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**Working Paper**

## Deindustrialization and the polarization of household incomes: The example of urban agglomerations in Germany

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# Deindustrialization and the Polarization of Household Incomes: The Example of Urban Agglomerations in Germany

Jan Goebel and Martin Gornig

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# **Deindustrialization and the Polarization of Household Incomes: The Example of Urban Agglomerations in Germany**

Jan Goebel\* and Martin Gornig\*\*

## **Abstract**

The tertiarization, or perhaps more accurately, the deindustrialization of the economy has left deep scars on cities. It is evident not only in the industrial wastelands and empty factory buildings scattered throughout the urban landscape, but also in the income and social structures of cities. Industrialization, collective wage setting and the welfare state led to a stark reduction in income differences over the course of the twentieth century. Conversely, deindustrialization and the shift to tertiary sectors could result in increasing wage differentiation. Moreover, numerous studies on global cities, the dual city, and divided cities have also identified income polarization as a central phenomenon in the development of major cities. Using data from the German Socio-Economic Panel (SOEP), we find an increasing polarization of household income structures since the mid-1990s. In agglomerations, this income polarization is even more pronounced than in the more rural regions. The income polarization in Germany is likely to have multiple causes, some of which are directly linked to policies such as the deregulation of the labor market. But extensive deindustrialization is probably also one of the drivers, that has led directly to the weakening of middle income groups.

JEL: R20, Z13, R11

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## **1. Background and Research Questions**

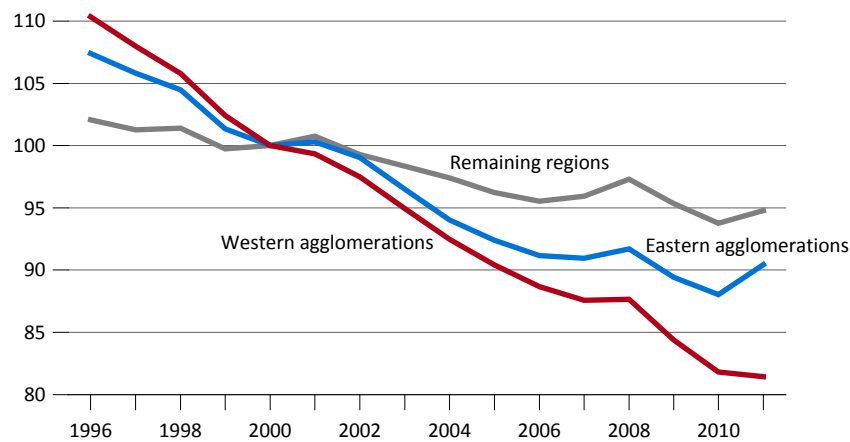
The growth of major cities is closely associated with the process of industrialization. Historically, urbanization and industrialization have been inextricably linked (Croon 1963). Despite the dominance of industrial growth in this process, the tertiary sector has also made a significant contribution to the economic strength of many cities. However, for a long time, there was relatively low interest among regional researchers in such structural differences since the vast majority of towns and urban regions, regardless of their functional orientation, were growing. Nevertheless, peripheral rural areas were lagging behind.

However, the sectoral structural changes in the US and Western Europe in the mid-1970s also led to a change in regional growth patterns (Hall/Hay 1980; Norton 1986). The situation was now no longer defined by the development gap between the center and the periphery but rather by disparities among different urban agglomerations. Regions with large coal and steel industries were particularly hit hard and came to be referred to as “traditional industrial regions.” Typical examples are the Ruhr district and Saarland in West Germany.

East Germany remained largely unaffected by these changes (Gornig/Häußermann 2002). Prior to World War II, economic development in the GDR had exceeded the German average, and urban economies in Saxony (Leipzig, Chemnitz, and Dresden) were among Germany’s strongest. In 1939, per capita employment in manufacturing was considerably higher in eastern than in western Germany. After the division of Germany, the Communist leadership continued to promote industrialization up to the end of the GDR and, in 1989, the level of industrialization in East Germany was 50 percent higher than in West Germany. After German unification, however, the manufacturing industry in the GDR collapsed almost completely. At the same time, a historically unprecedented level of direct investment flowed into the East from the West (Burda 2006). Since 2005, there has been a marked consolidation in manufacturing. The share of industry in GDP in Eastern German cities is now rising again after a period of decline between 2008-2010 (see Figure 1).

