 4) distinguishes the effects that come from a more intense integration between the NMS and the EU-15 markets (Scenario 2a) and from a more intense integration among the NMS (Scenario 2b). As expected, Scenario 2a is more beneficial than Scenario 2b to regions in proximity to prosperous EU-15 markets, particularly regions in Slovenia, the Czech Republic, and Estonia, as well as most regions in Hungary and Slovakia. By contrast, the scenario with a stronger integration among the NMS (Scenario 2b) is more favorable to the regions of Bulgaria, Romania, Lithuania, Latvia, and southern Poland, which are more or less out of range of large positive effects from reduced border impediments to the EU-15. However, the effects of a more pronounced decline in border impediments among the NMS are comparatively small, as initial purchasing power in most regions of the NMS is comparatively low. All in all, the sum of the effects on regional market potentials in the NMS is much stronger in the case of a more intense integration with the EU-15 market.

So far, the results suggest that integration effects should promote the catching-up of the NMS to the EU-15. However, in all three integration scenarios, the highest growth rates of regional market potentials are realized in the Czech Republic, Slovakia, Hungary, and Slovenia. Because regional income levels in these countries are already relatively high compared to income levels in other NMS regions, economic integration may work against regional convergence across the NMS. To investigate more systematically to what extent changes in market potentials could support the convergence process at the regional level in the European Union, we examine whether poor NMS regions tend to realize stronger increases in market potentials than do rich ones. Figure 5 shows a positive relation between the growth of market access, released by reduced border impediments based on Scenario 1, and regional income levels in 1995. This implies that relatively rich regions tend to profit more from integration effects in terms of increasing market access than do poorer ones. In other words, regions in countries that lag most behind benefit less from reduced border impediments. Thus, it can be expected that, while generally supporting the catching-up of the NMS toward the EU-15, reduced border impediments between NMS and the EU-15 might promote increasing disparities within the NMS.

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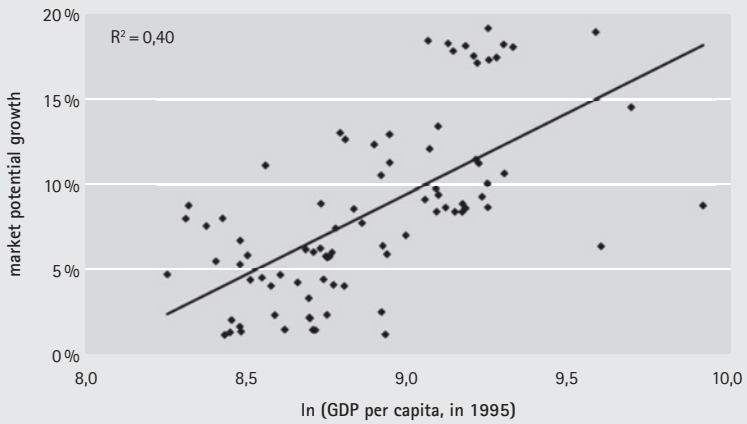
Figure 5: Regional Income Levels and Relative Changes in Market Access in the NMS



Overall, the pattern of changing market access suggests that economic integration between the old and new EU member states favors a general catching-up of the NMS. Such integration effects, however, work mainly in spatial proximity to the relatively prosperous markets of the EU-15 and wear off with increasing distance. As a consequence, the catching-up of the (already) relatively prosperous regions in the southwest NMS may be favored disproportionately. If increasing market potentials turn out to affect regional growth rates significantly, EU eastward enlargement may enhance income disparities among the NMS, at least temporarily. Whether such integration effects effectively challenge regional convergence in the European Union is investigated in the next section.

5.2 Regional Convergence in the Enlarged European Union

This section investigates recent developments in regional convergence in the enlarged European Union. Figure 6 shows a negative correlation between initial income levels and regional growth from 1995 to 2004. This indicates that relatively poor regions tend to grow faster than do rich ones. Most NMS regions (marked in gray) are situated in the top left area of the plot, showing relatively low initial income levels but relatively high growth rates. Thus, the catching-up of the NMS is a central feature in the European growth pattern during that period. However, the scatter plot also indicates that the regional growth and convergence patterns differ between the EU-15 and the NMS. The convergence relation in the enlarged European Union might be driven by differences in income levels and growth between old and new member states. Therefore, we test the convergence hypothesis in separate models for the EU-15, the NMS, and the European Union as a whole.

Figure 6: Initial Income Levels and Growth in the EU, 1995 to 2004

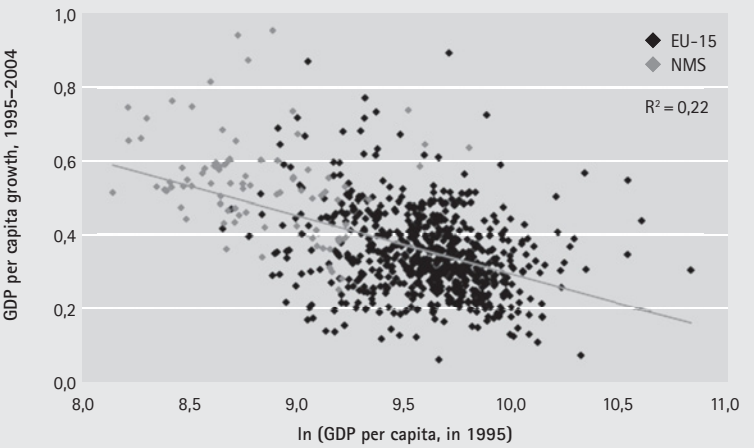


Table 2 presents the results obtained from estimating Equation (11), not including integration effects and ignoring differences in steady states. There is a significant process of absolute convergence across EU regions. The estimated average annual rate β amounts to 1.92 percent, which implies a half-life of thirty-six years. A convergence rate of about 2 percent has been observed in various convergence studies analyzing different cross sections over longer time spans (e.g., Barro and Sala-í-Martin 1995). The estimated speed of absolute convergence is clearly less pronounced in the NMS and the EU-15. The respective rates of 1.24 percent and 1.15 percent imply half-lives of fifty-six years in the NMS and up to sixty years in the EU-15.

Table 2: Regional Convergence, No National Effects, No Integration Effects

	EU (728 observations)		EU-15 (643 observations)		NMS (85 observations)	
	OLS	SEM	OLS	SEM	OLS	SEM
Const.	1.880** (15.92)	1.357** (7.70)	1.293** (7.61)	1.180** (5.78)	1.471** (3.71)	−0.680 (−1.30)
β	−0.158** (−12.83)	−0.093** (−5.19)	−0.098** (−5.56)	−0.081** (−3.72)	−0.105* (−2.32)	0.135* (2.30)
λ	–	0.966** (32.14)	–	0.944** (23.65)	–	0.857** (10.97)
β^*	1.92	1.08	1.15	0.93	1.24	−1.41
Half-life	36	64	60	74	56	-
AIC	−1064	−1315	−1004	−1229	−103	−125
Diagnostics of the OLS Regressions						
Normality:	Jarque-Bera = 246.60**		Jarque-Bera = 231.00**		Jarque-Bera = 16.23**	
Spatial error:	Moran's I = 23.79**; LM = 535.25**; RLM = 60.62**		Moran's I = 23.57**; LM = 521.02**; RLM = 43.86**		Moran's I = 4.14**; LM = 12.33**; RLM = 15.05**	
Spatial lag:	LM = 490.85**; RLM = 16.22**		LM = 478.08**; RLM = 0.91		LM = 21.19**; RLM = 23.91**	

Notes: *t*-statistics (in parentheses) are based upon White's heteroscedasticity-adjusted standard errors.
** significant at the 0.01 level, * significant at the 0.05 level.

Implementing country dummies into the models reveals a substantial influence of national effects on the convergence process in the European Union (see Table 3). Hence, the convergence process between countries differs from regional within-country convergence. Including national effects reduces the speed of convergence to 0.46 percent in the European Union. However, though accounting for country effects has a relatively moderate effect on the convergence speed in the EU-15, the rate of the NMS even changes sign. Regional per capita incomes within the NMS countries actually diverge at an annual rate of 2.09 percent. Thus, within the individual NMS, richer regions tend to grow faster than do poorer ones. Overall, the catching-up process in the EU-25 is predominantly a national phenomenon.

Table 3: Regional Convergence, Including National Effects[a], No Integration Effects

	EU (728 observations)		EU-15 (643 observations)		NMS (85 observations)	
	OLS	SEM	OLS	SEM	OLS	SEM
Const.	0.702** (4.09)	0.709** (3.86)	0.955** (5.73)	1.000** (5.52)	–1.384** (–3.14)	–1.405** (–3.04)
β	–0.040* (–2.28)	–0.041* (–2.15)	–0.066** (–3.88)	–0.071** (–3.79)	0.207** (4.32)	0.210** (4.16)
λ	–	0.596* (2.55)	–	0.635* (2.23)	–	–0.070 (–0.27)
β^*	0.46	0.46	0.76	0.82	–2.09	–2.12
Half-life	152	151	91	85	–	–
AIC	–1450	–1470	–1330	–1351	–152	–148
Diagnostics of the OLS Regressions						
Normality:	Jarque-Bera = 1195.00**		Jarque-Bera = 1436.00**		Jarque-Bera = 21.50**	
Spatial error:	Moran's I = 7.45**; LM = 25.44**; RLM = 16.61**		Moran's I = 7.36**; LM = 28.85**; RLM = 27.05**		Moran's I = 1.33; LM = 0.06; RLM = 1.45	
Spatial lag:	LM = 12.75**; RLM = 3.92		LM = 12.50**; RLM = 10.70**		LM = 0.02; RLM = 1.42	

Notes: *t*-statistics (in parentheses) are based upon White's heteroscedasticity-adjusted standard errors.
** significant at the 0.01 level, * significant at the 0.05 level.

[a] In most cases national effects are significant at the 0.05 level. The estimated coefficients and *t*-statistics can be obtained by the authors upon request.

The results of Moran's I test, presented in Tables 2 and 3, show the presence of significant spatial autocorrelation in the residuals in all models except the NMS case, in which country dummies are applied. To identify the form of spatial autocorrelation – spatial error or spatial lag dependence – we apply the decision rule by Anselin and Florax (1995) based on Lagrange multiplier (LM) tests.[19] Because the LM tests do not provide clear information about the form of spatial autocorrelation, we estimate the spatial error as well as the spatial lag model.[20] However, due to the likeness of the results, we present only the outcome of the SEM.[21]

Applying SEM estimation without control for country-specific effects yields relatively low convergence rates of 1.08 percent in the European Union as a whole and 0.93 percent in the EU-15, implying half-lives of sixty-four years and

19 See Anselin and Florax (1995) for more details.

20 Additionally, the presence of non-normality detected by the Jarque-Bera test makes the LM-tests less reliable.

21 The results obtained from SLM-estimations are available from the authors upon request.

seventy-four years, respectively (see Table 2). Strikingly, the convergence rate for the NMS changes sign, indicating divergence.[22] The spatial error coefficient λ is highly significant in all models that ignore national effects. Moreover, the Akaike information criterion (AIC)[23] shows improved model fits. Hence, regional growth rates seem to be spatially correlated, leading to misspecification of the ordinary least squares (OLS) model. However, when country dummies are included, there is a very slow process of conditional convergence taking place in the EU-15, whereas income levels within the individual NMS diverge. Also, the model fits do not vary remarkably from the corresponding OLS models. Overall estimations, including spatial effects, yield similar results to those of the conditional OLS estimations. Therefore, the country dummies capture spatial dependence to a large extent, indicating that national differences influence regional growth more than does spatial dependence.[24] Similar results are found by Geppert et al. (2005) for regions in Western Europe and by Feldkircher (2006) and Paas and Schlitte (2008) for regions in the enlarged European Union.

The estimated speed of convergence obtained by the analysis of β-convergence may be overestimated, when considering the actual decline in the variation of regional incomes over time. However, the direction of the results obtained by this analysis and its implications are confirmed by the analysis on the development of within- and between-country inequalities in per capita incomes applying Theil's index of inequality presented in Chapter 2. The inequality analysis by means of Theil's inequality index has shown a decrease in total income inequality in the EU, which is, however, mainly due to diminishing income disparities at the country level. While the level of within-country inequality in the EU-15 countries remains relatively constant, the NMS experience a significant increase in regional within-country inequality.

5.3 Convergence and the Effects of Integration

To investigate the effect of changing market access on the regional catching-up process in the enlarged European Union, we augment the convergence models by including the simulated change in regional market potentials (Equation (13)). Because the regression results implementing our three alternative scenarios do not differ significantly, only the results including the effects of changing market

22 It should be noted that a direct comparison of β-coefficients between the spatial models and OLS is not quite possible since indirect and induced effects may be included in the estimated speed of convergence when spatial autocorrelation is taken into account (see Abreu et al. 2005 or Pace and Le Sage 2006 for more details).

23 The R^2 in ML-estimations is only a pseudo measure and therefore not suitable for comparison to the model fit in OLS estimation. This requires information criteria, such as the AIC.

24 Applying different spatial weights matrices (see Scenario 3) has shown that the results are robust towards changes in the specification of the spatial weights.

potentials based on Scenario 1 are presented in this chapter (see Tables 4 and 5).[25] There is a significant effect of market access in the EU model without controls for national effects. This indicates that the catching-up of the NMS is not only driven by differences in the marginal productivity of production factors, but also by accessibility. According to the estimation results, a 1 percent increase in the regional market potential increases regional per capita income levels by 0.77 percent in the OLS model and by 0.88 percent in the SEM. This implies that an increase in the regional market potential in Slovenia of up to 20 percent (as in Scenario 1) would raise per capita incomes by 15.3 percent and 17.7 percent, respectively.

Because the effects of declining border impediments through the EU enlargement process are remarkable only in the NMS, but not in the EU-15, the lack of a significant effect in the EU-15 model is unsurprising. However, contrary to our expectations, we do not find any effect of changes in regional market potentials released by reduced border impediments on per capita growth in the NMS model. This outcome, however, should be treated with caution, as it may be affected in several ways by the assumptions we made in the simulation analysis or by specification problems in our model. First, the assumptions about the magnitude and uniformity of the reduction in border impediments may be inappropriate. It is very hard to quantify integration effects on impediments to cross-border trade. Further-more, it is likely that integration effects are not identical at every border in our cross section but differ significantly. Bilateral trade relations between some regions will improve faster than others. Second, our analysis keeps out growth dynamics. Relatively high-income growth rates in the NMS strongly affect regional market potentials. Therefore, economic integration in the NMS may lead to cumulative effects of increasing income levels and market potentials.

Furthermore, there are specification problems in the estimation models. As Figure 5 shows, there is a correlation between income levels and changes in market potential. Therefore, we have to deal with pronounced multicollinearity. This increases the variance of the slope estimators and thus affects inference on the change in market access (low *t*-statistics). The coefficient cannot be estimated with great precision. This problem becomes more severe for smaller sample sizes, as a smaller sample size reduces the variation in the explanatory variables, which in turn increases the variance of the estimators (see Wooldridge 2006). However, the results for the convergence parameter are almost unchanged. This suggests that the estimates of the convergence rate in the specification without market access are unbiased, indicating that the effect of the change in market access on convergence of per capita income is negligible.

25 The results including effects from the alternative scenarios can be obtained upon request from the authors.

Table 4: Regional Convergence, No National Effects, Including Integration Effects

	EU (728 observations)		EU-15 (643 observations)		NMS (85 observations)	
	OLS	SEM	OLS	SEM	OLS	SEM
Const.	1.601** (12.29)	1.161** (6.60)	1.316** (7.72)	1.192** (5.64)	1.513** (3.01)	−0.692 (−1.33)
β	−0.130** (−9.59)	−0.074** (−3.98)	−0.100** (−5.68)	−0.082** (−3.70)	−0.111 (−1.86)	0.138* (2.30)
ϕ	0.765** (5.33)	0.884** (4.12)	−2.012 (−1.39)	−1.645 (−0.48)	0.065 (0.23)	−0.185 (−0.37)
λ	–	0.960** (28.82)	–	0.945** (23.86)	–	0.853** (10.48)
β^*	1.55	0.856	1.17	0.95	1.30	−1.44
Half-life	45	81	59	73	53	–
AIC	−1088	−1332	−1004	−1227	−101	−123
Diagnostics of the OLS Regressions						
Normality:	Jarque-Bera = 255.70**		Jarque-Bera = 220.00**		Jarque-Bera = 17.41**	
Spatial error:	Moran's I = 23.63**; LM = 520.66**; RLM = 56.62**		Moran's I = 23.67**; LM = 513.39**; RLM = 41.51**		Moran's I = 4.28**; LM = 11.71**; RLM = 18.00**	
Spatial lag:	LM = 475.94**; RLM = 11.90**		LM = 473.16**; RLM = 1.28		LM = 21.03**; RLM = 27.32**	

Notes: *t*-statistics (in parentheses) are based upon White's heteroscedasticity-adjusted standard errors.
** significant at the 0.01 level, * significant at the 0.05 level.

Table 5: Regional Convergence, Including National Effects[a] and Integration Effects

	EU (728 observations)		EU-15 (643 observations)		NMS (85 observations)	
	OLS	SEM	OLS	SEM	OLS	SEM
Const.	0.702** (4.06)	0.709** (3.84)	0.986** (5.85)	1.024** (5.58)	−1.352** (−3.23)	−1.384** (−3.05)
β	−0.040* (−2.26)	−0.041* (−2.14)	−0.069** (−3.99)	−0.073** (−3.87)	0.218** (4.44)	0.222** (4.12)
ϕ	−0.068 (−0.08)	−0.054 (−0.06)	−3.803 (−1.46)	−3.206 (−1.10)	−0.722 (−0.85)	−0.718 (−0.91)
λ	–	0.596* (2.55)	–	0.605* (2.50)	–	−0.079 (−0.29)
β^*	0.45	0.46	0.79	0.84	−2.19	−2.23
Half-life	153	151	87	83	–	–
AIC	−1448	−1468	−1332	−1351	−151	−147
Diagnostics of the OLS Regressions						
Normality:	Jarque-Bera = 1193.00**		Jarque-Bera = 1377.00**		Jarque-Bera = 21.21**	
Spatial error:	Moran's I = 7.50**; LM = 25.43**; RLM = 16.76**		Moran's I = 7.12**; LM = 25.53**; RLM = 21.66**		Moran's I = 1.41; LM = 0.07; RLM = 2.06	
Spatial lag:	LM = 12.78**; RLM = 4.10*		LM = 11.71**; RLM = 7.84*		LM = 0.04; RLM = 2.03	

Notes: *t*-statistics (in parentheses) are based upon White's heteroscedasticity-adjusted standard errors.
** significant at the 0.01 level, * significant at the 0.05 level.

[a] In most cases national effects are significant at the 0.05 level. The estimated coefficients and *t*-statistics can be obtained by the authors upon request.

The results of the estimations in which country dummies have been employed do not show significant effects of changing market potentials on growth in any of the models. Another look at Figure 2 shows a national pattern in the spatial distribution of the simulated change in regional market potentials in the NMS. National effects in changing market potentials and per capita growth interfere, leading to lower *t*-values.

Overall, it can be expected that growing market access through reduced border impediments promotes the catching-up of the NMS to the EU-15. However, there is no evidence that integration effects have affected regional within-country convergence so far. Analyses of recent economic developments in NMS regions show that the capital cities especially have been outperforming other regions of the respective countries in economic growth (e.g., Jasmand and Stiller 2005). National NMS growth rates seem to be driven mainly by agglomeration processes. Similar developments of regional growth have been observed in the cohesion countries during earlier enlargement rounds of the European Union (see European Commission 2004). This might indicate that, at least in earlier stages of economic integration processes, the effects of a decreased relative importance of the home market reducing the centripetal force might be dominated by the effects of increased international competition that lower the centrifugal force.

6 Conclusions

Our analysis of integration effects has shown that NMS regions benefit more from reduced border impediments in terms of increased market potentials than EU-15 regions. Even in EU-15 regions that share a common border with an NMS, the effects on their market potentials are almost negligible. This can be explained by the comparatively low NMS purchasing power. As increased market potentials are associated with rising wage levels, trade integration through EU enlargement should support the catching-up process of the NMS toward the EU-15. Due to the comparatively high purchasing power in the old member states, integration effects between old and new EU member states, in total, influence market potentials in the NMS more than does integration among the NMS. As expected, those NMS regions situated close to prosperous EU-15 markets benefit most in increasing market access. This is particularly the case in Estonia, Slovenia, Czech Republic, and the western parts of Hungary and Slovakia. Because income levels in most of these regions are already relatively high compared to the rest of the NMS, such integration effects are unlikely to support regional convergence across the NMS. Relatively poor regions in the eastern periphery of the EU might lag behind.

However, accounting for neoclassical catching-up mechanisms and country-specific growth factors, the change in market potential has hardly any effect on the growth of regional per capita incomes in the European Union. Furthermore, the regression analysis reveals that the EU catching-up process is mainly a national phenomenon, implying that national macroeconomic differences seem to influence regional growth rates more than do spatial spillovers. Accounting for national effects reveals increasing regional disparities within the NMS countries. Thus, the catching-up of the NMS is accompanied by regional divergence processes within the individual NMS countries. Previous analyses show that agglomeration processes dominate national growth rates, particularly in the capital regions.

The theoretical model from Crozet and Koenig-Soubeyran (2004) suggests that the negative effect on the centrifugal force due to increased international competition is stronger than the negative effect on the centripetal force released by the decreasing relative importance of the home market to domestic firms. Hence, under the assumptions of this model, integration is likely to result in agglomeration of manufacturing and human capital. Our empirical analysis is not designed to verify the model's assertion and does not allow for definite conclusions in that way. However, the observation that the EU eastward enlargement has been accompanied by agglomeration processes within the NMS corresponds to the model's implications.

It is perhaps too early to identify growth effects of changes in market access. Moreover, other integration effects, such as factor mobility, might be more important for growth and convergence. Furthermore, measurement problems might be important in estimating the integration effects from reduced border impediments. The difficulties in assessing the magnitude of the reduction in barriers to cross-border trade – and the assumption of a uniform reduction at all borders – imply a considerable degree of uncertainty regarding the precision of the estimated integration effects. However, our analysis gives first insights on this issue, which is relevant for EU cohesion policy. Further research is necessary to obtain more comprehensive information on integration effects through EU enlargement.

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Chapter 4 The Determinants of Regional Differences in Skill Segregation – Evidence from a Cross Section of German Regions

FRISO SCHLITTE[1], FABIAN BÖTTCHER[2], ANNEKATRIN NIEBUHR[3], JAVIER REVILLA DIEZ[4]

Abstract: Increasing inequality in qualification specific employment prospects characterises labour markets in most highly developed countries. Theoretical models suggest that in-plant skill segregation might matter for the polarisation of employment and wages. According to these models production technology and the educational level of the work force are important determinants of skill segregation. There are some studies that investigate the increasing in-plant skill segregation at the national level. However, since production technologies and skill structures are characterised by pronounced regional differences, there are likely significant differences in the level of segregation between regions. But empirical evidence on corresponding regional inequalities is lacking. The objective of this analysis is to investigate regional differences in skill segregation in Germany. Our findings point to marked differences among German regions. Moreover, we analyse the determinants of these differences at the regional level. The results of a regression analysis indicate that the local endowment with human capital is an important determinant for the regional level of skill segregation. Furthermore, skill segregation is increasing in most areas during the period under consideration, which may lead to unfavourable labour-market conditions for low-skilled workers in corresponding regional labour markets.

1 Introduction

Labour markets in most highly developed countries are characterised by increasing inequalities in qualifications-specific employment prospects. Nickel and Bell (1995) for example find that the demand for high-skilled workers is steadily rising, while low-skilled employment is subject to a considerable decline in many countries of

1 Institute for Employment Research (IAB), Germany, and Hamburg Institute of International Economics (HWWI), Germany.

2, 4 Institute of Economic and Cultural Geography, Leibniz University of Hannover, Germany, and Lower Saxonian Institute for Economic Research, Germany.

3 Institute for Employment Research (IAB), Germany, and Department of Economics, Christian-Albrechts-Universität zu Kiel, Germany.

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the OECD. On the one hand, this might be explained by a growing supply of skills due to the educational expansion in the 1960s and 1970s. On the other hand, it can be argued, that the increasing international division of labour together with technological and organisational change have been leading to a unilateral rise in the demand for high-skilled labour whereas the low-skilled compete more and more with workers in low-wages countries (see Wood 1994, 2002). Furthermore, as a consequence of skill-biased technological and organisational changes more and more less qualified workers do not meet the increasing requirements of jobs on the domestic labour market (see Acemoglu 1998, 2002; Lindbeck and Snower 1996; Spitz-Oener 2006). Some authors also find evidence for a polarisation in skill-specific employment. Autor et al. (2003) hypothesise that highly standardised occupations of medium-skilled employees, such as book- and record-keeping, may be displaced more easily by technological innovations, e.g. by computer programmes, than comparatively simple and less standardised jobs, such as cleaning. Further empirical evidence for this hypothesis is provided by Manning (2004) or Goos and Manning (2007) for the UK and Spitz-Oener (2006) for Germany.

One aspect of the qualification specific changes on the labour market that has not received much attention up to now is the segregation by skill in the production process. The qualification-related structural change affects the internal skill structure of employment at the firm level. However, the changes in the skill composition within firms do not merely reflect the general shift to increasing shares of high-skilled workers in overall employment. Different theoretical models suggest that with proceeding economic integration and due to technological and organisational change segregation by education at the workplace is likely to increase (e.g. Kremer and Maskin 1996; Acemoglu 1999; Duranton 2004). In other words, more and more firms tend to employ predominantly one specific type of qualification. Some companies, such as fast-food or supermarket chains, recruit mainly low-skilled labour, while others tend to employ primarily high-skilled workers, as for instance software or high-tech producers. As a consequence, employees tend to work more often with similarly qualified co-workers and share less frequently a common workplace with differently skilled colleagues. Thus, production processes are characterised by an increasing segregation by skill.

According to these models a key determinant for the level of skill segregation is the level and the variety of skills in the labour force available to firms. Since production technologies and skill structures are characterised by pronounced regional differences, there are likely significant differences in the level of segregation between regions. In particular, there might exist differences between cities and rural areas. High-skilled workers are to be found more frequently in agglomerated areas because of their specific sector structure as well as

urbanisation and localisation advantages (for Germany see Fromhold-Eisebith and Schrattenecker 2006). Therefore, skill segregation could be more pronounced in agglomerated areas. Moreover, these models provide a link between the level of skill segregation and increasing wage inequalities between qualification groups. Potential effects on skill-specific productivity levels may translate into changes in skill specific employment prospects. Schlitte (2010) shows that skill segregation exerts an unfavourable effect on low-skilled employment in Western German regions. Thus, skill segregation in the production process is an important issue for regional labour market research and policy.

There are empirical studies that deal with the development of skill segregation at the national level pointing to an increasing separation of skill groups in several highly developed countries. Davis and Haltiwanger (1991) as well as Kremer and Maskin (1996) analyse the wage structure within and between firms in the U.S. manufacturing sector between 1975 and 1987. They find that the variance of wages between firms has increased more profoundly than wage differences within firms. Based on these findings the authors conclude that the degree of skill segregation across workplaces has increased. Kramarz et al. (1996) provide evidence for increasing segregation by skill across firms in France. They show that it is more likely to find low-skilled employees at the same workplace in 1992 than in 1986. The same finding applies to high-skilled employees. Similar results for Germany are provided by Stephan (2001) analysing wage differentials within and across firms in Lower Saxony between 1994 and 2000, or by Gerlach et al. (2002) who investigate manufacturing firms between 1986 and 1992.

Overall, there is evidence for increasing levels of skill segregation in highly developed countries. However, there is a lack of studies investigating the phenomenon of skill segregation at the regional level. The regional level of skill segregation might be used as an indicator for the degree of specialisation of local production on specific skills. It can be connected to proceeding economic integration and technological and organisational change at the regional level. Since skill segregation may have a profound impact on the employment prospects of low-skilled persons, information on differences in regional levels of skill segregation and their determinants is of particular importance for regional policies designed to promote employment at the lower bound of the skill distribution.

To the best of our knowledge this is the first analysis that considers regional differences in segregation by skill. Furthermore, the chapter aims at identifying characteristics of regional labour markets that influence the extent of skill segregation. In particular, we focus on the effect of high-skilled labour supply on skill segregation at the workplace. Based on plant level information we use a direct measurement of skill segregation. Our findings reveal that the skill segregation

is marked by pronounced regional differences in Germany. Moreover, the results show that the local endowment with human capital is an important determinant for the regional level of skill segregation. Although a rising stock of local human capital tends to have a positive effect on regional labour markets in general, the low-skilled might benefit to a lesser extent, because they tend to work in firms with relatively less modern and less complex production technologies decreasing their productivity and employment prospects.

The rest of the chapter is organised as follows. In the next section we briefly outline theoretical explanations for increasing levels of skill segregation. Section 3 introduces the data set and Section 4 presents methodological issues on measuring skill segregation and the specification of our regression models. The results of our analysis are provided in Section 5. Finally, Section 6 concludes.

2 Theoretical Background

There are different theoretical approaches that link rising levels of skill segregation to proceeding economic integration and to technological and organisational change (e.g. Kremer and Maskin 1996; Acemoglu 1999; Duranton 2004). Although the mechanisms differ substantially, the models have in common that the skill structure of labour supply is a key determinant for skill segregation in the production process.

According to the model by Kremer and Maskin (1996) a firm is characterised by different tasks that are complementary on the one hand but also require different skills on the other hand. Hence, different skills within a firm are not perfectly substitutable. While the complementary relation of tasks promotes joint work processes involving workers from different skill groups, the asymmetry between the tasks favours segregated work processes. Whether the tasks within a firm are accomplished by a team consisting of similar or dissimilar qualification types depends on the degree of asymmetry in qualification requirements and on the heterogeneity in the structure of skills available to firms. An increasing level of skill segregation can be released by a rising dispersion of skills within the pool of labour available to firms and by increasing differences in the skill requirements that are needed to perform the tasks.

Acemoglu (1999) proposes a search theoretic model where human capital is assumed to be complementary to physical capital. As a consequence, firms try to adapt the production technology to the skills of the work force. Because of information asymmetries the firms are not able to assess precisely the skills of potential employees beforehand. Investments in production technology, however, are made before staffing. Thus, the future internal skill structure can only be

estimated by the company. This happens on the basis of the skill composition within the available pool of labour. When the supply of skills and the dispersion in the distribution of skills are relatively low, firms tend to create jobs that are suitable for a large range of skill types. While strong differences in skill levels make it easier for firms to distinguish high- from low-skilled workers, a large share of human capital raises the probability to employ a high-skilled person. Hence, in this model a rise in the supply of skills may be sufficient to release skill segregation. When the probability to hire a high-skilled person increases, more and more firms then tend to direct investments into technologies suitable to more skilled workers only. This leads to the exclusion of low-skilled workers from modern production technologies, in order to achieve higher productivity levels.

Duranton (2004) also assumes skills and technology to be complements. Each firm produces a good of a distinct quality and is either a supplier to other firms or a final good producer. Supply firms and the final good producer form a vertical production system. Because the quality of the intermediate goods has to comply with the quality of the final good, the quality level in a production system is determined by the final good producer. Furthermore, the quality of the produced good determines the complexity of the production technology and, therefore, the type of skill that is required for producing this good. Hence, aggregate production in an economy comprises vertical production systems that differ by the complexity of production process and the workers' skill level. There are two opposing forces working for or against segmentation into production systems. On the one hand, productivity gains by specialising on high-quality products are disproportionately high because of the complementary relation between physical and human capital. On the other hand, thick-market externalities that arise through a relatively large variety of intermediate goods supplied in large production systems work against segmentation. If the supply of high-skilled workers is comparatively high the relative importance of the thick-market externality declines and the incentives for firms to produce goods of a higher quality increase. Thus, with a rising share of human capital there is an increasing probability of production to be segmented into different vertical production systems that differ by the qualification levels of employees. In line with the model by Acemoglu (1999) a rising supply of high skills is sufficient to trigger skill segregation.

Closely related to the models described above, recent literature discusses more factors that may give rise to changes in the qualification structure and skill segregation. Gerlach et al. (2002) and Tsertsvadze (2005) argue that an increasing fragmentation of production processes might influence the degree of segmentation by skill. According to this reasoning, proceeding economic integration caused by a decline of transport and communication costs boosts the use of intermediate products. Hence firms outsource parts of the production process and apply specialised

intermediate products (see Autor 2001). They focus thereby on the work procedures for which they possess a comparative advantage. This development results in a specialisation of the staff on certain skill types. Findings in Tsertsvadze (2005) that base on German establishment data indicate that outsourcing significantly increases the probability for a firm to develop a relatively segregated qualification structure.

In line with the models presented above, Gerlach et al. (2002) argue that characteristics of the production technology probably influence segregation at the workplace since complementarities between technology and specific qualification levels might give rise to a decline of skill diversity within firms. Since production technologies likely differ between industries and different firm sizes, region-specific sector and firm-size structures probably form a source of regional differences in skill segregation.

Overall, the increasing level of skill segregation in highly developed countries might be explained by changes in production conditions and in the skill composition of labour supply. A rise in the dispersion of skills as well as an increasing supply of high skills may release rising levels of skill segregation. Thus, the educational expansion in the 1960s and the 1970s might have generally increased the incentives for firms to apply more complex production technologies. Technological progress in turn might have raised the demand for high skills even further leading to the exclusion of less skilled workers from carrying out more complex tasks (see Griliches 1969; Lindbeck and Snower 1996). The models presented in this section provide mechanisms that link the skill structure of labour supply and changes in production conditions to skill segregation at the firm level. Hence, in our empirical analysis we focus on the role of human capital endowment as a potential determinant of regional differences in skill segregation.

3 Data

We use functional regions as observational units (so-called Raumordnungsregionen) which consist of several counties (NUTS-3 regions) that are linked by intense commuting and should therefore serve as an approximation of regional labour markets. By applying functional regions most relevant processes such as job search, matching of vacancies and workers or the adjustment of firm technology to skill specific labour supply, should take place within the regions. Altogether there are 97 functional regions in Germany that we consider in the descriptive analyses. However, we have to restrict the regression analysis to the 74 West German regions since the development of skill segregation in East Germany seems to be severely affected by the transformation process of the economy in the 1990s. Moreover, East and West Germany are still marked by systematic differences in the skill structure

of the work force. These differences seem to represent, at least partly, some kind of heritage of the educational systems of the two former German states. Furthermore, the analysis takes into account the region type. Starting from a classification based on a typology of settlement structure according to the criteria population density and size of the regional centre, we differentiate between agglomerated, urbanized and rural regions.[5]

In the literature different measures of segregation by skill are applied. Frequently the between- and within-plant wage dispersion serves as an indicator for segregation (e.g. Davis and Haltiwanger 1991; Kremer and Maskin 1996). However, we prefer a more direct measurement of skill segregation via the formal qualification of workers. Thus, we need plant level information on employment by educational attainment. The Establishment History Panel of the Institute for Employment Research (IAB) offers corresponding annual data. The dataset contains detailed information on all establishments in Germany with at least one employee liable to social security for East and West Germany for the period 1993 to 2005.[6] The data include a region identifier that allows aggregation of the establishment information to the regional level. The indicators of skill segregation are based on employment data differentiated by educational attainment of the workers. We can differentiate between 3 levels of education: no formal vocational qualification, completed apprenticeship and university degree that are subsequently denoted un- or low-skilled, medium-skilled and high-skilled, respectively. In order to control for effects arising from the rapidly growing number of marginal part-time workers we include only full-time employees in our analysis. Furthermore, all employees that have not been assigned to an educational level were excluded from our dataset.

In the regression analysis, we include several explanatory variables that rest on information from the employment statistics of the German Federal Employment Agency for the period 1993 to 2005. The employment statistic covers all employment subject to social security contributions. The data is given on the NUTS-3 level and refers to workplace location. We use employment data differentiated by educational level, branch[7], occupation, and firm size in order to generate several explanatory variables.

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5 The classification has been developed by the Federal Office for Building and Regional Planning. For details see URL: http://www.bbr.bund.de/raumordnung/europa/download/spesp_indicator_description_may2000.pdf.

6 For a detailed description of the Establishment History Panel see: http://fdz.iab.de/en/ FDZ_Establishment_Data/ Establishment_History_Panel.aspx.

7 Due to changes in the statistical recording of firms' affiliations to sectors, the information on the sector structure had to be back-dated from 1998 to earlier years. As a consequence, the data on the regional sector structure in the year prior to 1998 is only an approximation. Changes in the regional sector composition during that period might be underestimated.

4 Methodological Issues

4.1 Measurement of Skill Segregation

In order to investigate regional differences in skill segregation we use a segregation measure that assesses the extent of segregation between two distinct skill groups, i.e. workplace segregation of skilled- and unskilled workers. We use the Duncan index, also called index of dissimilarity, introduced by Duncan and Duncan (1955), which is one of the most frequently applied measures for group-specific segregation:

$$S_i = 0.5^* \sum_w \left| \frac{N^u_{wi}}{N^u_i} - \frac{N^s_{wi}}{N^s_i} \right|, 0 \leq S_r \leq 1 \qquad (1)$$

where N^u_{wi} (N^s_{wi}) denotes the number of unskilled (skilled) employees in workplace w and region i. The segregation measure S_i gives the proportion of low-skilled employees that has to be redistributed to other workplaces in order to get identical shares of high- and low-skilled employees at each workplace w in region i. In case of "no segregation" the Duncan index is equal to zero. In contrast, complete segregation is indicated by a value of one.

Economic and sociological literature provides a number of alternative measures of group-specific segregation that possess different properties.[8] In contrast to the Duncan index, some of these measures are sensitive to changes in the overall group shares. This applies for example to the co-worker index introduced by Hellerstein and Neumark (2003) or the OECD measure applied by Gerlach et al. (2002). As regards skill segregation these measures are thus affected by shifts in the regional skill shares even if the skill distribution across firms remains constant. It can be argued that changes in the relative group sizes matter for the degree of segregation irrespective of the distribution across firms. For instance, it might be reasonable to argue, that a doubling in the number of high-skilled employees in the labour force keeping constant the number of low-skilled employees increases segregation level of unskilled employees.

However, this analysis focuses on the determinants that make some firms hire predominantly skilled workers, while the others specialise on unskilled workers. According to the theoretical results discussed in Section 2 we hypothesise that the regional skill structure is a key factor regarding the incentive of firms to invest in

8 For a more extensive discussion about the properties of different segregation measures see for example Flückiger and Silber (1999) or Cutler et al. (1999).

skill-specific technologies and employ either skilled or unskilled workers. Since we include cross-sectional as well as longitudinal data in our analysis the segregation measure should be insensitive to changes in the regional skill composition. Therefore, scale invariance with respect to skill shares is a useful property for our purpose. Another useful characteristic of the Duncan index is that it is weighted by firm size. This ensures, that comparatively large firms matter more for the regional level of skill segregation than small firms.

In the following we use two different notions for the term "skilled worker" in our segregation measure. The first one includes only the high-skilled (= with university degree) and the second one includes all employees that have received a professional degree (= medium- and high-skilled). Hence, the following two variants of the Duncan index are applied in this study:

- Variant 1: Segregation between unskilled and high-skilled employees;
- Variant 2: Segregation between unskilled and the rest of all other employees.

The first variant is applied in order to find out whether skill segregation takes place between the bottom and the top end of the skill distribution, i.e. when the discrepancy between educational levels is relatively high. However, in Germany, where university degree generally correspond to a master's rather than to a bachelor's level the high-skilled represent a slightly more specific type of human capital than, for example, college degrees in the United States.[9] Hence, the relevance of joint work processes including academics and unskilled workers on the German labour market may be rather limited. Besides, the so-called dual education system, which combines formal schooling and on-the-job training produces a large number of highly skilled employees without university degree. In general, comprising a wide range of skills the group of workers with completed apprenticeship training is very heterogeneous. Overall, the cooperation between academics and unskilled workers might occur less frequent in production processes than to joint work of unskilled and medium-skilled employees, as for example an unskilled and a supervising craftsman or a technician. Therefore, the second variant of our segregation measure aims at investigating whether skill segregation is characterised by a decoupling of unskilled workers from all other workers in the production process.

9 Bachelor and master degrees have been introduced only very recently to German universities and are not an issue for the time period observed in this chapter.