In Western Germany, after a brief post-unification boom, manufacturing initially also declined. Over time, however, the German industry focused increasingly on research-intensive sectors (electrical and mechanical engineering, automobile manufacturing, the chemical industry). In 2007 and 2008, the manufacturing industry even became an engine for growth. But the global financial and economic crises interrupted this process. Yet new engines of growth have emerged in Germany, as in other high-wage countries, not only in highly specialized industries but also in tradable knowledge-intensive services (Illeris 2005; Beyers 2005; Gornig 2005) concentrated in major cities (Südekum 2005; Geppert et al. 2008). Despite the recovery of manufacturing, these sectors have led to further tertiarization in Western German urban agglomerations (see Figure 1).

**Figure 1: Industry Shares in Western and Eastern German Urban Agglomerations 1996-2011**



Source: NAS of *Länder*, own calculations.

The tertiarization, or perhaps more accurately, the deindustrialization of the economy has left deep scars on cities, with industrial wastelands and empty factory buildings dotting the urban landscape. The impacts of deindustrialization are evident not only in the marked differences in growth between cities but also in urban income and social structures. The combined effects of industrialization, collective wage setting, and the welfare state led to a decline in income differences over the course of the twentieth century. This enabled broad segments of the working population to participate in the growing prosperity into the early 1970s. Cities that developed during the industrial revolution played a key role in the reduction of income disparities in Europe. The combination of economic growth and urban regulation made these cities key drivers of social integration (Häußermann/Kapphan 2000).

On the other hand, however, the current shift to deindustrialization and tertiarization could result in increasing wage differentiation. Economic theory provides a hypothesis on the expansion of employment in the service sector that is based on a combination of two factors: firstly, a rise in demand caused by the increasing income elasticity of demand and secondly, a low increase in productivity as a result of temporal and spatial consumer and producer constraints (Fisher 1939). From an early stage limited potential for productivity increases was identified as a possible catalyst for bottlenecks in demand (Baumol 1967). Increases in mass income lead to rising prices for services, even if productivity levels stagnate. Over time, services with low productivity levels (low-skilled services) can only employ more workers if wages remain low relative to the overall income trends. On the other hand, services with high productivity levels can expand despite increasing wage costs since their unit labor costs do not need to rise. The process of tertiarization therefore creates both relatively badly paid, low-skilled service jobs and high-skilled, well-paid employment. As a result, wage dispersion increases during the transition from an industrial to a service society (Harrison/Bluestone 1988).

Another concept sees wage polarization as the result of technological change (Autor et al. 2003). It is assumed that the computerization of the economy can effect employment in various ways. Jobs that initially comprised a large share of routine tasks can easily be substituted by computers. At the same time the new technologies requests tasks that demand flexibility, creativity or communication. These complementary jobs usually have high educational requirements and are located at the upper end of the wage distribution. While the routinized, programmable tasks like clerical and craft work were typically found in the middle of the education and wage distribution.

Parallel to this development low wage, low-skill, personal service jobs are not affected by technological rationalization, they cannot be replaced by computers This results in polarization, with employment and wage losses in the middle of the distribution, strong growth at the top end and medium growth at the very bottom end of the employment distribution, with workers originally employed in the middle sorting to high-end and low-end jobs (Autor/Dorn 2013). This changing demand in labor requires the parallel development of labor supply as for example in qualification and age. Trade and migration can also have a possible impact on the extent of polarization.

Aside from changes in the structure of occupations and tasks, changes in the industry structure can also fuel polarization. Different industries pay different wages for the same occupation. This can be due to different levels of rent sharing (Du Caju et al 2009) or negotiation power on the supply side due to unionization (Gerlach/Stephan 2007). Manufacturing traditionally had higher levels of unionization and higher levels of rent sharing than other sectors. The deindustrialization resulting in a shift to Services, leading to deunionization, is another dimension that needs to be considered when trying to explain income polarization.

For the US, the increasing polarization of the income distribution has been a virtually undisputed fact since the end of the 1970s (Bernstein et al. 2002). Since 2000, however, there has also been a marked increase in income disparities in Germany and the rest of Europe (OECD 2011).

Especially in Europe it is important to take into account both the effects in primary and secondary income distribution. Reallocation arrangements play an important role in many European states. They can weaken the effects of wage polarization as well as fuel polarizing tendencies by changes in social insurance and tax legislation. For Germany, however, empirical evidence indicates that the increase in income inequality is caused by changes in market income rather than policy impacts (Biewen/Juhasz 2012).

On a regional level, the income polarization issue has been part of discussions relating to global cities (Sassen 1991), the dual city (Mollenkopf/Castells 1991), and divided cities (Fainstein et al. 1992). The idea expressed in these hypotheses—that income polarization is predominantly found in major cities—has prompted a multitude of studies analyzing the

change in social structures in Western European cities. However, the majority of these studies, such as those conducted in Oslo (Wessel 2000), Helsinki (Vaattovaara/Kortteinen 2003), Amsterdam, and Rotterdam (Burgers/Musterd 2002), have drawn their conclusions from a very narrow empirical basis. Representative income data could only be used in a small number of cases, such as London (Hamnett 2003) and Zürich (Koll-Schretzenmayr et al. 2005).

Systematic statistical analyses regarding the development of spatial income dispersion within regions have so far focused on changes in market income. Eeckhout et al. (2014) researched the different developments of incomes in US regions. They explain the above-average dispersion of wages in large cities with the same idea that Sassen (1994) has used: extreme skill complementarity. Its core idea is that cities attract many highly qualified, hence highly productive workers. These can even further enhance their productivity by handing down complementary low-skill tasks, at either the household level or at work, to less paid service personnel, which is thus also attracted to cities.

Other regional income studies, however, see wage polarization as the direct result of technological change. For the US Autor/Dorn (2013) attribute differences in wage polarization between regions to differences in their initial occupational structure. Regions with an initially large share of routine tasks show particularly strong polarization. For Germany there are similar results for regions in Western Germany (Dauth 2014).

However, there has been no systematic statistical analysis to date looking at the development of income structures in cities by regional comparison after redistribution. This is primarily due to the lack of a sufficient data basis. Despite the increasing number of cities, both in Germany and elsewhere, that would like to obtain an overview of their household income situation, this research has primarily been conducted in the form of separate, parallel studies, which do not allow for comparative analysis (Aehnelt et al. 2009). The present analysis uses a unified German data basis to compare income polarization within different cities. The database consists of regional information from the Socio-Economic Panel (SOEP). The empirical analysis for Germany aims to provide a starting point to answer the following two questions:

- Is income polarization a phenomenon specific to major metropolitan regions or is it a general characteristic of current social development?
- What are the different patterns of development in Eastern and Western German metropolitan regions which not only had completely different initial socio-political conditions but also show significant disparities in the development of economic structures?



## 2. Data and Methodology

### 2.1 Data Basis

The Socio-Economic Panel (SOEP)<sup>1</sup> study is a representative longitudinal survey of socio-economic and demographic characteristics for research on the living conditions of the German population.<sup>2</sup> The SOEP has been surveying the same households and individuals in West Germany since the mid-1980s and, in 1990, after unification, SOEP expanded to include the *Länder* of the former GDR. In response to extensive migration from abroad between the end of the 1980s and the beginning of the 1990s, an immigrant sample was added in 1994/5 to account for migrant households. Over the years, further samples were added and changes made, specifically a doubling of the sample size in 2000 and the addition of a high-income sample in 2006.

Further, the SOEP sample size varies from year to year as a result of mortality and the addition of new households and individuals to the survey. In 1984, 5,921 households with a total of 12,290 individual respondents were surveyed. The sample was increased in 2000, and by 2003 it was almost twice its initial size, with 12,061 households and 22,611 individual respondents. In the long term, the aim is to maintain a constant sample size of approximately 11,000 households. In total, over the entire survey period since 1984, SOEP has contacted more than 50,000 individuals. These expansions to the SOEP enable us to better analyze small subgroups of the population based on a larger number of cases and thus to better examine regional disparities.