4.2 Regression Analysis

The basic specification of the regression model that is applied to investigate the determinants of regional differences in skill segregation links our pivotal explanatory variable, i.e. our proxy for human capital endowment, to the regional level of skill segregation:

$$S_{it} = \alpha_0 + \alpha_1 HC_{it-T} + \sum_{k=1}^{K} \beta_k C_{kit} + u_{it} \qquad (2)$$

where S_{it} is skill segregation in region *i* and year *t*. HC_{it-T} is the lagged share of high-skilled workers (university degree) in total employment and u_{it} is the error term. Since we assume that the impact of the local skill structure on skill segregation might not be immediate, but rather works via investments in technology and sets in somewhat deferred, the share of high-skilled workers enters into the model with a time lag.

Furthermore, we expand the basic specification by some control variables C_{kit} in order to avoid misspecification due to omitted variables. Controls comprise indicators for the sectoral specialisation of regional economies and the firm size structure of employment. We include the percentages of small (up to 49 employees) and large (250 or more employees) firms in total employment and the location coefficients of 20 branches.

There are some econometric issues in analysing the effect of high-skilled labour supply on segregation by education. The first one is the omitted variable bias that can result from the potential correlation between unobserved regional characteristics and the dependent variable, i.e. the regional level of within plant skill segregation. We can deal with time-invariant regional characteristics by applying a fixed effects model:

$$S_{it} = \alpha_0 + \alpha_1 HC_{it-T} + \sum_{k=1}^{K} \beta_k C_{kit} + \eta_i + \lambda_t + \varepsilon_{it} \qquad (3)$$

where η_i denotes a region-specific effect, controlling for unobservable regional characteristics that are time-invariant, λ_i captures unobservable time effects and ε_{it} is a white noise error term. The region-specific effect will also capture any systematic differences in skill segregation between rural and urban regions.

The second econometric issue concerns the simultaneity bias resulting from reverse causality between regional human capital and skill segregation. Due to potential endogeneity of the employment share of high-skilled labour the relationships estimated by OLS or a fixed effects model might not be interpreted as causal. According to the theoretical models outlined in Section 2, the differentiation of the regional economy into several production systems and the accompanying

skill segregation likely give rise to significant differences in skill specific labour demand. Thus, we cannot assume that the regional human capital endowment is an exogenous variable. The simultaneity bias can be addressed using instrumental variable (IV) estimation. In order to identify the causal impact of high-skilled labour supply on the dependent variable, we instrument the human capital variable by time lags of the share of high-skilled workers applying two-stage-least-squares (2SLS) estimation. The lags are valid instruments if they are relevant and uncorrelated with the error term. More precisely, relevance requires a partial correlation of the instrument with the endogenous regressor, namely, the coefficient of the instrument variable should be significant in the first stage regression.

Finally, we might consider spillover effects among neighbouring labour markets. Spatial interaction should mainly take place within our observational units because we apply functional regions. However, we cannot preclude significant spillover effects across the borders of regional labour markets. Spatial dependence might be an issue although the models in Section 2 provide no theoretical arguments for important interaction among neighbouring regions as regards differences in skill segregation. The models imply that the supply of high-skilled labour affects the firm's choice of production technology and this in turn might give rise to segregation by skill. Firms may also take into account labour supply in nearby regions when deciding on investments in technology as neighbouring labour markets are likely linked by the mobility of workers, i.e. migration and commuting. We introduce a spatial lag of human capital in the regression model to account for these effects:

$$S_{it} = \alpha_0 + \alpha_1 HC_{it-T} + \rho \sum_{j=1}^{R} \omega_{ij} HC_{jt-T} + \sum_{k=1}^{K} \beta_k C_{kit} + \eta_i + \lambda_t + \varepsilon_{it} \qquad (4)$$

Thus we extend the non-spatial model by a spatial lag of the pivotal explanatory variable $\sum_{j=1}^{R} \omega_{ij} HC_{jt-T}$ where ω_{ij} is an element of the $R \times R$ spatial weights matrix $\boldsymbol{\Omega}$.[10]

Taking into account the weighted sum of human capital in neighbouring regions implies that spatial autocorrelation of the error term is caused by omission of some substantive form of spatial dependence caused by neighbourhood effects. However, spatial autocorrelation in measurement errors or in variables that are otherwise not crucial to the model might also entail spatial error dependence. Provided that the unobservable common factors are uncorrelated with the explanatory variables, the coefficient estimates from the non-spatial model are still unbiased, but standard

10 In order to check the robustness of results with respect to variation of the spatial weighting scheme we apply two different weighting schemes. The first specification of $\boldsymbol{\Omega}$ is a binary spatial weights matrix such that $\omega_{ij} = 1$ if the largest municipalities of regions *i* and *j* are within reach of not more than 100 km to each other and $\omega_{ij} = 0$ otherwise. Secondly, ω_{ij} is set to the inverse of distance between the largest municipalities of regions *i* and *j*.

error estimates are biased and hence statistical inference that is based on such standard errors is invalid. To deal with this issue we apply the nonparametric covariance matrix estimator introduced by Driscoll and Kraay (1998), which provides heteroscedasticity consistent standard errors that are robust to very general forms of spatial and temporal dependence.[11]

5 Evidence on Regional Differences in Skill Segregation among German Regions

5.1 Descriptive Overview

This section illustrates the development and level of segregation by skill in the period 1993 to 2005. In addition to the distinction between East and West Germany we provide evidence on skill segregation for 97 functional regions and for three different area types.

Skill segregation in Germany is marked by a distinctive increase in the overall level between 1993 and 2005 (see Table 1). This increase in the level of skill segregation, however, has been particularly strong during the 1990s. Since 1999, by contrast, we observe only small changes in segregation levels. Overall, this result is in line with previous findings that point to an increase of segregation by skill in developed economies. Hence, according to both variants of skill segregation differently skilled workers tend to work more and more in different firms rather than sharing a common workplace. Unsurprisingly, the level of skill segregation between unskilled and high-skilled workers (Variant 1) is higher than in the case of Variant 2 (between unskilled and all other workers).

Most noticeable, the development as well as the level of skill-segregation is marked by a pronounced east-west gradient. Both variants of segregation measurement display a substantially higher level in East Germany (Table 1). The development of skill segregation in East German regions in the period under consideration is likely driven by the impact of economic transformation. Moreover, systematic differences in the development of the skill composition in East and West Germany in the 1990s might have affected the changes in skill segregation. For instance, findings by Fromhold-Eisebith and Schrattenecker (2006) show that the share of high-skilled employment declined substantially while the share of low-skilled employment increased in most East German regions. This is in strong contrast to the development of the skill composition in West Germany.

11 See Hoechle (2007) for more details.

Table 1: Segregation in East and West Germany

	East Germany		West Germany		Germany	
	Variant 1	Variant 2	Variant 1	Variant 2	Variant 1	Variant 2
Duncan index, 1993	0.727	0.603	0.718	0.534	0.738	0.564
Duncan index, 1999	0.784	0.690	0.739	0.567	0.755	0.599
Duncan index, 2005	0.795	0.694	0.747	0.574	0.761	0.602
change of Duncan index, 1993–2005	0.068	0.091	0.029	0.040	0.023	0.038
correlation: level in 1993 and change between 1993 and 2005	–0.658	–0.335	–0.524	–0.283	–0.379	0.274
R^2	0.433	0.112	0.274	0.080	0.144	0.075

Figure 1 and Figure 2 reveal changes in the spatial pattern of skill segregation. Overall, skill segregation has been increasing in most German regions between 1993 and 2005. Only ten regions in Variant 1 and two regions in Variant 2 out of 97 regions experienced declining levels of segregation. As shown in Table 1 the increase of segregation in East German regions is much stronger than in West Germany. According to the correlation coefficient shown in Table 1 regions with relatively low initial levels of skill segregation in 1993 have subsequently exhibited on average a more pronounced increase of skill segregation than those with comparatively high initial levels. This applies to the entire cross section as well as to the East and West German subsamples.

Figure 3 and 4 indicate that despite this convergence since 1993 there are still substantial differences in skill segregation across German regions in 2005. With exception of Ingolstadt (in the south of West Germany), the most highly segregated regions are situated exclusively in East Germany. Segregation levels do not only differ between East and West, but there is also a significant variation of regional segregation levels within East and West Germany. However, because of the likely influence of transformation effects on the level of skill segregation in East Germany the following analyses on regional differences in skill segregation are restricted to the West German subsample.

In Braunschweig for example 57 percent of the low-skilled would have to be redistributed to other firms in order to get identical shares of high- and low-skilled employees at each firm in 2005. By contrast in Cloppenburg 84 percent of low-skilled workers would have to swap their workplace with higher skilled workers in other firms. While the least segregated regions are mainly located in the southern part of the country, the spatial pattern in the northern part appears to be rather scattered. Along the eastern and southern boundaries of West Germany the degree of skill segregation tends to be comparatively low.

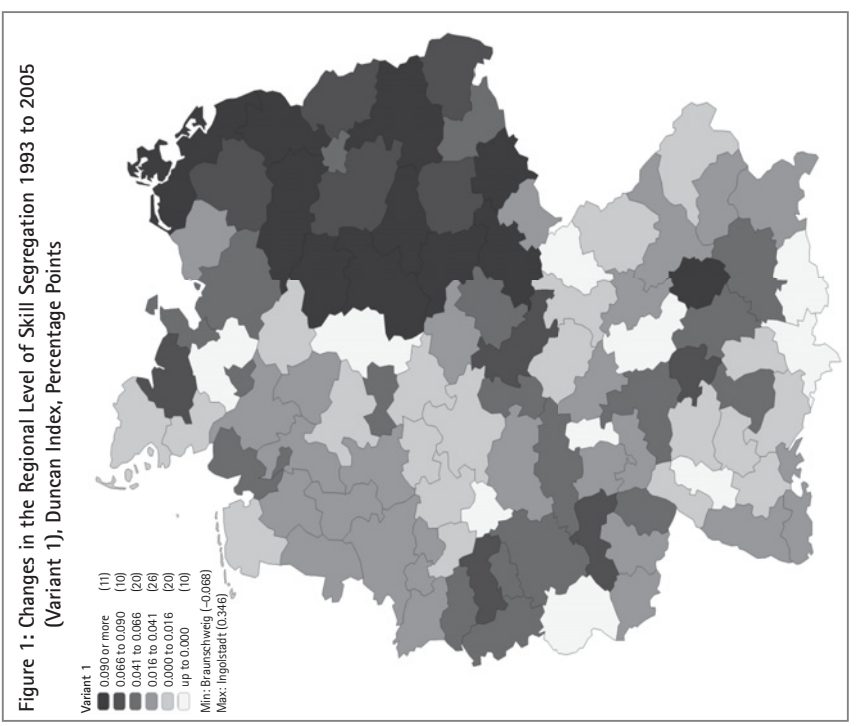


Figure 1: Changes in the Regional Level of Skill Segregation 1993 to 2005
(Variant 1), Duncan Index, Percentage Points
Variant 1
0.090 or more (11)
0.066 to 0.090 (10)
0.041 to 0.066 (20)
0.016 to 0.041 (26)
0.000 to 0.016 (20)
up to 0.000 (10)
Min: Braunschweig (–0.068)
Max: Ingolstadt (0.346)

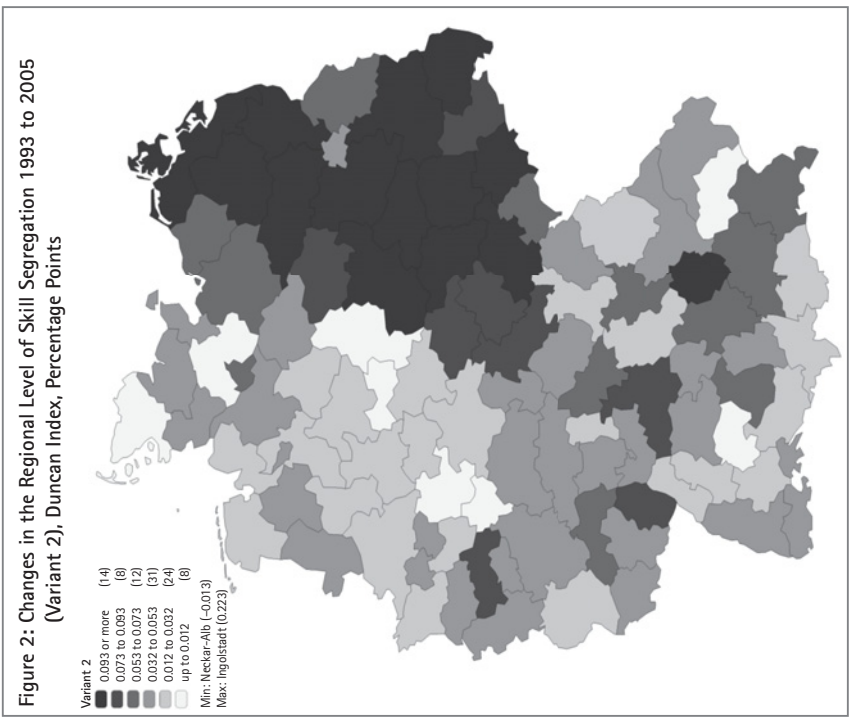


Figure 2: Changes in the Regional Level of Skill Segregation 1993 to 2005
(Variant 2), Duncan Index, Percentage Points
Variant 2
0.093 or more (14)
0.073 to 0.093 (8)
0.053 to 0.073 (12)
0.032 to 0.053 (31)
0.012 to 0.032 (24)
up to 0.012 (8)
Min: Neckar-Alb (–0.013)
Max: Ingolstadt (0.223)

Figure 3: Regional Levels of Skill Segregation 2005 (Variant 1), Duncan Index

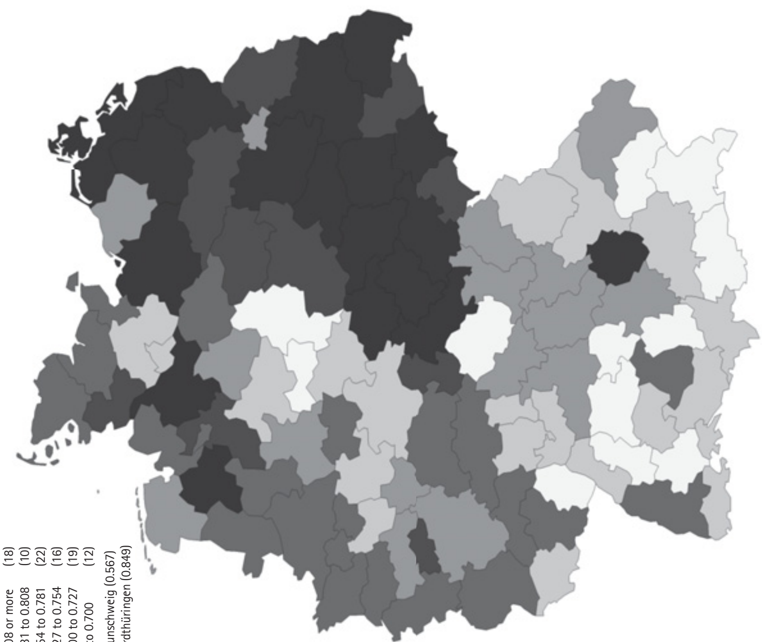


Figure 4: Regional Levels of Skill Segregation 2005 (Variant 2), Duncan Index

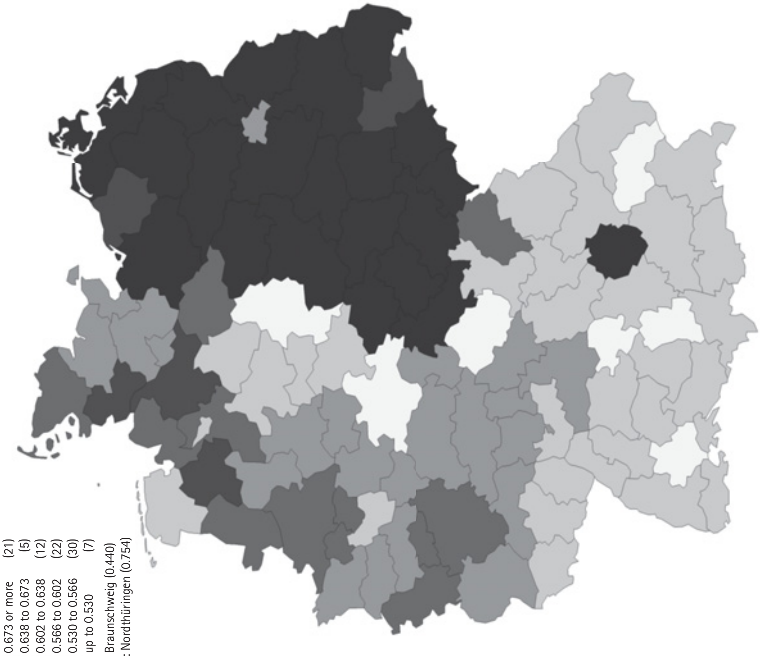


Figure 5: Skill Segregation by Area Types in West Germany, 1993 to 2005 (Variant 1)

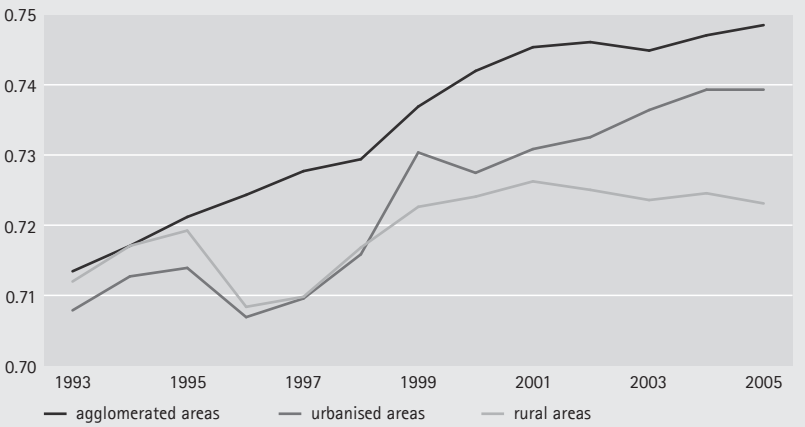
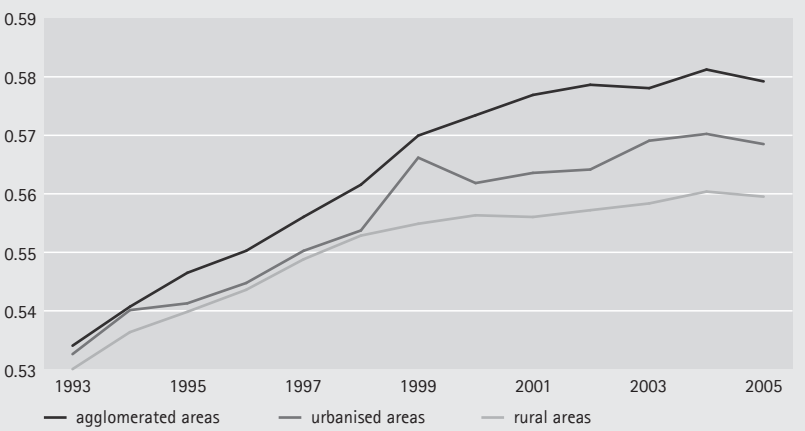


Figure 6: Skill Segregation by Area Types in West Germany, 1993 to 2005 (Variant 2)



We also investigate the development of skill segregation by different area types, i.e. agglomerated, urbanised and rural areas. Regarding the first variant (segregation between unskilled and high-skilled employees), agglomerated areas are characterised by a higher level of segregation by skill than urbanised and rural areas throughout the entire period (see Figure 5). Moreover, it is discernible that the differences between the three region types have been somewhat increasing since the end of the 1990s. While skill segregation in rural areas has remained on a more or less constant level, skill segregation in urbanised and agglomerated areas have been increasing. As illustrated in Figure 6, levels of skill segregation across area types in Variant 2 (segregation between unskilled and all other workers) are very similar during the 1990s but start to diverge at the end of the decade.