To describe the income situation of households in the SOEP, this analysis is based on their annual income information. In the survey year ( $t$ ), all income components affecting a surveyed household as a whole, and all the individual gross incomes of the current members of household surveyed are added together, in each case referring to the previous calendar year ( $t-1$ , the income year). In addition, income from statutory pensions and social transfer payments is taken into account. The annual income is calculated by employing a simulation of taxes and social security contributions—including one-off payments such as a 13th or 14th month's salary or a Christmas or vacation bonus.

Annual wage and income tax payments and social security contributions payable are calculated based on a micro-simulation model that estimates household tax, taking into account all forms of income covered by the German Income Tax Act (*Einkommensteuergesetz*), including tax exemptions, income-related expenses, and special expenses. Since this model cannot simulate the complexity of German tax law due to the numerous special provisions thereof, it is assumed to underestimate the income inequality measured in the SOEP. All figures and tables show the income year.

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<sup>1</sup> All calculations are based on SOEP v29, doi:10.5684/soep.v29.

<sup>2</sup> Wagner et al. (2007).

In order to compare the income situations of households of different sizes and compositions, the household's entire income is converted into equivalized incomes following a procedure that is now standardized EU-wide in the new (revised) OECD equivalence scale. All income data are in euros. The analysis is at the individual level and provides a statistical representation of the entire population of private households in Germany. The institutional population (for example, those living in retirement homes) is disregarded.

In order to assess the evolution of purchasing power, income is standardized at 2000 prices. In each case, prices are adjusted to the respective income year. Finally, each new subsample is only taken into account starting with the second survey wave in order to exclude fluctuations over time due to methodological factors influencing response behavior. This restriction on the cases surveyed is based on analyses indicating that even representative longitudinal studies exhibit differing response behavior in the first wave in questions on income (Frick et al. 2006). The analyses therefore exclude subsample F in 2000 and subsample H in 2006, as well as subsample G (high income households), as the latter is only available from 2002.

The SOEP includes detailed regional information about the households surveyed. Below, we describe the division of the Federal Republic of Germany into environmental planning regions (*Raumordnungsregionen*) which are linked to SOEP data. For the purposes of the present analysis, regional data are available for the period 1995 to 2011.

## **2.2 Methodology**

To date, there is no standard approach for measuring income polarization. Dauth (2014) uses a quadratic term in a linear regression on employment growth by occupations for the estimation of polarization of the German labor market. The quadratic term gives estimation about the polarization effect of employment growth given the wage ranks in 1980. The major finding is that job polarization almost exclusively occurs in urban areas between 1980 and 2010. However, this regression approach totally ignores possible polarization effects due to a widening wage spread. Other studies using specific indices to measure polarization do not always make a clear distinction between the terms "polarization" and "inequality." Classical indices of inequality measure the income gap between individuals or different social groups whereas polarization focuses not only on the gap between incomes, but also on the number of people with low or high incomes relative to the share of population in the middle-income segment. Inequality, therefore, indicates the divergence from the general mean of a distribution, whereas polarization highlights convergences around local means (Cowell 2000). Therefore, polarization and growing inequality do not always coincide. It is even possible for inequality to decrease despite increasing polarization. For example, the differences within the groups at the distribution margins may decline while the spread of the overall income distribution increases (Esteban/Ray 1994).

This method of measuring polarization presupposes, at least for a descriptive representation, a division of income distribution into groups. Yet there is no generally accepted method of implementing this division in the literature, although poverty research does provide possible criteria for differentiation. The concept of poverty most frequently used in empirical studies is based on a relative income concept and follows the European Union definition (Eurostat Task Force 1998). According to this definition, and in line with the thresholds provided by Eurostat, the statistical office of the EU, those living in a household whose income is less than 60 percent of median equivalized income are at risk of poverty. Additionally, figures for "severe poverty" (40 percent of the median), "pronounced poverty" (50 percent of the median), and "low income" (70 percent of the median) are also cited frequently, for instance, in the German Federal Government's Report on Poverty and Wealth.

As outlined above, the difference between income polarization and income inequality or income poverty in evaluating changes in income distribution is generally that both margins of income distribution play a particular role in relation to the center. Unlike poverty research, the research on income polarization focuses not only on the size of and changes in the lower margin but also on the upper one. In order to measure the polarization of income distribution, therefore, three groups are usually created: bottom, middle, and top. There is however no generally recognized practice for the empirical definition of the upper or lower income margins. These income ranges therefore follow the definitions used in the German Federal Government's Report on Poverty and Wealth (BMAS 2001, 2005, and 2008).

The government's report refers to the bottom margin in part as the "low-income range," which refers to households with an equivalized income of more than 30 percent less than the median. The upper income range consists of households with an income of 50 percent or more than the median which should represent the income group with a high level of prosperity. This results in the following groups:

- Lower range (low income): household income of less than 70 percent of the median
- Middle range (middle income): household income of at least 70 percent of the median, but not more than 150 percent of the median income
- Upper range (high income): household income of more than 150 percent of the median

A number of approaches can be used to identify and measure income polarization, each of which focuses on a different dimension thereof. One approach is to analyze the percentage of the population that falls into the three income groups. If, over time, the share of population in the middle shifts toward the margins, then income polarization has occurred (quantitative polarization). This approach forms the basis for the proposition that the middle-income groups have declined over time (see, e.g., Grabka/Frick 2008; Goebel et al. 2010). A second approach is to examine the gap between the average incomes in the income groups. For example, if the difference between the three group's median incomes increases, this is referred to as a trend toward increased polarization (qualified or qualitative polarization). A

third approach is to consider absolute changes in income. If the poor become poorer and the rich become richer, this reflects an absolute polarization tendency. If the income groups move further apart and, at the same time, the income levels of all of the income groups rise or fall, this is referred to as relative polarization.

The method that appears most suitable for representing the different dimensions of income polarization is to analyze both the shares of population in the different income groups as well as the average income of the respective groups or changes in these values. Temporal and spatial comparisons require a single figure (index) with clearly defined basic assumptions (axioms) for the analysis of income polarization. This is all the more important if the two aforementioned dimensions are to be combined in the analysis. If the analysis of the polarization tendencies only describes the percentage of the population that falls within the defined groups, or the changing gaps between the group-specific average values, then it is impossible to decide which of the compared developments represent stronger polarization. Does a five-percent increase in the share of population in the lowest group, with no change in average value, represent stronger or weaker polarization than if the lower income group only grew by three percent but has to accept losses of income at the same time?

The index which most accurately describes the change in the share of population is the polarization index proposed by Reynal-Querol in 2002. Since the author's background is in political conflict research, this index does not use the additional information on the income gap between the groups. Formally, the index is defined as

$$PRQ(y) = 1 - \sum \left( \frac{0.5 - \pi_i}{0.5} \right)^2 \pi_i \quad ,$$

where  $n$  signifies the number of groups and  $\pi_i$  represents the relative size of group  $i$ . If we assume only two groups, the index is zero when the whole population falls into one of the groups. The index reaches its maximum value when both groups are exactly the same size (50 percent of the population in each group). This index therefore summarizes phenomena such as the decline in importance of the middle-income group (shrinking middle class) by focusing on the proportions of individuals. But the downside is that the additional information from the analysis of income polarization (the average income gap between the groups) is not used.

Attempts to merge the two dimensions of polarization into a single key figure (index) have been proposed, in particular by Esteban and Ray (1994). These indices are based on a reference system of identification and alienation. The underlying idea is relatively simple: polarization is caused by the alienation of different (income) groups from each other and, at the same time, a sense of identification with individuals in an (income) group. However, this does not explain how the individual components should be weighted against each other.

Esteban and Ray 1994 not only developed the "Identification and Alienation" reference system but even proposed an empirical method of measuring it. The index they proposed

weights the population ratios of the groups to each other with the absolute gap between the average incomes of the respective groups. A simple Euclidean distance is used to measure the gap. The index is thus defined as

$$ER(\pi, y) = \sum_{i=1}^n \sum_{j=1}^n \pi_i^{1+\alpha} \pi_j / |y_i - y_j|, \quad ,$$

where  $n$  also represents the number of groups,  $\pi_i$  the relative size of group  $i$ , and  $y_i$  is the median income of group  $i$ . Parameter  $\alpha$  determines the degree of sensitivity of the measure to polarization, i.e., how much more the polarization measure differs from standard inequality measures. Or, in other words, how much an individual in group  $i$  feels alienated from group  $j$ . If parameter  $\alpha$  is equal to zero, this polarization measure corresponds to the Gini coefficient for measuring inequality.