5.2 Regression Results

As shown in the previous section transformation effects seem to severely influence the level of skill segregation in Eastern Germany during our period of observation. Since these effects are likely to interfere, we exclude the East German regions from the regression analysis. The estimation results are presented in Tables 2 and 3. The models displayed in the tables only differ with respect to the applied measure of skill segregation (Variants 1 and 2). They provide results for the Equations (3) and (4), i.e. with and without considering a spatial lag of human capital in the regression model, both including our proxy for the skill share in labour supply as well as employment shares of small and large firms and various branches. In addition to standard fixed effects estimations, the tables present the estimates obtained by applying Driscoll and Kraay standard errors and IV estimation.[12]

In the standard fixed effects model the human capital measure enters without time lag. However, we also consider specifications where skill shares enter with different time lags. The results indicate that the impact of high-skilled labour supply is not immediate. Irrespective of the variant of skill segregation measurement, the share of high-skilled workers (without time lag) yields a positive but insignificant coefficient. However, in both cases the corresponding coefficients are statistically significant with a lag of two periods (at the 5 % level in Variant 1 and at the 1 % level in Variant 2).[13] Hence, the findings suggest that the regional level of skill segregation is significantly and positively affected by previous shares of local human capital. This might reflect that investments in skill-specific technologies and its impact on skill segregation due to changes in the supply of human capital emerge only decelerated in time. According to our results a relatively large share of employees that received a tertiary education positively affects segregation between low- and high-skilled employees at the firm level (Variant 1) as well as segregation between the low-skilled and the rest of all employees (Variant 2) within about two years time.

The results of the 2SLS estimations suggest that endogeneity of the regional human capital endowment is unlikely to be a major problem. We apply the share of high-skilled workers lagged by six years as an instrument for human capital. According to the first-stage regressions the share of high-skilled lagged by six periods is a valid instrument. The high significance (at the 0.01 level) of the instrument in the first stage regression indicates that the partial correlation between the instrument and the endogenous explanatory variable is sufficient

12 Period and region-specific fixed effects are included in the regression model, but the estimated coefficients are not included in the presentation of this chapter.

13 The estimation results including skill shares with different time lags can be obtained from the authors upon request.

to ensure unbiased estimates and relatively small standard errors.[14] The impact of regional human capital endowment on skill segregation is even reinforced in the IV regressions. According to IV estimation results an increase in the share of local high-skilled employment by one percentage point increases the level of segregation, i.e. the share of unskilled employees that has to be redistributed in order to maintain no skill segregation, by 0.56 percentage points in Variant 1 and 0.62 percentage points in Variant 2.

The IV estimates are positive, significant, and larger than their simple fixed effects counterparts for both variants of segregation measurement. This is surprising since simultaneity should result in upward biased fixed-effects estimates of the impact of human capital. This suggests that the simultaneity bias in the fixed effects estimates is relatively small. The gap between fixed effects and IV estimates might reflect a downward bias in the fixed effects estimates caused by measurement errors. This may indicate that the measurement error's bias towards zero is more important than the upward bias due to the impact of segregation on the regional human capital. Another explanation is that there is heterogeneity in the effect of high-skilled labour supply on skill segregation, and that the IV estimates tend to recover effects for a subset of regions with relatively strong impact of human capital on segregation.[15]

14 The first-stage estimation results can be obtained from the authors upon request.

15 See Card (2001) for a corresponding reasoning with respect to returns to schooling.

Table 2: Results for Variant 1 (low- vs high-skilled)

Model	FE		FE-Robust		IV	
Skill supply (lagged by 2 years)	0.404 **	0.378 **	0.404 *	0.378 *	0.558 ***	0.508 ***
	(0.159)	(0.158)	(0.207)	(0.191)	(0.185)	(0.183)
Spatially lagged skill supply	-	1.013 ***	-	1.013 ***	-	0.790 **
	-	(0.346)	-	(0.141)	-	(0.396)
Small firms	−0.477 ***	−0.460 ***	−0.477 ***	−0.460 ***	−0.461 ***	−0.451 ***
	(0.104)	(0.103)	(0.147)	(0.148)	(0.104)	(0.104)
Large firms	−0.218 ***	−0.212 ***	−0.218 *	−0.212 *	−0.209 ***	−0.207 ***
	(0.071)	(0.071)	(0.125)	(0.121)	(0.071)	(0.071)
Food, Drink & Tobacco	0.020 **	0.019 **	0.020 ***	0.019 ***	0.021 **	0.020 **
	(0.008)	(0.008)	(0.006)	(0.006)	(0.008)	(0.008)
Textile & Leather	0.006 *	0.007 **	0.006	0.007 *	0.006 *	0.007 **
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Wood	0.000	−0.002	0.000	−0.002	0.001	−0.001
	(0.004)	(0.004)	(0.002)	(0.002)	(0.004)	(0.004)
Paper & Printing	−0.014	−0.012	−0.014	−0.012	−0.012	−0.011
	(0.010)	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)
Chemistry and Synthetic Materials	−0.007	−0.005	−0.007 *	−0.005	−0.006	−0.005
	(0.006)	(0.006)	(0.004)	(0.004)	(0.006)	(0.006)
Glass & Ceramics	−0.001	0.000	−0.001	0.000	−0.001	−0.001
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Metal-Production & Manufactoring	−0.005	−0.004	−0.005	−0.004	−0.004	−0.003
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Machinery	−0.015 **	−0.016 **	−0.015 ***	−0.016 ***	−0.014 **	−0.015 **
	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)	(0.006)
Electrical Engineering	−0.001	0.001	−0.001	0.001	0.000	0.001
	(0.007)	(0.007)	(0.006)	(0.006)	(0.007)	(0.007)
Motor Vehicles	−0.007 *	−0.007 *	−0.007	−0.007	−0.007 *	−0.007 *
	(0.004)	(0.004)	(0.011)	(0.011)	(0.004)	(0.004)
Building & Construction	0.000	−0.001	0.000	−0.001	0.004	0.002
	(0.013)	(0.013)	(0.009)	(0.009)	(0.013)	(0.013)
Commerce	−0.019	−0.028	−0.019	−0.028	−0.018	−0.026
	(0.024)	(0.025)	(0.019)	(0.019)	(0.024)	(0.025)
Hotels & Gastronomy	0.042 ***	0.045 ***	0.042 ***	0.045 ***	0.041 ***	0.044 ***
	(0.010)	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)
Information & Transportation	0.020 **	0.017 *	0.020 **	0.017 **	0.022 **	0.019 *
	(0.010)	(0.010)	(0.008)	(0.008)	(0.010)	(0.010)

Table 2: continued

Model	FE		FE-Robust		IV	
Finance & Insurance	−0.046 ***	−0.041 **	−0.046	−0.041	−0.047 ***	−0.043 **
	(0.017)	(0.017)	(0.031)	(0.030)	(0.017)	(0.017)
Simple Business-Related Services	−0.011	−0.014	−0.011 **	−0.014 ***	−0.010	−0.012
	(0.009)	(0.009)	(0.005)	(0.005)	(0.009)	(0.009)
Complex Business-Related Services	0.020 **	0.017 *	0.020 *	0.017	0.018 *	0.016
	(0.010)	(0.010)	(0.011)	(0.011)	(0.010)	(0.010)
Temporary Employment	0.004	0.003	0.004	0.003	0.005	0.004
	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)
Education	0.006	0.007	0.006	0.007 *	0.006	0.007
	(0.006)	(0.006)	(0.004)	(0.004)	(0.006)	(0.006)
Health & Social Services	0.037 **	0.034 **	0.037 ***	0.034 **	0.038 **	0.035 **
	(0.017)	(0.017)	(0.014)	(0.013)	(0.017)	(0.017)
Constant	0.940 ***	0.855 ***	0.940 ***	0.855 ***	0.906 ***	0.846 ***
	(0.077)	(0.082)	(0.090)	(0.099)	(0.080)	(0.087)
R^2 within	0.382	0.388	0.382	0.388	0.381	0.388
R^2 between	0.090	0.053	–	–	0.078	0.054
R^2 overall	0.125	0.087	–	–	0.113	0.089
No. of obs.	962	962	962	962	962	962

Notes: *** significant at the 0.01 level; ** significant at the 0.05 level, * significant at the 0.1 level.
Standard errors reported in parentheses.

Table 3: Results for Variant 2 (low- vs all others)

Model	FE		FE-Robust		IV	
Skill supply (lagged by 2 years)	0.325 ***	0.300 **	0.325 ***	0.300 ***	0.616 ***	0.546 ***
	(0.117)	(0.117)	(0.120)	(0.101)	(0.137)	(0.135)
Spatially lagged skill supply	–	0.976 ***	–	0.976 ***	–	1.097 ***
	–	(0.255)	–	(0.118)	–	(0.293)
Small firms	−0.209 ***	−0.193 **	−0.209 ***	−0.193 ***	−0.179 **	−0.165 **
	(0.077)	(0.076)	(0.072)	(0.071)	(0.077)	(0.077)
Large firms	0.005	0.010	0.005	0.010	0.020	0.024
	(0.053)	(0.052)	(0.087)	(0.084)	(0.053)	(0.052)
Food, Drink & Tobacco	0.023 ***	0.022 ***	0.023 ***	0.022 ***	0.024 ***	0.022 ***
	(0.006)	(0.006)	(0.004)	(0.004)	(0.006)	(0.006)
Textile & Leather	0.007 ***	0.008 ***	0.007 *	0.008 *	0.007 ***	0.008 ***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)
Wood	−0.002	−0.004	−0.002 *	−0.004 ***	−0.002	−0.004
	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)
Paper & Printing	−0.022 ***	−0.020 ***	−0.022 ***	−0.020 ***	−0.019 **	−0.017 **
	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)

Model	FE		FE-Robust		IV	
Chemistry and Synthetic Materials	−0.009 *	−0.007	−0.009	−0.007	−0.008	−0.006
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Glass & Ceramics	−0.003	−0.002	−0.003 *	−0.002	−0.003	−0.002
	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)
Metal-Production & Manufactoring	−0.012 **	−0.010 *	−0.012 **	−0.010 *	−0.010 *	−0.008
	(0.005)	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)
Machinery	−0.001	−0.002	−0.001	−0.002	0.001	0.000
	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)
Electrical Engineering	−0.012 **	−0.010 **	−0.012 ***	−0.010 ***	−0.011 **	−0.009 *
	(0.005)	(0.005)	(0.003)	(0.003)	(0.005)	(0.005)
Motor Vehicles	−0.009 ***	−0.009 ***	−0.009	−0.009	−0.008 ***	−0.008 ***
	(0.003)	(0.003)	(0.011)	(0.012)	(0.003)	(0.003)
Building & Construction	0.002	0.000	0.002	0.000	0.009	0.006
	(0.010)	(0.010)	(0.008)	(0.007)	(0.010)	(0.010)
Commerce	−0.011	−0.020	−0.011	−0.020	−0.009	−0.019
	(0.018)	(0.018)	(0.015)	(0.015)	(0.018)	(0.018)
Hotels & Gastronomy	0.019 ***	0.022 ***	0.019 ***	0.022 ***	0.018 **	0.021 ***
	(0.008)	(0.007)	(0.006)	(0.006)	(0.008)	(0.008)
Information & Transportation	0.017 **	0.014 *	0.017 ***	0.014 **	0.020 ***	0.016 **
	(0.007)	(0.007)	(0.005)	(0.006)	(0.007)	(0.007)
Finance & Insurance	−0.029 **	−0.024 *	−0.029	−0.024	−0.031 **	−0.025 **
	(0.013)	(0.013)	(0.019)	(0.018)	(0.013)	(0.013)
Simple Business-Related Services	−0.014 **	−0.017 ***	−0.014 ***	−0.017 ***	−0.012 *	−0.015 **
	(0.007)	(0.006)	(0.004)	(0.004)	(0.007)	(0.007)
Complex Business-Related Services	0.031 ***	0.028 ***	0.031 **	0.028 **	0.027 ***	0.024 ***
	(0.007)	(0.007)	(0.012)	(0.012)	(0.008)	(0.008)
Temporary Employment	−0.001	−0.002	−0.001	−0.002	0.001	−0.001
	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)
Education	0.005	0.005	0.005	0.005	0.005	0.006
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Health & Social Services	0.017	0.014	0.017 **	0.014 *	0.019	0.015
	(0.013)	(0.013)	(0.008)	(0.008)	(0.013)	(0.013)
Constant	0.636 ***	0.554 ***	0.636 ***	0.554 ***	0.570 ***	0.487 ***
	(0.057)	(0.061)	(0.034)	(0.042)	(0.060)	(0.064)
R^2 within	0.604	0.610	0.604	0.610	0.601	0.608
R^2 between	0.055	0.046	–	–	0.034	0.028
R^2 overall	0.118	0.110	–	–	0.089	0.084
No. of obs.	962	962	962	962	962	962

Notes: *** significant at the 0.01 level; ** significant at the 0.05 level, * significant at the 0.1 level.
Standard errors reported in parentheses.

Including the spatially lagged share of high-skilled employment (Equation 4) does not ultimately change these findings. For instance, applying a binary spatial weights matrix as specified above does only slightly affect the sizes as well as the significances of the estimates for the local skill supply (see Tables 2 and 3). In both segregation variants the corresponding coefficients in the spatial models are somewhat below those in the non-spatial model. The marginal effect in the spatial IV model for example reduces from 0.56 to 0.51 in Variant 1 and from 0.62 to 0.55 in Variant 2. Thus, ignoring spatial dependence yields a small upwards bias in the estimates for the local skill supply. Nevertheless, this does not alter our conclusions in general. The coefficients of the spatially lagged variable are significantly positive for each model specification reported in the tables. However, while the estimates for local skill supply are robust to changes in the specification of the spatial weight matrix the coefficients of the spatially lagged skill shares are sensitive to alternative weighting schemes.[16] Increasing the distance cut-off, that is expanding the area of surrounding regions considered for spatial interaction, to 150 and more kilometres affects the coefficients' size and significance. Overall, this indicates that firms take into account labour supply in nearby regions, i.e. within reach of 100 kilometres, when deciding on investments in technology.

Furthermore, our results do not alter by applying Driscoll and Kraay (1998) standard errors that are robust to heteroscedasticity and general forms of cross-sectional and time series autocorrelation. Tables 2 and 3 show the fixed-effects estimates (Equation 3) with robust standard errors including the share of human capital lagged by two periods. Thus, we can preclude spatial autocorrelation in measurement errors, such as a wrongly specified regional system to seriously affect statistical inference.

The coefficients of the control variables show that both the firm-size structure and specialisation of the regional economy on specific branches matter for the level of segregation by skill. The coefficients of the employment shares of small and of large firms are significantly negative in the case of Variant 1. Thus, the phenomenon of segregation between unskilled workers and university graduates seems to be more pronounced in regional labour markets characterised by large share of medium sized firms. The second variant of skill segregation is only significantly and negatively affected by the percentage of small firms.

In both variants the results for the location coefficients of specific branches show that a specialisation in manufacturing branches tends to correlate negatively with segregation by skill. The only exceptions are the branches "Food, Drink and

16 The results applying alternative weighting schemes can be obtained upon request by the authors.

Tobacco" and "Textiles and Leather". In particular, regarding Variant 2 most of the estimated effects significantly differ from zero. By contrast, in the service sector the majority of the coefficients exhibit positive signs. However, the branches "Finance and Insurance" and "Simple Business-related Services" also exert a negative influence on skill segregation. Altogether, these findings suggest that sectoral specialisation has differentiated effects on skill segregation. Whereas some branches tend to boost segregation by skill, other industries, mainly manufacturing branches, seem to dampen the regional intensity of segregation. Moreover, the sector structure seems to be slightly more important for segregation between the unskilled and the rest of all workers.

Overall our empirical models explain a significant part of the regional differences in skill segregation. According to the R^2 of the within estimators nearly 40 percent in Variant 1 and around 60 percent in Variant 2 of the (within) variation can be explained by our model. Moreover, the results show that the regional supply of skilled labour is indeed a key determinant as regards the development of within-firm segregation by skill, which is in line with the theoretical models presented in Section 2.

6 Conclusions

Our analysis aims at investigating regional differences in workplace segregation by skill and its determinants. While previous analyses examine skill segregation mainly on the national level, we provide first evidence on regional differences in segregation by skills. Applying the Duncan index on regional and firm-level data we investigate two variants of skill segregation at the regional level, namely segregation between unskilled and high-skilled workers and segregation between unskilled and the rest of all workers. The results point to pronounced regional differences in the level of skill segregation across German regions for both types of segregation. Furthermore, the development of skill segregation is marked by a distinctive increase between 1993 and 2005. Due to transformation process in the 1990s and systematic differences in the qualification structure between East and West Germany the development and levels of skill segregation differ substantially between both parts of the country. In contrast, we detect only small differences between urban and rural areas by the end of the 1990s. However, since 2000 the development of segregation across different area types seems to diverge. Especially in more densely populated areas the relatively strong increases in the level of skill segregation may negatively impact the employment prospects for the low-skilled.

The regression analysis reveals significant effects of the local skill composition on the level of skill segregation. Skill segregation is positively affected by a large

local supply of human capital. We assume that the effect of the local skill structure works via investments in technology and sets in somewhat deferred. Applying different time lags demonstrates that the impact of the local skill supply on segregation levels is not immediate, but sets in with a delay of about two years. Furthermore, including a spatially lagged share of human capital in our regression model shows that firms also take the skill supply in nearby regions into account when making decisions on investments in production technology. This, however, does not ultimately affect the estimates on our proxy for the local supply of human capital.

Overall, our findings are in line with theoretical results providing a link between proceeding economic integration and technological change on the one hand and rising levels of skill segregation in the production process on the other hand. In the corresponding models the supply of human capital is a key determinant for the segmentation of skills in the production process. Thus, for Germany as a highly developed country we identify an important factor with respect to increasing skill segregation. Furthermore, our findings indicate that sectoral specialisation as well as the firm-size structure matter for the regional level of skill segregation. This possibly reflects different skill compositions across firm-size classes and branches. The latter can be explained by differences in production technologies.

The theoretical results discussed in Section 2 further propose a link between skill segregation and rising wage inequalities as well as the possibility of adverse effects on low-skilled employment. Schlitte (2010) provides evidence on adverse effects of segregation on labour market prospects of low-skilled. Thus, due to adverse effects from skill segregation the low-skilled might benefit less from the positive labour market effects of local human capital that are frequently found in the literature. Therefore, our findings on the determinants for the regional level of skill segregation have important implications for regional labour market policy.

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Chapter 5 Local Human Capital, Segregation by Skill, and Skill-Specific Employment Growth[1]

FRISO SCHLITTE[2]

Abstract: Labour markets in most highly developed countries are marked by rising levels of segregation by skill and increasing inequality in skill-specific employment prospects. However, analyses on regional employment growth by different skill levels are scarce and empirical evidence on the possible effects of skill segregation is completely lacking. By applying regional and firm-level data for West Germany, this analysis provides new evidence for the adverse effects of skill segregation on low-skilled employment growth. Furthermore, the findings reveal that a large share of local high-skilled employment does not foster regional concentration of human capital, but ameliorates the employment prospects of less skilled workers.

1 Introduction

The labour markets in most highly developed countries are marked by rising inequalities between different qualification groups. While the level of high-skilled employment is steadily increasing, the demand for low-skilled workers is subject to a considerable decline (see Nickell and Bell 1995). In West Germany, the number of employed university graduates (high-skilled) has increased by roughly sixty percent between 1993 and 2009. At the same time the number of untrained employees (low-skilled) has shrunk by about one third (see Figure 1).

The decreasing demand for low skills is often explained by increased international competition promoting specialisation in human-capital intensive industries (see Wood 1994, 2002) and skill-biased technological and organisational changes (see Acemoglu 1998, 2002; Lindbeck and Snower 1996; Spitz-Oener 2006). However, recent studies (e.g. Autor et al. 2003) suggest that low-skilled labour might be less affected by decreasing demand than some types of medium-skilled labour. In particular, highly standardised medium-skill occupations, such as book- and record-keeping can be more easily substituted by technology than less standardised low-skill jobs, such as cleaning or gardening. Manning (2004) and Goos and Manning (2007) for example, find that some jobs belonging to the

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2 Institute for Employment Research (IAB), Germany, and Hamburg Institute of International Economics (HWWI), Germany.