Esteban, Gradín, and Ray (2007) also proposed a generalized version of this index. This version deducts an “error term” which is calculated as the difference between the Gini of the original and the grouped income.<sup>3</sup> This error term, created by the grouping of income distribution, is minimized using an algorithm to automatically determine the groups’ boundaries. The researcher no longer determines the exact income threshold, but instead only defines the number of groups to be formed. The groups’ boundaries are then automatically chosen so that income dispersion within the group is minimized, or, in other words, so the error term, which will later be corrected, is minimized. The discussion about income polarization often only focuses on changes in the percentage of the population in each income group; the impact of income distribution within and between these groups is not usually taken into account. To ensure the complementarity of the descriptive analyses of the percentage shifts, our results only focus on the index originally proposed by Esteban and Ray which maintains the boundaries of the income groups. We use Esteban, Gradín, and Ray’s advanced index for robustness checks.

Other indices proposed for measuring polarization include the index by Wolfson (1994 and 1997) or from Duclos, Esteban, and Ray (2004), both of which, however, are not as well suited to addressing the issues raised here. On the one hand, there is the Wolfson index (also called bi-polarization index), which specifically limits the focus to two groups around the median and therefore cannot reflect the three-way split we have chosen. The other extreme is the index proposed by Duclos et al. which completely omits group dispersion and assesses the polarization of a distribution by estimating its density function.

The confidence intervals were determined using a bootstrapping procedure to estimate the statistical probability of error in determining the polarization measurement used. We worked with 500 replications in this procedure.

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<sup>3</sup> Gigliarano/Mosler (2009) even proposes a multivariate version of a polarization index based on the differentiation of inequality between groups, inequality within groups, and relative groups size.

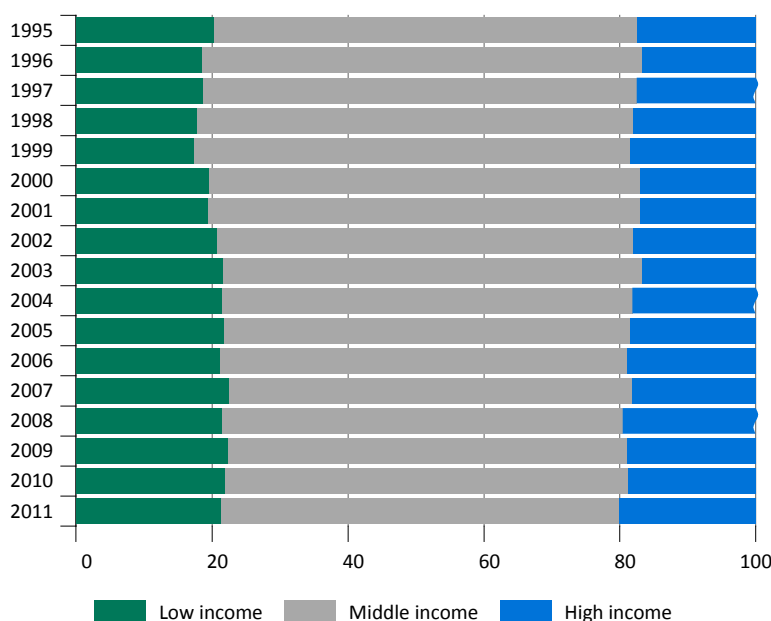
### 3. Results

#### 3.1 Germany Overall

In Europe, the phenomenon of increasing income differences has long been overlooked (OECD 2011). In Germany, however, it was assumed that there were no clear trends in changes in income distribution up to the late 1990s (Hauser 2003). A glance at the development of share of population in the three income groups in Germany as a whole also confirms this view (see Figure 2). The group shares had barely changed up until 2000.