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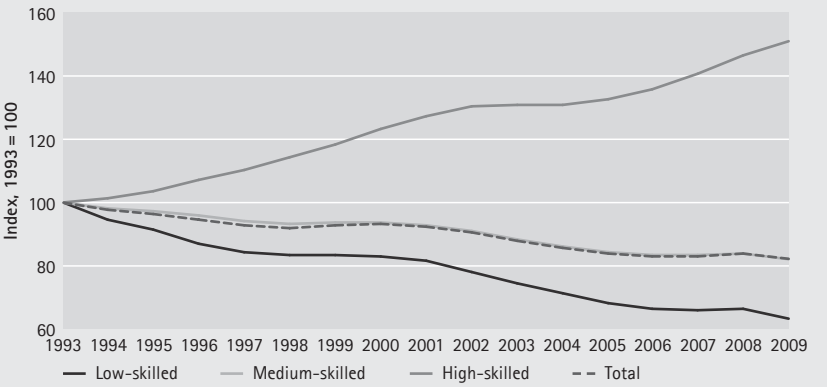
latter type are among the fastest growing occupations in the UK. Similar results are obtained by Spitz-Oener (2006) for Germany.

Figure 1: Skill-Specific Employment Growth[a] in West Germany, in Percent, 1993 to 2006



Notes: [a] The data includes only full-time employees that are subject to social security contributions, as provided by the German Federal Employment Agency.

Table 1: Skill-Specific Employment Growth[a] in West German Planning Regions[b], in Percent, 1993 to 2006

	Total	Low-skilled	Medium-skilled	High-skilled
No. of observations	74	74	74	74
Minimum	–20.3	–48.5	–24.4	19.1
Maximum	14.3	–18.1	19.2	113.8
Median	–3.9	–30.8	–8.8	45.3
Std. deviation	6.4	6.0	7.9	16.8

Notes: [a] The data includes only full-time employees that are subject to social security contributions as provided by the German Federal Employment Agency. [b] There are 74 planning regions as defined by the as defined by the German Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR), which are used here to delimit regional labour markets.

Despite similar institutions and the same macroeconomic environment, the development of skill specific employment varies substantially across regions within highly developed countries. In West Germany, the decrease in regional low-skilled employment has ranged from about one fifth to one half, between 1993 and 2006. During the same period high-skilled employment growth has varied from around 19 to 114 percent, across regional labour markets (see Table 1). Frequently, the local supply of human capital is regarded as a major cause for regional growth disparities. Several studies show that a large share of local high-skilled employment

increases subsequent employment growth (e.g. Glaeser et al. 1995; Simon 1998; Simon and Nardelli 2002; Glaeser and Saiz 2004; Shapiro 2006; Blien et al. 2006). Generally based on the assumption that the productivity of less skilled workers can be positively affected by localised human capital externalities or by complementary relations between different skills, there are numerous analyses investigating the effects of local human capital on the wage levels in different educational groups (e.g. Rauch 1993; Moretti 2004a; Acemoglu and Angrist 2000; Ciccone and Peri 2006; Bacolod et al. 2009). Although complementarities or externalities have a likely impact on skill-specific employment, corresponding empirical evidence is rare (e.g. Südekum 2008; Cordes 2008). An increasing number of local high-skilled workers, for instance, may raise the demand among local services for low-skilled workers, which may be responsible for the phenomenon described by Autor et al. (2003).

Another aspect of qualification specific changes in the labour market that has not received much attention until now is segregation by skill in the production process. Qualification-related structural change affects the internal qualification structure of employment at the firm level. However, rather than merely reflecting the general shift to increasing shares of high-skilled workers in overall employment, several empirical studies also show increasing levels of workplace segregation by skill (e.g. Davis and Haltiwanger 1991; Kremer and Maskin 1996; Kramarz et al. 1996; Stephan 2001; Gerlach et al. 2002). In other words, more and more firms tend to employ predominantly a single specific type of qualification. Thus, labour demand is increasingly divided into firms either hiring predominantly low skills, such as providers of simple services or fast food chains, or knowledge intensive industries and services primarily recruiting high skills. As a consequence, employees tend to work more often with similarly qualified co-workers and less frequently share a common workplace with differently skilled colleagues. Different theoretical models provide a link between qualification related structural changes and workplace segregation by skill (Kremer and Maskin 1996; Acemoglu 1999; Duranton 2004). The models suggest that skill segregation may lead to rising wage inequalities across skill groups and also to absolute wage losses among less skilled employees.

Issues of skill segregation and human capital effects are likely to be closely connected. For instance, workplace segregation by skill may prevent knowledge transfers or other types of human capital externalities to benefit less skilled employees. Moreover, if firms tend to create more and more qualification-specific jobs, this should reduce the degree of substitutability between skills. Hence, there is a likely link between the existence of localised human capital externalities, skill complementarities and segregation by qualification level.

This study investigates the effects of local skill structure and the level of skill segregation on regional employment growth, applying panel data estimations for

74 West German regions between 1993 and 2006. First, the chapter adds to the empirical evidence of local human capital effects on employment growth by different skill levels. Evidence which has thus far been scarce. Secondly, this analysis provides first empirical results on the impacts of segregation on the development of skill-specific employment, focussing in particular on the employment prospects for workers without formal vocational education. Empirical evidence on the possible effects of skill segregation as suggested by theoretical models has been completely lacking thus far. Furthermore, the extent of skill segregation in the production process is assessed at the regional level, which sets this analysis further apart from previous studies investigating skill segregation only at the national level. The results of the analysis show that the local endowment of human capital is an important determinant for skill-specific employment growth in West German regions. There is some evidence for the existence of skill complementarities. The results, however, are not conclusive on that point. Moreover, the findings reveal that high regional levels of skill segregation have a significant negative impact on low-skilled employment growth.

Overall, the analysis relates the literature on skill segregation to the literature investigating human capital externalities and skill complementarities. It is, however, beyond the scope of this analysis to distinguish different effects of human capital on qualification-specific employment or to establish a direct link to skill segregation. Furthermore, this analysis estimates the effects on employment growth rather than on wages. The underlying assumption for doing so is that changes in skill specific productivity levels have an impact on the growth of jobs for the different skill types.[3] This is in line with Duranton (2004) who concludes that increasing levels of skill segregation may spur unemployment of the least skilled by decreasing the productivity levels in that skill group. In particular, this assumption will hold if wages are sticky moving downwards at the lower end of the income distribution. The latter is frequently supposed to be true of labour markets in Continental Europe, which leads many economists to believe that increasing unemployment rates in Continental Europe can be traced back to the same causes (e.g. rising disparities in the skill-specific productivity levels) as the increasing wage inequalities in Anglo-Saxon countries (e.g. Krugman 1994; Freeman 1995).

The rest of the chapter is organised as follows. The next section briefly presents the relevant literature dealing with local human capital externalities, skill complementarities and skill segregation in the production process. The data set is introduced in the third section, and section four discusses the segregation measures used in this chapter and provides a descriptive overview on the spatial pattern of skill segregation in West Germany. The specifications of the empirical

3 Südekum (2006) establishes this link in a theoretical framework, which is based on Moretti (2004a).

model and the estimation results are outlined in section five. Finally, the sixth section concludes the chapter.

2 Local Human Capital and Skill Segregation

2.1 Human Capital Externalities and Skill Complementarities

The local endowment of human capital may affect skill-specific productivity levels and employment growth in different ways. According to Lucas (1988) knowledge spillovers, generated by formal and informal interaction between people, are a possible explanation for persisting differences in the economic development across countries. Empirical studies find that a significant portion of knowledge transfers decrease rapidly in space (e.g. Audretsch and Feldman 2003). Hence, human capital may raise the local level of productivity through localised externalities. Knowledge may transfer from skilled worker to skilled worker, but also between skilled and unskilled workers. Theoretical results obtained by Jovanovic and Rob (1989) or Glaeser (1999) show for example, that spatial proximity between high- and low-skilled workers increases the chances for the latter to learn from the former.

Furthermore, Acemoglu (1996) shows theoretically that the wage level of less skilled workers may be positively affected by pecuniary human capital externalities that arise irrespectively of the existence of knowledge transfers. This result is based on the assumption that human capital and physical capital are complements. Due to asymmetric information between firms and individual workers, an employer cannot precisely assess the individual skill levels of potential workers beforehand. Investments in production technology, however, are made before staffing. As a consequence, firms adapt their production technology to the qualifications available on the labour market. If the share of skilled workers is high firms tend to invest more in production technology. Hence, new and modern production technologies, that are initially implemented to exploit complementarities with human capital, can raise the productivity of less skilled workers as well.

Another possible explanation for a positive impact of local human capital on wages and employment prospects of less skilled workers is a complementary relation between different skills in the production process. According to simple supply and demand side considerations, the relative supply of imperfectly substitutable production factors determines their marginal productivity. Hence, if high-skilled workers are locally abundant, less skilled workers are relatively scarce, which brings them higher pay than identically skilled workers in a less skilled region (e.g. Moretti 2004a; Südekum 2008).

There are several studies investigating the effects of human capital on local labour markets. Most of these analyses estimate the effects of local high-skilled employment on qualification specific wages.[4] Some studies, such as Rauch (1993) find significantly positive effects on wages. Moretti (2004a) found both, spillovers and skill complementarities, to be relevant for skill-specific wage levels. In contrast, the results obtained by Acemoglu and Angrist (2000) or Ciccone and Peri (2006) suggest that the impact of local human capital is rather weak. Until now, there is only little evidence on the effects of local human capital on skill-specific employment growth. Südekum (2008) estimates the effect of the share of high-skilled employment on qualification-specific employment growth in West German regions. He finds that the percentage of workers with tertiary education has a positive effect on low- and medium-skilled employment growth, but not on the employment growth of the highly-skilled. Südekum concludes because of the latter result that skill complementarities are more important than knowledge spillovers. As another exception Cordes (2008) investigates the determinants of employment growth in different occupational groups across West German regions. His findings point to existing complementarities between occupational groups. These findings are in line with Poelhekke (2009) who analyses the effects of different skill groups on regional overall employment in Germany. According to his results the interaction of different skill groups may enhance local productivity and overall employment growth.

Overall, most studies that investigate the impact of human capital on regional employment growth do not differentiate the growth variable into different qualification levels. Analyses that consider different skill levels tend to focus on wages, but do not take the possible influences on skill-specific employment prospects into account.

2.2 Human Capital, Skill Segregation and Employment Growth

There are different theoretical approaches that link rising levels of skill segregation to increasing inequalities in qualification-specific employment prospects (e.g. Kremer and Maskin 1996; Acemoglu 1999; Duranton 2004). While skill segregation may raise the productivity among skilled workers, it may negatively impact the productivity level at the lower end of the skill distribution. Although the mechanisms differ substantially, the models have a few characteristics in common: skill segregation in highly developed countries is closely related to the proceeding

4 A more detailed overview of literature dealing with the effects of local human capital on skill-specific wages is provided for example, by Moretti (2004b), Duranton (2006) or Halfdanarson et al. (2008).

internationalisation of labour markets, technological and organisational changes as well as the skill structure in the labour supply.

Kremer and Maskin (1996) propose a model that accounts for a simultaneous increase in skill segregation and wage inequality between qualification groups, and also for an absolute decline in low-skill wages. Therefore, the model offers skill segregation as a reasonable explanation for the development of qualification-specific wage levels, as documented for example by Katz and Murphy (1992) for the U.S. labour market. The model is based on matching complementarities between pairs of workers that join to perform specific tasks. A firm is characterised by different tasks that are complementary on the one hand, but simultaneously require different skills on the other. Hence, different skills within a firm are not perfectly substitutable. While the complementary relation of tasks promotes joint work processes involving workers from different skill groups, the asymmetry of qualification requirements between the tasks favours segregated work processes. Whether the tasks within a firm are accomplished by a team consisting of similar or dissimilar qualification types depends on the degree of asymmetry between the tasks and on the heterogeneity of the firm's skill structure. An increasing level of skill segregation can be released by a rising dispersion of skills within the pool of labour available to firms and by increasing differences in the skill requirements that are needed to perform the tasks. Kremer and Maskin (1996) furthermore argue that pressures for more equal pay across skill groups are higher within firms than between firms. As a consequence, this may reduce the output of firms with heterogeneous skill structures and may cause high-skill workers to sort themselves into segregated firms, increasing the level of workplace segregation through skill and qualification-specific wage inequalities.

The model from Kremer and Maskin (1996) requires an increasing dispersion in the skill distribution on the labour market. By contrast, an absolute increase in the supply of high-skills is sufficient to promote skill segregation in the models developed by Acemoglu (1999) and Duranton (2004). Acemoglu (1999) proposes a search theoretic model where human capital is assumed to be complementary to physical capital. Firms are not able to assess precisely the skills of potential employees beforehand because of information asymmetries. Hence, they adapt the production technology to the skills available in the labour market pool. When the supply of high skills and the dispersion of skills in the distribution are relatively low, firms tend to create jobs that are suitable for a large range of skill types. While strong differences in qualification levels make it easier for firms to distinguish individual skill levels, a large share of human capital raises the probability that a firm will employ a high-skilled person. Hence, when the probability that a high-skilled person will be hired increases, more and more firms tend to direct

investments into technologies suitable only to more qualified workers. This leads to the exclusion of low-skilled workers from modern production technologies and processes. Thus, compared to a company employing various qualification levels, low-skilled workers in segregated firms may suffer even absolute wage losses while the productivity of high skills increases.

Duranton (2004) also assumes skills and technology to be complements. Each firm produces a good of a distinct quality and is either a supplier to other firms or a final good producer. Supply firms and the final good producer form a vertical production system. Given that the qualities of the intermediate and final good have to comply, it is the final good producer that determines the quality standard in a production system. Furthermore, the grade of the produced good determines the complexity of the production technology and, therefore, the type of qualification that is required for producing this good. Hence, aggregate production in an economy comprises vertical production systems that differ by the complexity of the production process and the workers' skill level. There are two opposing forces working for or against segregation into production systems. On the one hand, productivity gains by specialising on high-quality products are disproportionately high because of the complementary relationship between physical and human capital. On the other hand, thick-market externalities that arise through a relatively large variety of intermediate goods supplied in large production systems work against segmentation. If the supply of highly skilled workers is comparatively high, the relative importance of the thick-market externality declines and the incentives for firms to produce goods of a higher quality increase. Thus, with a rising share of human capital there is an increasing probability of total production to be segmented into vertical production systems that differ by the qualification levels of employees and the corresponding level of technology. Duranton (2004) argues that the crucial mechanism in the model is one of biased-technical change. Due to less modern production techniques, the productivity in low-skill production systems is likely to fall below the pre-segmentation level. The model allows for the coexistence of several production systems comprising various skill levels. The least skilled production system may vanish when its productivity level falls below the reservation wage, and the least skilled workers are released into unemployment.

All three models introduced above share the conception that changes in the qualification structure may generate segregation by skill, which may lead in turn to rising wage inequalities across skill groups and even to absolute wage losses among less skilled employees. As a consequence it is likely that increasing levels of workplace segregation by skill affect employment levels at the lower end of the skill distribution, via declining productivity among the low-skilled. There are several studies documenting increasing levels of skill segregation in highly

developed economies, such as the US, France or Germany (Davis and Haltiwanger 1991; Kremer and Maskin 1996; Kramarz et al. 1996; Stephan 2001; Gerlach et al. 2002). However, although the theoretical results point to a possible influence of skill segregation on qualification-specific productivity and employment, corresponding empirical evidence is still lacking. Since workplace segregation by skill may prevent knowledge transfers or other types of human capital externalities to benefit less skilled employees, there are likely links between localised knowledge spillovers, pecuniary externalities or skill complementarities, and skill segregation. It is, however, beyond the scope of this analysis to investigate these links in detail.

3 Data

This study investigates qualification-specific employment growth in West German regions from 1993 to 2006. Due to the specific economic development in East Germany during the transition process after reunification, and because of structural differences in skill levels that were inherited from the different educational systems in the formerly separated states, East German regions are excluded from this analysis. Overall, the cross-section comprises 74 planning regions[5] in West Germany. Planning regions are functional areas that comprise several counties (NUTS-3 regions) and are defined mainly on the basis of commuting patterns. Hence, planning regions provide a suitable delimitation of labour market areas including most relevant processes for the purpose of this investigation such as job search, recruitment of workers and adjustment of production technology to skill-specific labour supply.

Regional employment growth is differentiated according to three levels of education: un- or low-skilled (no formal vocational qualification), medium-skilled (completed apprenticeship) and high-skilled (university degree). This is a frequently applied classification of skill levels in German employment data. The categories, however, may differ with the skill groups used for other countries. The so-called dual education system in Germany, which combines formal schooling and on-the-job training, may generate a relatively high number of highly skilled employees who do not hold a university degree. Furthermore, university degrees in Germany (Diplom) generally correspond to a master's rather than to a bachelor's level.[6] Therefore, the high-skilled in Germany represent a slightly more specific type of human capital than, for example, college degrees in the United States.

5 Planning regions ("Raumordnungsregionen") as defined by the German Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR).

6 Bachelor and Master degrees have been introduced only very recently to German universities, and did not yet exist in the time period observed for this chapter.

The employment data used in this analysis were taken from the official employment statistics of the Federal Employment Agency, which covers the full population of employees subject to social security contributions. The data are highly reliable and refer to workplace location. However, the statistic does not cover civil servants or self-employed persons. Moreover, the employment statistics provide information for several explanatory variables included in this analysis, such as the regional sector composition and firm-size structure of employment as well as further regional employment characteristics, i.e. wage levels, gender and age structures that are additionally applied to compute wage levels, adjusted to the characteristics of the regional labour force.

In this study the regional level of skill segregation is assessed using a measurement based on the formal qualification of workers and their distribution across workplaces. For this purpose, the Establishment History Panel from the Institute for Employment Research (IAB) offers annual firm level data on employment by educational attainment. The dataset contains detailed information on all establishments in Germany, with at least one employee liable to social security from 1993 to 2005. Applying a regional identifier, the information on establishments is aggregated to the regional level.

In order to control for effects arising from the rapidly growing number of marginal part-time workers, we include only full-time employees in our analysis. Furthermore, all employees that have not been assigned to an educational level were excluded from our dataset. Finally, due to changes in the statistical recording of firms' affiliations to sectors, the information on the sector structure had to be backdated from 1998 to earlier years. As a consequence, the data on the regional sector structure in the years prior to 1998 is only an approximation. Changes in the regional employment structure by branches during that period might be underestimated. Therefore, the regression analysis was additionally conducted on a data subset constraining the observation period to the years following 1998.

4 Skill Segregation

4.1 Measuring Skill Segregation

In the literature, various measures of segregation by skill are applied. Frequently, the wage dispersion between and within firms serves as an indicator for skill segregation (e.g. Davis and Haltiwanger 1991; Kremer and Maskin 1996; Kramarz et al. 1996). In this study, however, a more direct measurement of skill segregation via the formal qualification of workers is preferred. More

precisely, the measure shall assess the degree of workplace segregation between skilled and unskilled workers, i.e. workers with and without formal vocational education. Economic and sociological literature provides different measures for group-specific segregation.[7] This analysis applies two different segregation measures: the so-called Duncan index and the co-worker index. The Duncan index, also called the index of dissimilarity, was introduced by Duncan and Duncan (1955) and is frequently used in the literature as a measure for group-specific segregation:

$$D_r = 0.5 * \sum_i \left| \frac{N_{ir}^u}{N_r^u} - \frac{N_{ir}^s}{N_r^s} \right|, \; 0 \leq D_r \leq 1 \tag{1}$$

where N_{ir}^u (N_{ir}^s) denotes the number of full-time unskilled (skilled) employees in plant i and region r. The Duncan index D_r gives the proportion of low-skilled employees that has to be redistributed among plants in order to get identical shares of unskilled and skilled employees in each firm i in region r. Thus, in the case of "no segregation" the Duncan index is equal to zero. In contrast, a value of one indicates complete segregation.

The co-worker index, introduced by Hellerstein and Neumark (2008), assesses the extent to which unskilled workers are more likely than skilled workers to share a common workplace with other unskilled workers. The co-worker index C_r is defined as the difference between the so-called isolation index I_r and the exposure index E_r:

$$\begin{aligned} C_r &= I_r - E_r, \text{ where } I_r = \frac{1}{N_r^u} \sum_i \frac{N_{ir}^u - 1}{N_{ir}^u + N_{ir}^s - 1} * N_{ir}^u \\ &\text{and} \quad E_r = \frac{1}{N_r^s} \sum_i \frac{N_{ir}^u}{N_{ir}^u + N_{ir}^s - 1} * N_{ir}^s \end{aligned} \tag{2}$$

The isolation index equals the average percentage of unskilled employees among the co-workers of an unskilled employee, while the exposure index equals the average percentage of unskilled employees among the co-workers of a skilled employee.