But since the turn of the millennium, income differentiation has increased noticeably in Germany (Goebel et al. 2010). Our results indicate at least a quantitative polarization of income distribution. The percentages of households in the middle-income groups (the middle class) have decreased whereas those in the upper and lower groups have tended to increase. Looking at the three group divisions used here, the increase in the proportion of households with low incomes is particularly clear. This trend continued in 2007 and 2008 where economic development increased significantly, as it also did in the crisis year of 2009. At the same time, the percentage of households with more than 150 percent of median income between 2000 and 2008 has increased almost continuously. The significant decrease in the proportion of individuals living in households with higher incomes in the crisis year of 2009 was already compensated for in subsequent years. In 2012, the share of population in the highest income group was greater than ever before at over 20 percent.

**Figure 2: Income Polarization in Germany 1995 to 2011: Share of Income Groups in Percent**

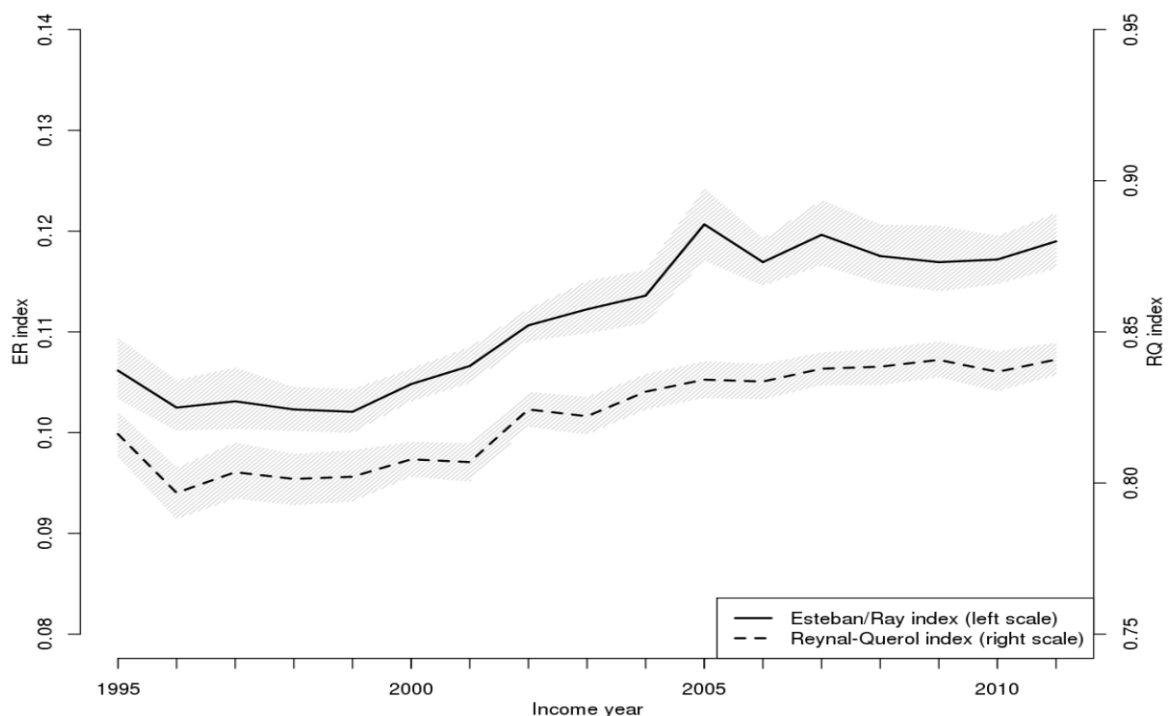


Source: SOEP v29; own calculations.

Looking at the change in percentage of population on both margins of income distribution, the period between 2000 and 2006 is marked by the largest increase in income polarization. This percentage shift is clearly reflected in the Reynal-Querol index (see Figure 3). The percentages of population on the margins of income distribution increased steadily from 2000 to 2008. After a short break in 2009, the index reached its highest peak again in 2011. The gray zone around the line for the index value marks the range of statistical uncertainty with an error probability of five percent. In a longer-term context, the percentage shifts are statistically significant.