The difference between the Duncan index and the co-worker index most relevant to this analysis, is that the former is scale invariant while the latter is not. In other words, the Duncan index is insensitive to changes in the regional skill structure, while the co-worker index is affected by a shift in regional skill shares even if the skill distribution across firms remains constant. It can be argued that changes in the relative group size matter for the degree of segregation

7 See, for example, Flückiger and Silber (1999) for an overview and discussion of different segregation measures.

irrespective of the distribution across firms. For instance, it might be reasonable to argue that a doubling in the number of skilled employees in the labour force while maintaining the number of unskilled employees constant increases the segregation level of unskilled employees. Following this argument, the co-worker index is the more appropriate to assess the degree of skill segregation. However, there are likely structural differences in the changes of the regional skill composition. Agglomerated areas for example, are likely to attract comparatively more human capital than rural areas. In order to exclude such effects, the Duncan index is applied as an alternative measure.

Both measures assess group-specific segregation, i.e. the workplace segregation of unskilled and skilled workers. In the following, we use two different notions for the term "skilled worker" in our segregation measure. The first one includes only the high-skilled (university degree) and the second one includes all employees that have received a professional degree (medium- and high-skilled). Hence, the following two variants of segregation are assessed in this study:

Variant 1: Segregation between unskilled and high-skilled employees;
Variant 2: Segregation between unskilled and the rest of all other employees.

The first variant is applied in order to find out whether skill segregation takes place between the bottom and the top end of the skill distribution, i.e. when the discrepancy between educational levels is relatively high. However as mentioned, in Germany where a university degree generally correspond to an MA, the high-skilled represent a more specific type of human capital. Hence, the relevance of joint work processes including academically skilled and unskilled workers on the German labour market may be rather limited. In addition, the dual education system's combination of formal schooling and on-the-job training produces a large number of highly skilled employees without university degrees. In general, though their classification as a group comprises a wide range of skills, the classification of workers with completed apprenticeships (medium-skilled), represents a very heterogeneous skill level. Overall, the importance of cooperation between university graduates and unskilled workers in the production process may be low compared to the joint work of less diverse skill groups, as for example an unskilled and a supervising craftsman or a technician. Therefore, the second variant of our segregation measure aims at investigating whether skill segregation is characterised by a decoupling of unskilled workers from all other workers in the production process.

Overall, there are four alternative segregation measures applied in this analysis: the Duncan index and the co-worker index, each applying two different understandings of skilled workers (Variant 1 and Variant 2), respectively.

4.2 Skill Segregation in West German Regions

Table 2 displays the levels of skill segregation computed with the four alternative segregation measures in West Germany, both as a whole and differentiated by area types, with regard to the settlement structure from 1993 to 2005.[8] Unsurprisingly, the level of skill segregation between unskilled and high-skilled workers (Variant 1) is higher than in the case of Variant 2 (between unskilled all other workers). This applies to the Duncan as well as to the co-worker index.

Table 2: Skill Segregation by Settlement Structure in West Germany, in 1993 and 2005

	Variant 1 (low- vs high-skilled)		Variant 2 (low-skilled vs all others)	
	1993	2005	1993	2005
Duncan index				
overall	0.718	0.747	0.534	0.574
agglomerated areas	0.713	0.749	0.534	0.579
urbanised areas	0.708	0.739	0.532	0.569
rural areas	0.712	0.723	0.530	0.559
Co-worker index				
overall	0.504	0.558	0.247	0.250
agglomerated areas	0.515	0.568	0.246	0.254
urbanised areas	0.469	0.533	0.248	0.248
rural areas	0.425	0.478	0.240	0.231

In the case of Variant 1, firms are more specialised in the employment of either high- or low-skilled workers in 2005 than they are in 1993. As for the second variant of skill segregation, this same increase appears in the Duncan index, but is evident to a lesser extent in the co-worker index, which indicates a fairly constant level of segregation. Overall, however, these results are all in line with previous findings on the increasing levels of segregation by skill in developed economies. Hence, differently skilled workers, in particular high- and low-skilled employees, tend more and more to work in different firms rather than share a common workplace.

8 The typology of settlement structure (agglomerated, urbanized and rural areas) is based on the criteria population density and size of the regional centre and has been developed by the Federal Office for Building and Regional Planning (BBSR). For details see URL: http://www.bbr.bund.de/raumordnung/europa/download/ spesp_indicator_description_may2000.pdf.

Distinguishing skill segregation by settlement structure reveals some differences between metropolitan, urbanised and rural areas. In both variants, the Duncan index shows similar levels across region types in 1993. However, the subsequent development of skill segregation in the production process is marked by increasing disparities across different area types. In both variants, the Duncan index indicates the lowest increases being in rural areas and the greatest coming in metropolitan areas. According to the co-worker index, which is sensitive to relative changes in the skill shares of employment, agglomerated areas exhibit somewhat higher, and rural areas slightly lower, levels of skill segregation than urban areas in 1993 and 2005.

Regarding segregation levels across planning regions, all alternative measures are subject to significant variation across regions. Table 3 shows the mean, the standard deviation as well as the three top and bottom levels of regional skill segregation for the four alternative measures in 2005. The regions Ingolstadt and Oldenburg are amongst the three top end regions, while Braunschweig and Main-Rhön belong to the three regions at the bottom end in all four cases, respectively. In Braunschweig, for example, 57 percent of the low-skilled would have to be redistributed to other firms in order to get identical shares of high- and low-skilled employees at each firm. In Oldenburg by contrast, 84 percent of unskilled workers would have to swap their workplace with high-skilled workers in other firms. In terms of the co-worker index, it is nearly twice as likely that low-skilled workers share a common workplace with other low-skilled workers in Ingolstadt as compared to low-skilled workers in Main-Rhön. The ranges between top and bottom levels of regional segregation are about equal in both the Duncan and the co-worker index, calculated on the basis of Variant 2, i.e. segregation between the low-skilled and all other employees.

According to Spearman's rank correlation coefficient, there is a pronounced positive relationship between all pairs of the alternative indices (see Table 4). Thus, in most cases, regions that are marked by a relatively high segregation level according to one measure exhibit relatively high levels using the alternative measures as well. The same is equally true for regions marked by low segregation; they tend to be marked by low levels in both indexes, parallel to one another.

Table 3: Skill Segregation in West German Regions, 2005

	Duncan index		Co-worker index	
Variant 1 (low- vs high-skilled)				
mean		0.736		0.522
std. deviation		0.046		0.059
top 3				
1.	Oldenburg	0.837	Ingolstadt	0.665
2.	Ingolstadt	0.836	Oldenburg	0.641
3.	Hamburg-Umland-Süd	0.820	Bonn	0.618
bottom 3		...		...
72	Landshut	0.639	Landshut	0.407
73.	Main-Rhön	0.586	Braunschweig	0.399
74.	Braunschweig	0.567	Main-Rhön	0.364
Variant 2 (low-skilled vs all others)				
mean		0.569		0.241
std. deviation		0.041		0.036
top 3				
1.	Ingolstadt	0.685	Osnabrück	0.335
2.	Hamburg-Umland-Süd	0.655	Oldenburg	0.331
3.	Oldenburg	0.653	Ingolstadt	0.324
bottom 3		...		...
72	Main-Rhön	0.474	Göttingen	0.183
73.	Landshut	0.452	Main-Rhön	0.178
74.	Braunschweig	0.440	Braunschweig	0.143

Table 4: Rank Correlation Between Pairs of Segregation Measures

		Variant 1 (low- vs high-skilled)		Variant 2 (low-skilled vs all others)	
		Duncan	Co-worker	Duncan	Co-worker
Variant 1	Duncan	1.00	0.82	0.82	0.58
	Co-worker	0.82	1.00	0.68	0.67
Variant 2	Duncan	0.82	0.68	1.00	0.67
	Co-worker	0.58	0.67	0.67	1.00

Figures 2 and 3 present the regional distribution of segregation levels in 2005. Apart from a few planning regions, the spatial pattern of skill segregation is quite similar in all four cases. Regardless, the variant of skill segregation and the measurement applied segregation levels are relatively high in the north and in the west of West Germany. Along the eastern and southern boundaries, the degree of skill segregation tends to be comparatively low. Overall, the results indicate that regions in West Germany are marked by pronounced disparities in the level of skill segregation.

Figure 2: Regional Levels of Segregation Between Low-Skilled and High-Skilled Employees

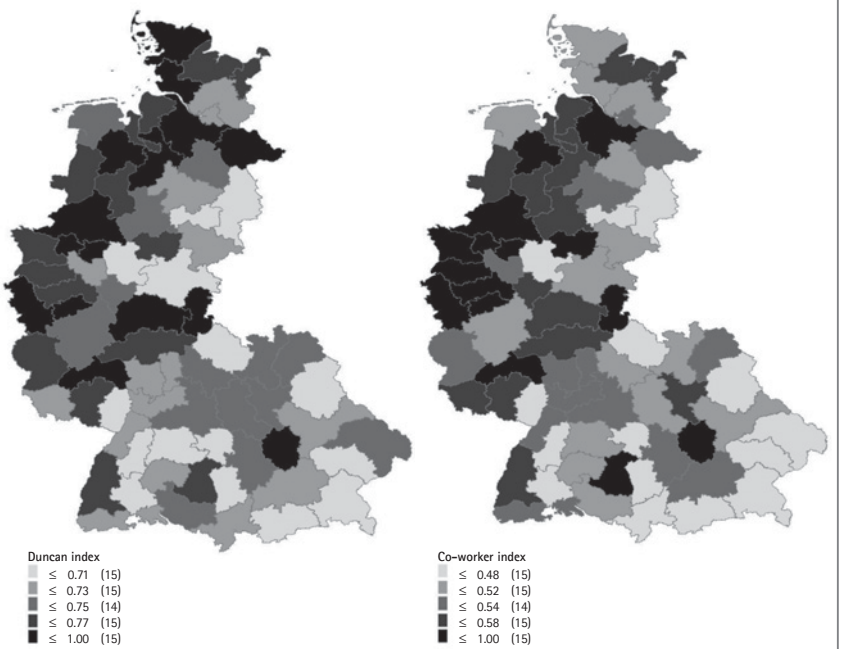
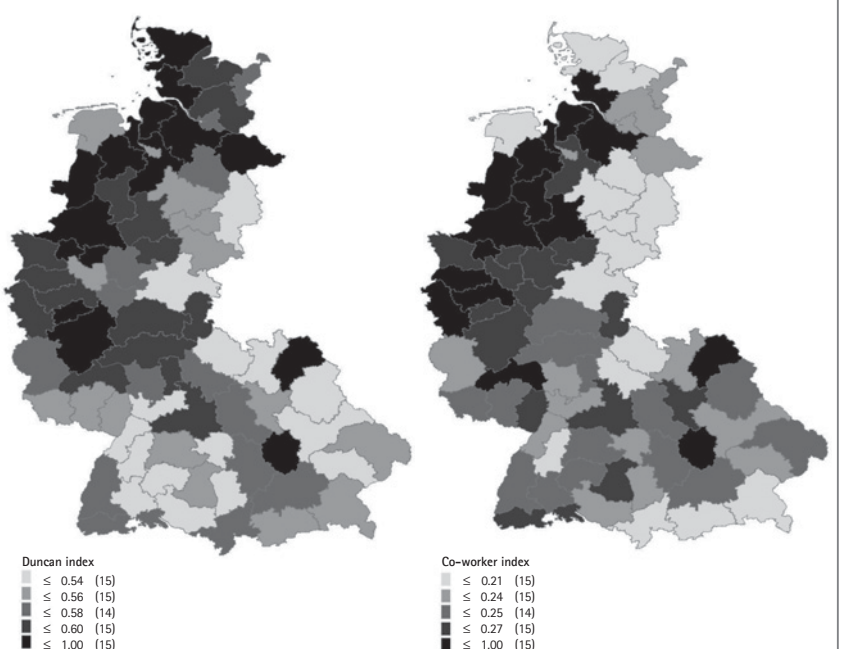


Figure 3: Regional Levels of Segregation Between Low-Skilled and All Other Employees



5 Regression Model

5.1 Specification

For estimation purposes, a panel set up including observations of 74 West German planning regions over a period of 13 years is applied. This allows for time-invariant region-specific effects to be controlled for. Applying a fixed effects panel approach reduces the omitted variable bias problem, caused by unobserved region-specific characteristics that correlate with employment growth. The impact of the local abundance of human capital and the level of skill segregation on qualification-specific employment growth is investigated by estimating the following regression model:

$$\frac{N_{ert} - N_{er(t-1)}}{N_{er(t-1)}} = \alpha + \sum_{e=1}^{3} \beta_e Q_{er(t-1)} + \gamma S_{r(t-1)} + \sum_{z=1}^{Z} \delta_z X_{zr(t-1)} + \tau_t + \kappa_r + \varepsilon_{ert} \qquad (3)$$

The term on the left hand side represents skill-specific employment growth, where N_{ert} denotes the number of employees with educational level e (=unskilled, medium-skilled or high-skilled) in region r and year t. Equation 3 is estimated for each specific skill group separately. The explanatory variables of central interest in this analysis are the employment shares by the skill level $E_{er(t-1)}$ entering simultaneously in each regression, and the level of skill segregation $S_{r(t-1)}$, which is approximated by the alternative measures (the Duncan index and the co-worker index computed for Variants 1 and 2, respectively), in turn. Furthermore, the model includes a set Z of additional control variables $X_{zr(t-1)}$ as well as a period dummy τ_t and a region dummy κ_r. The random error term is represented by ε_{ert}.

The set of additional control variables comprises the regional sector and firm-size structure as well as a neutralised level of local wages.[9] The local firm-size structure enters into the model as the regional employment shares that small (less than 50 employees), medium (50 to 249 employees) and large (250 and more employees) firms hold of the overall regional employment. Furthermore, the regional sector structure is controlled by the inclusion of the regional employment shares of 26 different sectors.

The neutralised wage levels represent the residuals obtained from cross-sectional regressions of the (log) wage level in each year based on several characteristics of the regional workforce, including the employment structure with respect to skills,

9 These factors are found to be influential on regional employment growth for example by Möller and Tassinopoulos (2000), Blien et al. (2003) or Südekum et al. (2006).

sectors, firm-sizes, part-time positions, age and gender as well as the number of employees per square kilometre. The latter variable was included to control for structural differences in wage levels or the costs of living between agglomerated regions and less densely populated areas. The residuals can be interpreted as deviation from the expected wage level given by the local characteristics of the work force. Therefore, the neutralised wage levels are adjusted for region-specific features of the workforce and characteristics of the regional economy.[10]

Two specific problems arise in the estimation of Equation 3. The first one concerns the heterogeneity in the sizes of the observation units, and hence their relative importance for average growth rates. Since the employment levels differ substantially across regions, the same absolute change in employment implies very different changes in employment growth rates. Furthermore, slight absolute change may boost employment growth in small regions inducing model inherent heteroscedasticity. To circumvent this problem, Equation 3 is estimated with weighted least squares (WLS) using the square root of the regional employment shares as weights:[11]

$$w_{ert} = \sqrt{\frac{N_{ert}}{N_{et}}} \tag{4}$$

The second problem in the estimation of Equation 3 extends from the interpretation of the skill-specific employment shares' estimated effects on regional employment growth. As the shares add up to one, the inclusion of all shares would lead to perfect multicollinearity. Commonly, one reference category is left out and the coefficients of the included share variables show the effects in relation to the reference variable. Measuring the effects in reference to an arbitrarily omitted category would not provide a feasible interpretation for the purpose of this study. Applying the following identifying linear constraint on the coefficients, β_1 to β_3 can be interpreted as the effects of the regional deviation of the employment shares to the average employment shares of the respective skill groups over all regions and periods:[12]

$$\sum_{e=1}^{3} \frac{N_{er}^{T}}{N_{e}^{T}} \beta_e = 0 \tag{5}$$

10 A similar procedure was applied, for example, by Südekum and Blien (2007) and Südekum et al. (2006).

11 A similar approach is discussed in more detail by Möller and Tassinopoulos (2000) or Südekum et al. (2006).

12 A similar approach is discussed in more detail by Möller and Tassinopoulos (2000) or Südekum et al. (2006).

where N_{er}^{T} and N_{e}^{T} denote the average employment level by skill group *e*, in region *r* and West Germany, respectively, over the observed period *T*. This method represents a normalisation where the sum of the weighted coefficients equals zero, which does not affect the other estimators.[13]

As outlined above, changes in the sector composition might be underestimated due to data restrictions for the years before 1998. Furthermore, it might be appropriate to estimate Equation 3 for a sub-period in order to check for the stability of the estimated effects over time. In 1998 overall employment started to rise again after a decline over several years. Thus, it seems reasonable that the regressions be applied to the full time period from 1993 to 2006 and another shorter time period from 1998 to 2006.

Since regional employment growth may be affected by the economic development of neighbouring regions, the assumption of independence between the observation units might be invalid. Significant spatial dependence that is not considered in the model leads to inefficient estimates if spatial autocorrelation is restricted to the error term (spatial error dependence), or inefficient and biased estimates if there is direct spatial interaction in the endogenous variable (spatial lag dependence).[14] When using functional planning regions though, the occurrence of spatial dependence is less likely. However, the issue of spatial autocorrelation is accounted for using further robustness checks.

5.2 Results

A summary of the most important results obtained by estimating Equation 3 is presented in Tables 5 and 6. The tables include both estimation results, comprising the time period from 1993 to 2006 (upper part), as well as the shorter range from 1998 to 2006 (lower part). Only the coefficients of the pivotal variables, i.e. the skill group shares and the segregation measures, are presented in the tables.[15] The columns of the table refer to separate models for low-, medium- and high-skilled employment growth as dependent variables.

13 Similar restrictions are applied to the shares of firm-sizes and sectors, though the interpretation of the corresponding coefficients is not subject to this analysis.

14 See, e.g., Anselin (1988) for details.

15 See Table A1 in the appendix for a more complete table of the estimation results including the coefficients for the remaining control variables. For presentation purposes the table shows only the results including Variant 1 of the Duncan index.

Table 5: Estimation Results Including Variant 1 (low- vs high-skilled)

	High-skilled		Medium-skilled		Low-skilled	
Including years from 1993 to 2006						
Share of high skills	−0.270 *	−0.282 *	0.253 **	0.268 **	0.501 **	0.428 **
	(.0121)	(0.121)	(0.071)	(0.071)	(0.128)	(0.128)
Share of medium skills	0.174 **	0.172 **	−0.039 *	−0.042 *	0.27 **	0.281 **
	(0.035)	(0.036)	(0.018)	(0.018)	(0.033)	(0.033)
Share of low skills	−0.449 **	−0.437 **	0.017	0.02	−1.095 **	−1.097 **
	(0.117)	(0.118)	(0.059)	(0.060)	(0.107)	(0.108)
Duncan index	−0.043	–	0.038 *	–	−0.178 **	–
	(0.036)		(0.019)		(0.034)	
Co-worker index	–	−0.014	–	0.03	–	−0.141 **
		(0.031)		(0.016)		(0.029)
No. of observations	962	962	962	962	962	962
[a] R^2-adjusted	0.83	0.83	0.86	0.86	0.89	0.89
Including years from 1998 to 2006						
Share of high skills	−1.48 **	−1.486 **	−0.108	−0.09	0.529 *	0.427
	(0.195)	(0.196)	(0.125)	(0.125)	(0.228)	(0.228)
Share of medium skills	0.421 **	0.413 **	−0.006	−0.016	0.417 **	0.454 **
	(0.054)	(0.056)	(0.031)	(0.031)	(0.056)	(0.057)
Share of low skills	−0.722 **	−0.694 **	0.066	0.091	−1.583 **	−1.659 **
	(0.187)	(0.190)	(0.105)	(0.106)	(0.192)	(0.193)
Duncan index	−0.061	–	0.021	–	−0.241 **	–
	(0.056)		(0.031)		(0.058)	
Co-worker index	–	−0.012	–	0.034	–	−0.203 **
		(0.041)		(0.023)		(0.042)
No. of observations	592	592	592	592	592	592
[a] R^2-adjusted	0.86	0.86	0.89	0.88	0.87	0.87

Notes: ** significant at the 0.01 level; * significant at the 0.05 level. Standard errors in parentheses;
[a] The reported R^2 is obtained by estimating Equation 3 without imposing linear restrictions as described in Section 5.1, since estimations including such constraints do not yield the standard R^2.

Table 6: Estimation Results Including Variant 2 (low-skilled vs all others)

	High-skilled		Medium-skilled		Low-skilled	
Including years from 1993 to 2006						
Share of high skills	−0.282 *	−0.275 *	0.252 **	0.254 **	0.478 **	0.477 **
	(0.121)	(0.122)	(0.070)	(0.071)	(0.129)	(0.130)
Share of medium skills	0.166 **	0.168 **	−0.042 *	−0.033	0.256 **	0.237 **
	(0.035)	(0.035)	(0.018)	(0.018)	(0.033)	(0.032)
Share of low skills	−0.417 **	−0.426 **	0.027	−0.004	−1.038 **	−0.976 **
	(0.118)	(0.116)	(0.059)	(0.058)	(0.108)	(0.106)
Duncan index	0.019	–	0.063 *	–	−0.129 **	–
	(0.051)		(0.025)		(0.047)	
Co-worker index	–	−0.02	–	0.042	–	−0.107 *
		(0.055)		(0.028)		(0.052)
No. of observations	962	962	962	962	962	962
[a] R^2-adjusted	0.83	0.83	0.86	0.86	0.88	0.87
Including years from 1998 to 2006						
Share of high skills	−1.48 **	−1.48 **	−0.108	−0.107	0.532 *	0.514 *
	(0.195)	(0.195)	(0.124)	(0.125)	(0.228)	(0.229)
Share of medium skills	0.395 **	0.408 **	−0.013	−0.002	0.421 **	0.369 **
	(0.055)	(0.053)	(0.031)	(0.030)	(0.056)	(0.055)
Share of low skills	−0.64 **	−0.679 **	0.089	0.052	−1.595 **	−1.419 **
	(0.189)	(0.184)	(0.105)	(0.103)	(0.193)	(0.188)
Duncan index	0.057	–	0.052	–	−0.246 **	–
	(0.063)		(0.034)		(0.063)	
Co-worker index	–	−0.012	–	0.029	–	−0.286 **
		(0.075)		(0.042)		(0.078)
No. of observations	592	592	592	592	592	592
[a] R^2-adjusted	0.86	0.86	0.88	0.88	0.87	0.87

Notes: ** significant at the 0.01 level; * significant at the 0.05 level. Standard errors in parentheses;
[a] The reported R^2 is obtained by estimating Equation 3 without imposing linear restrictions as described in Section 5.1, since estimations including such constraints do not yield the standard R^2.

The results show that when a specific skill group enjoys a large regional share of employment, job growth in that skill group tends to be reduced significantly. Over the whole period from 1993 to 2006 this applies to each of the three qualification levels. With regards to the shorter time period, only the corresponding coefficient of the medium-skilled workers is insignificant. Overall, this is in line with the skill complementarities found by Südekum (2006, 2008), Cordes (2008) and Poelhekke (2009). The negative impact of a high share of human capital on high-skilled employment growth suggests that human capital externalities among the high-skilled might not be strong enough to outweigh the neoclassical supply effect. This effect might emerge because high-skilled workers are less productive in regions where they are relatively abundant. Hence, there is no process of regional concentration of human capital. Südekum (2008) also came to this result in investigating skill-specific employment growth across West German districts (NUTS-3 level regions). This results is in contrast to the divergence tendency in the United States, that was found for example by Berry and Glaeser (2005).

Furthermore, the results indicate that the development of low-skilled employment is positively affected by the presence of more qualified employees. Large employment shares of medium- and high-skilled workers have a significantly positive impact on low-skilled employment growth. This result is consistent with both time periods.[16] There is some evidence against pronounced complementarities between skills, as the impact of a high share of unskilled employment is significantly negative on high-skilled and insignificant on medium-skilled employment growth. Furthermore, the relative regional abundance of university graduates has no significant effect on the growth of the number of medium-skilled employees in the shorter time period. Yet it is difficult to identify whether the positive influence of skilled labour on the development of low-skilled employment is due to knowledge transfers, pecuniary externalities or complementary relations between different skills as described by Moretti (2004a).

The results presented in Tables 5 and 6 clearly demonstrate that skill segregation in the production process matters for the development of low-skilled employment. In both periods under consideration, the coefficients of the alternative segregation measures are statistically significant and negative. Hence, skill segregation negatively impacts low-skilled employment growth. According to the estimation results for the complete time period, an increase in the regional level of workplace

16 An increase in the share high-skilled employment by one percentage point raises regional low-skilled employment growth by about 0.5 percentage points in both estimation periods. The corresponding effects of the share of medium-skilled employment amount to around 0.25 percentage points in the complete and to around 0.4 percentage points in the shorter estimation period.

segregation by one standard deviation (Duncan index) reduces growth of low-skilled employment in both variants by about 0.8 percentage points.[17]

Overall, the positive effects of local human capital on low-skilled employment are dampened when low-skilled employees tend to work apart, i.e. are separated by workplace, from more skilled colleagues. Since, to my knowledge the regional level of skill segregation has not been empirically tested as a determinant for employment growth so far, this results presents a novelty in the economics literature. Considering the existence of these effects, the role of local human capital and the specialisation of production on specific skills becomes a slightly different notion with regards to the effects on low-skilled employment growth.

The estimation results do not reveal any notable effects between workplace segregation by skill and the employment prospects of more qualified workers. All estimated effects of skill segregation on high-skilled employment growth are insignificant. Medium-skilled employment growth is only significantly affected (0.05 level) when applying the Duncan index in the estimation on the complete time period. The theoretical results presented above also imply that skill segregation has an increasing impact on the wage level of more qualified workers. This may be due to increased complementarities between human and physical capital (Acemoglu 1999; Duranton 2004), or because of matching complementarities (Kremer and Maskin 1996). Alternatively, skill segregation might also lead to more intensified knowledge spillovers among high-skilled workers. However, if skill segregation promotes the productivity of more skilled workers, it does not seem to translate into employment growth.

In addition to the estimation of the effects for two different time periods, further robustness checks were also conducted. The estimation results have been checked for the presence of spatial autocorrelation and for influential observations (leverage points) combining a relatively small or large growth rate with outlying values for one of the pivotal explanatory variables. In order to control for the latter, I used a procedure where Equation 3 was repeatedly estimated, with successive observations being left out. The results of this procedure closely match the estimates previously presented. There is therefore no observation that exerts a particularly large influence on the estimates.[18]

In order to check for specification errors caused by spatial autocorrelation, Moran's I coefficient is applied on the residuals obtained by estimating Equation 3. Therefore, a spatial weights matrix was applied, which was supposed to capture

17 With respect to the co-worker index, the reduction by one cross-sectional standard deviation decreases low-skilled employment growth by about 0.5 percentage points in the case of Variant 1, and 0.4 percentage points in the case of Variant 2.

18 The results of the auxiliary estimations can be obtained upon request from the author.

the structure of spatial dependence. The weights matrix used for the calculation of Moran's I coefficients depicts whether regions have a common border or not, which is a frequently used approach (e.g., Rey and Montouri 1999). Thus, verification is made on whether the residuals of neighbouring regions are more similar than those of non-neighbouring regions.[19] The calculated I coefficient is significant in only a very few cases. For example, Table 7 shows Moran's I, calculated on the basis of the cross-sectional residuals applying the Duncan index (Variant 1) as a segregation measure.[20] Only two out of 39 coefficients are statistically significant. Hence, there is no reason to assume a severe mis-specification due to spatial autocorrelation. As a further robustness check, an unconstrained version of Equation 3 was estimated applying the nonparametric covariance matrix estimator introduced by Driscoll and Kraay (1998), which provides heteroscedasticity consistent standard errors that are robust to very general forms of spatial and temporal dependence (see also Hoechle 2007). In comparison, the unconstrained estimations with and without robust standard errors do not produce systematically different results. Therefore, the observation units, i.e. planning regions, provide a suitable delimitation of labour market areas enclosing most relevant activities.[21]

Table 7: Moran's I Coefficients

Year	High-skilled		Medium-skilled		Low-skilled	
1994	–0.018	(–0.053)	0.036	(0.662)	–0.006	(0.101)
1995	–0.019	(–0.071)	–0.010	(0.047)	–0.071	(–0.773)
1996	0.026	(0.535)	–0.023	(–0.127)	–0.020	(–0.084)
1997	–0.160	(–1.962)	–0.064	(–0.679)	0.059	(0.978)
1998	–0.054	(–0.537)	–0.055	(–0.545)	–0.059	(–0.612)
1999	–0.026	(–0.167)	–0.173 *	(–2.146)	–0.104	(–1.206)
2000	–0.087	(–0.986)	–0.033	(–0.260)	–0.101	(–1.173)
2001	–0.040	(–0.344)	0.106	(1.598)	0.157 *	(2.285)
2002	–0.078	(–0.873)	0.004	(0.248)	–0.052	(–0.521)
2003	0.012	(0.340)	–0.037	(–0.316)	0.093	(1.413)
2004	–0.107	(–1.260)	0.009	(0.303)	0.053	(0.887)
2005	–0.099	(–1.155)	–0.039	(0.303)	–0.097	(–1.124)
2006	–0.112	(–1.315)	–0.042	(0.303)	–0.110	(–1.290)

Notes: ** significant at the 0.01 level; * significant at the 0.05 level. Standardised Z-values in parentheses.

19 Because there is usually no a priori information about the exact nature of spatial dependence, the choice for the design of the spatial weight is somewhat arbitrary. See Le Gallo et al. (2003) for a more detailed discussion of the functional form of spatial weight matrices.

20 The results based on alternative specifications can be obtained upon request from the author.

21 The results of these test regressions can be obtained from the author upon request.

6 Conclusions

Workplace segregation by skill may impede knowledge transfers, or other pecuniary externalities arising from a relatively high level of technology, to benefit less skilled employees. Moreover, if firms create more and more qualification-specific jobs, that should reduce the degree of substitutability between skills. Hence, there is likely a link between the existence of localised human capital externalities, skill complementarities and segregation by qualification level. Assuming a close connection between these issues, this analysis examines the effects of the local skill composition and the level of skill segregation on skill-specific employment growth simultaneously. It is, however, beyond the scope of this analysis to distinguish different effects of human capital on qualification-specific employment or to establish a direct link to skill segregation. This study investigates a cross-section of 74 West German regions focussing in particular on the employment prospects for workers without formal vocational education.

A number of analyses (see the second section) suggest that local human capital positively impacts the productivity level of all skill groups. Evidence of its effects on skill-specific employment, however, is still rare. The results of this study show that a large regional share of more skilled employees positively affects the employment prospects of less skilled workers, but that the opposite is not the case, i.e. the effect is only seen in one direction. That is, unskilled workers profit from local high- as well as medium-skilled employment. In a similar manner, the effect of local high-skilled employment on medium-skilled employment growth is positively significant for the complete time period from 1993 to 2006, but cannot be validated by estimating the effects for a shorter control period from 1998 to 2006. Since a relative local abundance of each skill group has a negative impact on that same group itself, there is no evidence for a regional concentration of employment by qualification levels. This confirms the results obtained by Südekum (2008) for West German districts.

This study provides first empirical evidence on the impact of skill segregation in the production process on the development of skill-specific employment. Though theoretical results imply that skill segregation might matter for the polarisation of wages and employment, corresponding empirical evidence has been lacking so far. The results of this analysis reveals that a high level of segregation by qualification levels negatively affects the growth of regional low-skilled employment. Considering the existence of these effects, the role of local human capital and the specialisation of production on specific skills may have a slightly different notion with regards to the effects on low-skilled employment growth in future research in this field. The negative effect of workplace segregation by skill might

reflect the mechanisms described for example by Acemoglu (1999) or Duranton (2004), who find that employees without professional education, in segregated workplaces, tend to work in jobs characterised by low capital intensity and with working processes of little complexity. This is because firms tend to invest more in modern production technology when they can exploit complementarities between physical and human capital. As an alternative explanation, the dampening effect of skill segregation might also consist in impediments to learning effects. As for example modelled by Jovanovic and Rob (1989) or Glaeser (1999) the presence of more qualified co-workers could positively affect the productivity of low-skilled labour through knowledge transfers. It is not possible to draw precise conclusions from this result about the exact nature of the mechanisms. However, in both cases the productivity of low-skilled employees in segregated workplaces is relatively low when compared to those of their counterparts who share a common workplace with more qualified colleagues, a fact which adversely affects their employment prospects. This analysis did not find evidence for any effects of skill segregation on medium- or high-skilled employment. Though skill segregation has a likely positive effect on the productivity of more skilled workers, this may not have translated into employment growth during the period studied.

Overall, the analysis shows that a local abundance of human capital matters for skill-specific employment growth. While it does not foster further accumulation of human capital it has a positive impact on less skilled employment, in particular on workers without formal vocational education. However, according to the estimation results, there is another dimension than spatial proximity that matters when regarding the effects of local human capital. This analysis reveals that production processes (firms) employing different qualification types foster the employment prospects of low-skilled workers. Regarding the high unemployment rates of low-skilled workers in most developed countries, workplace segregation by skill is an important issue for further regional labour market research and policy. Additional research may be necessary to validate these results in other countries for example, or to identify the exact mechanisms behind the effects of local human capital, skill segregation and their interplay.

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Appendix

Table A1: Estimation Results Including Variant 1 (low- vs high-skilled) of the Duncan Index, 1993–2006 and 1998–2006.

	High-skilled		Medium-skilled		Low-skilled	
Period	1993–2006	1998–2006	1993–2006	1998–2006	1993–2006	1998–2006
Share of ...						
high skills	−0.270 *	−1.48 **	0.253 **	−0.108	0.501 **	0.529 *
	(.0121)	(0.195)	(0.071)	(0.125)	(0.128)	(0.228)
medium skills	0.174 **	0.421 **	−0.039 *	−0.006	0.27 **	0.417 **
	(0.035)	(0.054)	(0.018)	(0.031)	(0.033)	(0.056)
low skills	−0.449 **	−0.722 **	0.017	0.066	−1.095 **	−1.583 **
	(0.117)	(0.187)	(0.059)	(0.105)	(0.107)	(0.192)
Duncan index	−0.043	−0.061	0.038 *	0.021	−0.178 **	−0.241 **
	(0.036)	(0.056)	(0.019)	(0.031)	(0.034)	(0.058)
Neutralised wage level	0.126	−0.004	0.017	−0.100	0.081	0.028
	(0.073)	(0.092)	(0.038)	(0.054)	(0.070)	(0.100)
Share of ...						
small firms	−0.007	−0.021	0.025	0.068	0.103	0.065
	(0.059)	(0.083)	(0.029)	(0.046)	(0.053)	(0.086)
medium firms	0.196 **	0.190	0.011	−0.030	0.045	0.104
	(0.072)	(0.102)	(0.035)	(0.056)	(0.064)	(0.103)
large firms	−0.150 **	−0.127	−0.043	−0.068	−0.176 **	−0.173 *
	(0.048)	(0.069)	(0.025)	(0.039)	(0.045)	(0.072)
Agriculture & Forestry	−0.401	1.386	−1.171 **	0.100	−2.036 **	−1.756
	(0.788)	(1.049)	(0.375)	(0.573)	(0.694)	(1.065)
Mining	0.186	0.291	−0.045	−0.403 **	0.582 **	0.211
	(0.161)	(0.245)	(0.080)	(0.136)	(0.145)	(0.250)
Food, Drink & Tobacco	0.330	0.996	0.119	−0.254	1.085 **	1.144 *
	(0.407)	(0.576)	(0.195)	(0.305)	(0.357)	(0.562)
Textile & Leather	0.952 **	1.266 **	0.067	−0.179	0.663 **	0.741
	(0.189)	(0.439)	(0.092)	(0.238)	(0.161)	(0.419)
Wood	0.824	0.757	−0.077	−0.083	−0.814	−1.441
	(0.612)	(0.848)	(0.283)	(0.432)	(0.509)	(0.788)
Paper & Printing	0.366	0.494	0.264	−0.133	0.869 *	1.208
	(0.444)	(0.679)	(0.227)	(0.383)	(0.412)	(0.699)
Chemistry and Syntetic Materials	0.367 *	0.471 *	0.093	0.014	0.352 *	0.537 *
	(0.150)	(0.207)	(0.083)	(0.126)	(0.149)	(0.229)
Glass & Ceramics	0.378	−0.753	0.287	0.346	0.723 *	1.204 *
	(0.403)	(0.579)	(0.177)	(0.307)	(0.315)	(0.553)
Metal-Production & Manufacturing	0.532 **	−0.061	0.107	0.046	0.020	−0.259
	(0.145)	(0.288)	(0.076)	(0.162)	(0.137)	(0.294)

Table A1: continued

	High-skilled		Medium-skilled		Low-skilled	
Period	1993–2006	1998–2006	1993–2006	1998–2006	1993–2006	1998–2006
Machinery	−0.272	0.046	0.070	0.029	−0.129	−0.420 *
	(0.161)	(0.211)	(0.081)	(0.117)	(0.145)	(0.212)
Electical Engeneering	0.132	−0.027	−0.192 *	0.136	0.008	0.655 **
	(0.145)	(0.232)	(0.080)	(0.135)	(0.144)	(0.244)
Motor Vehicles	0.013	0.153	−0.006	0.042	−0.074	−0.316 *
	(0.112)	(0.150)	(0.057)	(0.084)	(0.106)	(0.155)
Other Manufacturing, Recycling	0.184	1.007 *	0.139	−0.266	0.194	0.358
	(0.309)	(0.490)	(0.139)	(0.248)	(0.245)	(0.446)
Building & Construction	−0.761 **	−0.166	−0.325 **	0.075	0.027	0.066
	(0.199)	(0.326)	(0.101)	(0.180)	(0.185)	(0.333)
Commerce	−0.026	0.031	0.118	0.050	−0.355 **	−0.487 *
	(0.142)	(0.196)	(0.075)	(0.115)	(0.136)	(0.212)
Hotels & Gastronomy	−0.310	0.385	−0.427 *	−0.321	−0.640	−1.466 *
	(0.396)	(0.607)	(0.197)	(0.343)	(0.362)	(0.640)
Information & Transportation	−0.429 *	−0.502 *	−0.211 *	−0.017	−0.148	0.341
	(0.167)	(0.251)	(0.090)	(0.146)	(0.166)	(0.272)
Finance & Insurance	0.208	−1.325 **	−0.128	−0.699 *	−0.874 **	−1.334 **
	(0.316)	(0.412)	(0.182)	(0.272)	(0.337)	(0.502)
Simple Business-Related Services	−0.250	−1.253 **	0.181	−0.198	0.263	−0.247
	(0.252)	(0.331)	(0.139)	(0.204)	(0.254)	(0.375)
Complex Business-Related Services	0.324 *	0.020	0.011	−0.06	0.076	0.254
	(0.134)	(0.190)	(0.072)	(0.115)	(0.132)	(0.214)
Temporary Employment	1.031 **	0.166	0.426 **	0.316 *	1.035 **	0.596 *
	(0.174)	(0.232)	(0.087)	(0.132)	(0.159)	(0.242)
Public Services	0.150	−0.059	0.084	0.030	0.324 *	0.700 **
	(0.133)	(0.184)	(0.077)	(0.122)	(0.144)	(0.228)
Education	0.225	1.139 **	−0.057	0.277	0.093	0.614 *
	(0.186)	(0.244)	(0.102)	(0.151)	(0.192)	(0.288)
Health & Social Services	−0.293 *	−0.296	0.152	0.278 *	0.080	0.078
	(0.143)	(0.226)	(0.078)	(0.135)	(0.144)	(0.254)
Other Services	−0.021	−0.011	−0.012	0.005	−0.031	−0.036
	(0.076)	(0.073)	(0.030)	(0.033)	(0.059)	(0.065)
Household-Related Services	1.834	6.634	0.034	−2.182	3.343	4.558
	(3.727)	(5.035)	(1.885)	(2.844)	(3.449)	(5.225)
No. of observations	962	592	962	592	962	592
[a] R^2	0.85	0.89	0.88	0.90	0.90	0.90
[a] R^2-adjusted	0.83	0.86	0.86	0.89	0.89	0.87

Notes: ** significant at the 0.01 level; * significant at the 0.05 level. Standard errors in parentheses;
[a] The reported R^2 is obtained by estimating Equation 3 without imposing linear restrictions as described in Section 5.1, since estimations including such constraints do not yield the standard R^2.

Chapter 6 Summary and Conclusions

1 Motivation and Common Features of the Chapters

The analysis of spatial disparities in the distribution of economic activities and the factors that drive a potential decline or deepening of regional disparities is a fundamental concern of regional economic science. The present dissertation provides empirical analyses on different aspects of this topic focusing on the development of regional economic disparities within the European Union. Economic convergence among its countries and regions, i.e. a reduction of existing differences in income and employment, is one of the basic objectives of the EU. The increased policy concerns with regional disparities in the course of the EU enlargement and the ongoing internationalisation of the markets have strongly coincided with regained interest in regional economic sciences. Despite the rapidly expanding amount of empirical studies spured by the emergence of new theories, such as endogenous growth theory and, in particular, New Economic Geography the regional economic studies are not conclusive about various problems concerning regional disparities so far. Relatively little is known, for example, about the development of spatial economic disparities in the light of EU enlargement and possible effects of economic integration on the spatial distribution of economic activities between and within countries. The latter is of particular relevance for the new member states (NMS). Another gap in existing studies is the lack of information on the determinants of regional disparities in employment growth regarding different qualification levels.

The present dissertation addresses both gaps which are highly relevant for EU cohesion policy as well as for national policies concerned with regional disparities and growth. Thereby, it combines two types of studies that are both relevant for policies concerned with spatial imbalances of economic activities. The first group of studies regards regional growth and a potential decline or deepening of regional income disparities in the course of a proceeding economic integration in Europe. The second group of studies deals with skill-specific labour market disparities, focusing in particular on the increasing inequalities between the employment prospects for high-skilled and low-skilled persons.

Overall, the dissertation consists of five analyses, one reviewing other relevant theoretical and empirical studies, the other four providing empirical analyses using extensive data resources aggregated on the regional level. Applying cross-sectional as well as cross-sectional time-series data, all four studies provide econometric analyses accounting in particular for spatial heterogeneity and spatial autocorrelation issues. The econometric analyses are flanked by descriptive evidence.

2 Summary of the Chapters

The Chapters 2 and 3 deal with the issue of regional convergence of per capita income and the effects of economic integration in the EU. Chapter 2 *"Regional Income Inequality and Convergence Processes in the EU-25"* aims at providing more distinct information on regional convergence processes in the enlarged EU. Applying descriptive and formal analysis regional convergence and income inequality is investigated for the period between 1995 and 2003 at a comparatively low level of regional aggregation comprising 861 regions of the EU-25. Special attention is paid to differences in regional growth processes between the EU-15 and the new member states (NMS), and to the role of national effects and the development of regional within-country disparities.

The chapter applies the Theil's index of inequality. In contrast to the dispersion of income measuring σ-convergence, applying Theil's index allows to decompose the level of overall inequality in regional per capital incomes into a between-country and a within-country component. This is especially useful for the purpose of analysing the development of regional within-country disparities in the context of the general catching-up process taking place in the enlarged EU. The formal convergence analysis is conducted by applying the concept of β-convergence. Conditional convergence is accounted for by controlling for national effects. Since spatial dependence has been found to be influential on regional growth in recent convergence studies, spatial econometric techniques are applied in order to control for spatial error and spatial lag dependence.

The results show a decrease in total income inequality in the EU. Given that the estimation of β-convergence is not oversize the decrease in regional income disparities,[1] the estimation of the speed of absolute convergence in the EU-25 yields an annual rate of about 2 percent. This implies a catching-up of the poor regions halving the disparities in income levels every 35 years. However, the convergence process is shown to be driven mainly by country-specific effects, i.e. national policies, legislation, tax systems etc. This is particularly the case in the NMS, where institutional changes in the course of market liberalisation have been large compared with Western Europe. Furthermore, the regression analysis reveals that national macroeconomic differences seem to influence regional growth rates more than spatial spillovers do. Overall, the general catching-up of the NMS is accompanied by regional divergence processes within the individual NMS countries. Thus, the analysis demonstrates that there may be a trade-off between convergence on the national level and regional within-country convergence in the

1 See discussion in Chapter 1 and Chapter 2.

NMS which may impede the European Commission in its pursuit of the objective of economic and social cohesion.

Chapter 3 *"EU Enlargement and Convergence – Does Market Access Matter?"* complements the analysis presented in Chapter 2 by investigating the effects of the eastward enlargement on the spatial distribution of economic activity and differences in regional per capita income in the enlarged EU. Departing from a NEG framework, the chapter focuses on integration effects caused by changes in market access, released by a reduction of trade impediments. The investigation focuses on the question, whether changes in market access released by declining impediments to cross-border trade support the catching-up of lagging regions or tend to work against convergence. Special attention is paid to the catching-up process of the NMS and the development of regional disparities within the East European countries.

This chapter offers empirical evidence on the spatial effects of EU enlargement, the development of regional disparities, and the interaction of both. Therefore, this analysis links two groups of studies dealing with EU enlargement. The first group of studies comprises studies dealing with a potential decline or deepening of regional disparities in the course of a proceeding economic integration in Europe (e.g. Fischer and Stirböck 2004; Feldkircher 2006; Tondl and Vuksic 2007). The second group of studies considers the spatial pattern of integration effects released by the eastern enlargement of the EU. Empirical studies on integration effects tends to focus on the EU-wide impact on growth and country effects (e.g. Baldwin et al. 1997; Breuss 2001). Only a few studies explicitly consider its effect at the regional level. Bröcker (1998), Brülhart et al. (2004), and Pfaffermayr et al. (2004) provide quantitative estimates of regional effects in Europe caused by the economic integration of the Central and East European countries.

The analysis applies a NEG model, which allows examining why market access might be decisive with respect to spatial integration effects and regional disparities. Only some models allow the consideration of disparities both between and within countries. Using a wage equation derived from the NEG framework the distance decay of demand linkages in the European Union is estimated in order to calculate changes in market access caused by a reduction of border impediments. The basic idea of the analysis is that the changes in the market potentials of EU regions, in turn, affect regional per capita income. To investigate the effect of changing market access on regional disparities, a formal convergence analysis including our accessibility measure is carried out. As the analysis is restricted to integration effects arising from changes in market access, it does not offer a comprehensive investigation of the spatial effects of integration and its consequences for cohesion. Effects emerging from differences in specialisation

and factor mobility are not considered, though they are likely to have an impact on regional income levels as well.

The results show that regions in the NMS realise significant increases in market potential through increased trade integration with the EU-15 market, whereas market potential changes in the EU-15 are more or less negligible. Therefore, reduced border impediments between old and new EU member states should promote the catching-up of the NMS towards the EU-15. However, accounting for neoclassical catching-up mechanisms and country-specific growth factors, the change in market potential has hardly any effect on per capita income growth in the EU. Furthermore, the analysis confirms the findings of the first chapter of the thesis, which demonstrate that the overall catching-up in the enlarged EU is dominated by national macroeconomic factors and accompanied by regional divergence processes within the individual countries of the NMS. Overall, this indicates that centripetal forces driving agglomeration prevail at the subnational level in the early stages of economic integration within the enlarged EU market.

The Chapters 4 and 5 deal with local human capital, skill segregation in the production process and their impact employment growth by qualification levels. Chapter 4 *"The Determinants of Regional Disparities in Skill Segregation – Evidence from a Cross Section of German Regions"* provides more detailed insights into the regional disparities in the levels of skill segregation and its determinants in Germany. More precisely, the chapter aims at identifying characteristics of regional labour markets that influence the extent of skill segregation focussing on the effect of high-skilled labour supply on skill segregation at the workplace. The study investigates the determinants of the regional disparities in the level of skill segregation for a cross section of German planning regions[2] in the period from 1993 to 2005. Panel and spatial econometric methods are applied in order to account for unobserved heterogeneity and spatial interaction among neighbouring labour markets. Furthermore, an instrumental variable approach is used to deal with the possibility of a simultaneity bias resulting from reverse causality between regional human capital and skill segregation.

Different measures of segregation by skill are applied in economic and sociological studies. Frequently the between- and within-plant wage dispersion serves as an indicator for segregation (e.g. Davis and Haltiwanger 1991; Kremer and Maskin 1996). In this study, however, a more direct measurement of skill segregation via the formal qualification of workers is preferred. The measure requires plant level information on employment by educational attainment, which

2 Planning regions ("Raumordnungsregionen") as defined by the German Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) are functional areas that comprise several counties (NUTS-3 regions) and are defined mainly on the basis of commuting patterns.

is provided by the Establishment History Panel of the Institute for Employment Research (IAB). The dataset contains detailed information on all establishments in Germany with at least one employee liable to social security for the period 1993 to 2005.

The findings of the analysis reveal that the level of skill segregation has increased in almost all regions under consideration. Furthermore, the segregation level is marked by pronounced regional disparities. The analysis identifies the local endowment with human capital to be an important determinant for the regional level of skill segregation. Besides the local stock of human capital within a region also the skill supply in neighbouring regions significantly affects the level of skill segregation. Following the theoretical models, it can be argued that firms adapt their production processes and technology to the skills available. In the case of a high level of human capital firms tend to specialise their production with respect to skills.

Chapter 5 *"Local Human Capital, Segregation by Skill, and Skill-Specific Employment Growth"* investigates the effects of local skill structure and the level of skill segregation on regional employment growth applying panel data estimations for 74 German regions between 1993 and 2006. The control variables include different measures for skill segregation based on the Employment History Panel as well as various statistics for all full-time employees subject to social security provided by the German Federal Employment Agency. The analysis accounts for unobserved spatial heterogeneity and spatial dependence by using fixed effects and spatial econometric methods. As a first contribution this analysis provides new empirical results with regard to the impacts of skill segregation on the development of qualification-specific employment, focussing in particular on the employment prospects for workers without formal vocational education. Secondly, the chapter adds to the empirical evidence on regional employment growth by different skill levels and the effects of local human capital, which has been scarce thus far.

The analysis relates the studies on skill segregation to the studies investigating human capital externalities and skill complementarities. In contrast to both types of studies, which focus on productivity and wages, this analysis estimates the effects on employment growth. This is in line with Südekum (2006, 2008) establishing a link between skill-specific productivity and employment growth or with Duranton (2004) who concludes that increasing levels of skill segregation may spur unemployment of the least skilled by decreasing the productivity levels in that skill group. The underlying assumption is that changes in skill specific productivity levels have an impact on the growth of jobs for the different skill types. In particular, if wages are sticky moving downwards at the lower end of

the income distribution a relative productivity decline of low-skilled labour should translate into decreasing low-skilled employment. This is frequently supposed to be the case in Continental European labour markets, which leads many economists to believe that increasing unemployment rates in Continental Europe can be traced back to the same causes – i.e. rising disparities in the skill-specific productivity levels – as the increasing wage inequalities in Anglo-Saxon countries (e.g. Krugman 1994; Freeman 1995).

The results of the analysis show that the local endowment of human capital is an important determinant for skill-specific employment growth in West German regions. While it does not foster further accumulation of human capital it has a positive impact on less skilled employment, in particular on workers without formal vocational education. This points to the existence of skill complementarities. The results, however, are not conclusive on that point. Although a rising stock of local human capital tends to have a positive effect on regional labour markets in general, the low-skilled might benefit to a lesser extent, because they tend to work in firms with relatively less modern and less complex production technologies decreasing their productivity and employment prospects. The findings reveal that high regional levels of skill segregation have a significant negative impact on low-skilled employment growth. Thus, regarding the high unemployment rates of low-skilled workers in most developed countries, workplace segregation by skill is an important issue for further regional labour market research and policy.

3 Conclusions

The convergence analysis in Chapter 2 shows that regional growth rates tend to be higher in relatively less developed regions of the EU, especially in the NMS, indicating a catching-up process. Yet, the general convergence process appears to be driven mainly by country-specific effects and is accompanied by increasing within-country disparities, in particular in the NMS. As increased market potentials are associated with rising wage levels, trade integration through EU enlargement should support the catching-up process of the NMS toward the EU-15. However, the analysis presented in Chapter 3 reveals that accounting for neoclassical catching-up mechanisms and country-specific growth factors, the change in market potential has hardly any effect on the growth of regional per capita incomes in the EU.

However, given the relatively short period of observation, these results should be treated with caution and should not be taken as an indication for long-run development. It is possible, for example, that forces driving regional inequality in the individual NMS will cease in the long run. Moreover, it is perhaps too early to identify growth effects of changes in market access, or other integration effects,

such as factor mobility, might be more important for growth and convergence. Nevertheless, the quintessence of the analysis outlines a trade-off between convergence on the national level and regional within-country convergence in the NMS which may impede the European Commission in reaching its objective of economic and social cohesion. Beyond this, the analysis provides new insights on the spatial effects of declining trade barriers in the course of the EU integration process.

The Chapters 4 and 5 address the issue of regional labour market disparities in skill-specific employment growth and its determinants. In the centre of the investigation are the local level of human capital and the regional level of skill segregation in the production process. Local human capital is frequently regarded as a major cause for regional variations in productivity and employment growth. Promoting the accumulation of skills is one of the key starting points for EU policy to create more jobs. The results show that a relatively skilled regional labour force positively affects employment growth in the medium- and the low-skilled segment. However, although a rising stock of local human capital tends to have a positive effect on local employment growth in general, the analysis also reveals that the positive effects of local human capital on low-skilled employment are dampened when low-skilled employees tend to work apart, i.e. are separated by workplace, from more skilled colleagues. These findings represent new empirical evidence and the existence of such effects should be considered in future research in this field and labour market policies addressing low-skilled workers. According to theoretical models, such adverse effects of skill segregation might be explained by relatively less modern and less complex production technologies or the lack of learning effects in firms that employ predominantly low-skilled workers. Thus, low-skilled employment may be promoted by policy schemes that counteract the decoupling of the low-skilled from other skill-groups in the production process. For instance, on-the-job training aiming explicitly at joint learning and working process of differently qualified employees might be considered as an appropriate policy measure in this context.

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Abstract

This thesis investigates different aspects regarding the development of regional economic disparities and growth in the EU. Consisting of different empirical studies, it provides new evidence on questions concerning the development of inequalities in regional income levels and skill-specific labour market disparities across regions in the EU. Though highly relevant for regional economic policies by the EU and its member states, these issues have not been comprehensively explored by empirical studies, yet.

Especially, there is a lack of information on the development of the spatial distribution of economic activities between and within countries and possible effects of economic integration in the light of the EU enlargement process. The results presented in Chapters 2 and 3 show that regional convergence is driven mainly by country-specific effects and accompanied by increasing within-country disparities, in particular in the new member states. Furthermore, it is shown that increasing market access due to reduced border impediments does not have a significant effect on the growth of regional per capita incomes in the EU at this stage of EU-integration.

Another gap of the current research in regional sciences (addressed in Chapters 4 and 5) refers to the lack of information on the determinants of regional employment growth by different skill levels. As the individual employment prospects shrink with decreasing skill-level, information on the determinants for spill-specific employment growth is of particular importance for regional policies designed to promote employment at the lower bound of the skill distribution. The results show that, although a rising stock of local human capital tends to have a positive effect on local low-skilled employment, this effect may be dampened when the low-skilled tend to work apart, i.e. are separated by workplace, from more skilled colleagues.

Kurzfassung

Die vorliegende Arbeit beleuchtet verschiedene Aspekte der Entwicklung von regionalen ökonomischen Disparitäten und Wachstum in der EU. Die Arbeit besteht aus mehreren empirischen Studien und liefert neue Befunde zur Entwicklung regionaler Einkommensunterschiede und qualifikationsspezifischer Arbeitsmarktdisparitäten. Trotz hoher Bedeutung für die Regionalpolitiken der EU oder ihrer Mitgliedstaaten sind verschiedene Fragestellungen zu diesem Thema noch nicht umfassend untersucht worden.

Es besteht beispielsweise ein Mangel an Informationen zur Entwicklung der räumlichen Verteilung von ökonomischen Aktivitäten zwischen und innerhalb der Mitgliedstaaten und zu möglichen Auswirkungen der ökonomischen Integration im Zuge des EU-Erweiterungsprozesses. Die Ergebnisse in Kapitel 2 und 3 zeigen, dass regionale Konvergenz in der EU hauptsächlich durch nationale Faktoren getrieben und von steigenden Disparitäten innerhalb der Länder – vor allem in den neuen Mitgliedstaaten – begleitet wird. Des Weiteren wird gezeigt, dass steigender Marktzugang aufgrund abnehmender Grenzhemmnisse bisher nicht in signifikantem Maße zum regionalen Wachstums- und Konvergenzprozess beigetragen hat.

Eine weitere Forschungslücke besteht im derzeitigen Mangel an Befunden über die Determinanten des regionalen Beschäftigungswachstums in unterschiedlichen Qualifikationsgruppen. Aufgrund der vergleichsweise niedrigen Beschäftigungschancen von Geringqualifizierten sind Informationen über die Determinanten der Beschäftigungsentwicklung in dieser Gruppe von besonderer Bedeutung für arbeitsmarktpolitische Maßnahmen, welche beispielsweise darauf abzielen, vergleichsweise hohe regionale Arbeitslosenquoten im unteren Qualifikationssegment zu senken. Die Untersuchungen in Kapitel 4 und 5 zeigen u. a., dass ein positiver Effekt von lokalem Humankapital auf die geringqualifizierte Beschäftigung besteht, aber durch ein hohes Ausmaß von qualifikatorischer Segregation signifikant gedämpft wird.

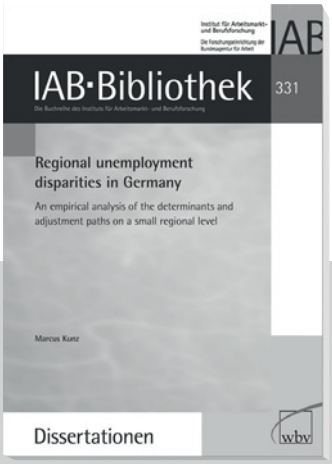
Regional unemployment disparities

An empirical analysis of the determinants and adjustment paths on a small regional level

Neither empirical data nor economic theory give a clear indication of how regional disparities develop and which political measures are adequate to reduce them. This holds particularly true for Germany, where the unification between West and East Germany in 1990 amplified regional unemployment disparities tremendously. Against this background, Marcus Kunz addresses three key questions:

1. Do unemployment rates across districts and regions converge or diverge within Germany?
2. How do districts and regions adjust in the aftermath of a regional labour market shock?
3. What are the reasons for the regional unemployment disparities observed in western Germany?

As opposed to previous studies about unemployment disparities within Germany which only focused on the larger regional level, Kunz' study provides a more precise empirical picture by focusing on development at the small district level where disparities are especially large.



Marcus Kunz

Regional unemployment disparities in Germany

An empirical analysis of the determinants and adjustment paths on a small regional level

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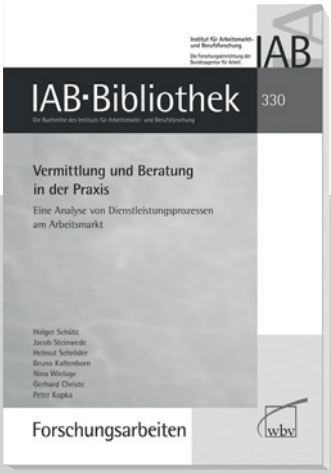
Die Autoren liefern eine vielschichtige Diagnose über das Vermittlungs- und Beratungsgeschehen und zeigen klare Ansatzpunkte auf, um diese Dienstleistungsprozesse zukünftig weiter zu verbessern. Die Anhänge können Sie sich kostenlos unter „Website zum Titel“ herunterladen (ISBN-A 10.978.37639/40479).



Gerhard Christe, Peter Kupka, Helmut Schröder, Holger Schütz, Jacob Steinwede, Nina Wielage

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- Wie werden die gesetzlichen Regelungen vor Ort umgesetzt?
- Wie nutzen die Betriebe die Förderung?
- Wie beurteilen Arbeitslose den Zuschuss?
- Spielt Gender Mainstreaming bei der Handhabung von Eingliederungszuschüssen eine Rolle?
- Haben sich die seit dem Jahr 2007 bestehenden Fördervarianten in der Praxis bewährt?
- Wie lässt sich das Instrument verbessern?

Die Studie gibt Expertinnen und Experten in Wissenschaft und Praxis, die sich mit der Reform der arbeitsmarktpolitischen Instrumente befassen, zu diesen und weiteren Fragen fundierte Antworten.

Martin Brussig,
Manuela Schwarzkopf

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Eine Implementationsstudie

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