Income polarization does not just mean the percentage shifts between income groups, however. Qualified (qualitative) income polarization only exists when the development of the mean income of the three defined groups also diverges. Both components of income polarization are reflected in the Esteban-Ray polarization index. This polarization index increased particularly strongly between 2000 and 2006 (see Figure 3). Income polarization in Germany increased by 18 percent over this period. The Esteban-Ray index shows no clear statistically significant increase or decrease in income polarization in previous or subsequent periods (see also Grabka/Goebel 2014).

**Figure 3: Polarization Indices in Germany, 1995 to 2011:** Esteban-Ray (left axis) and Reynal-Querol (right axis)



Source: SOEP v29; own calculations.

### 3.2 Urban vs. Rural Areas

The idea that income polarization is primarily an indicator of developments in major cities was made popular, in particular, by Saskia Sassen in her description of Global Cities (Sassen, 1994). However, there is no specific empirically verifiable definition for this type of region. The present analysis concentrates on all the major cities in Germany with more than 500,000 inhabitants. This not only includes the cities themselves but also the larger metropolitan areas to capture the relevant spatial economic units (see Map 1). The specific boundaries of the regions being analyzed are based on planning regions defined by the Federal Office for Building and Regional Planning (BBR 2014).

#### Map: Urban Agglomerations in Germany 2011

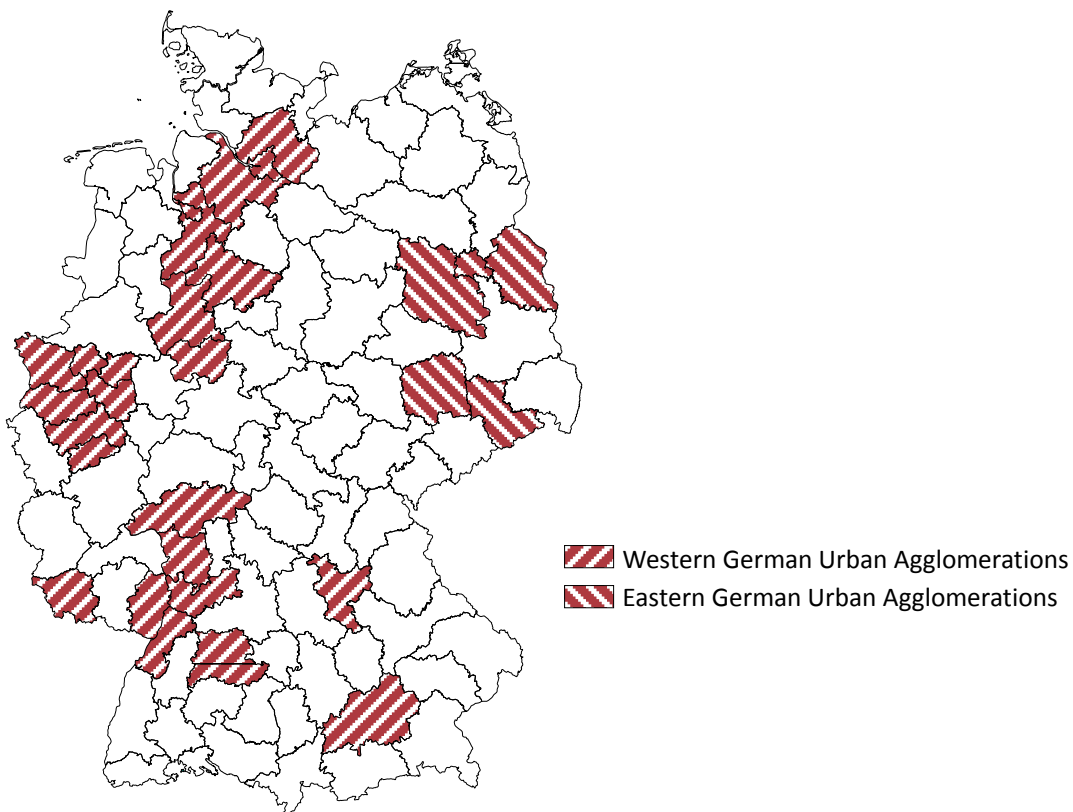
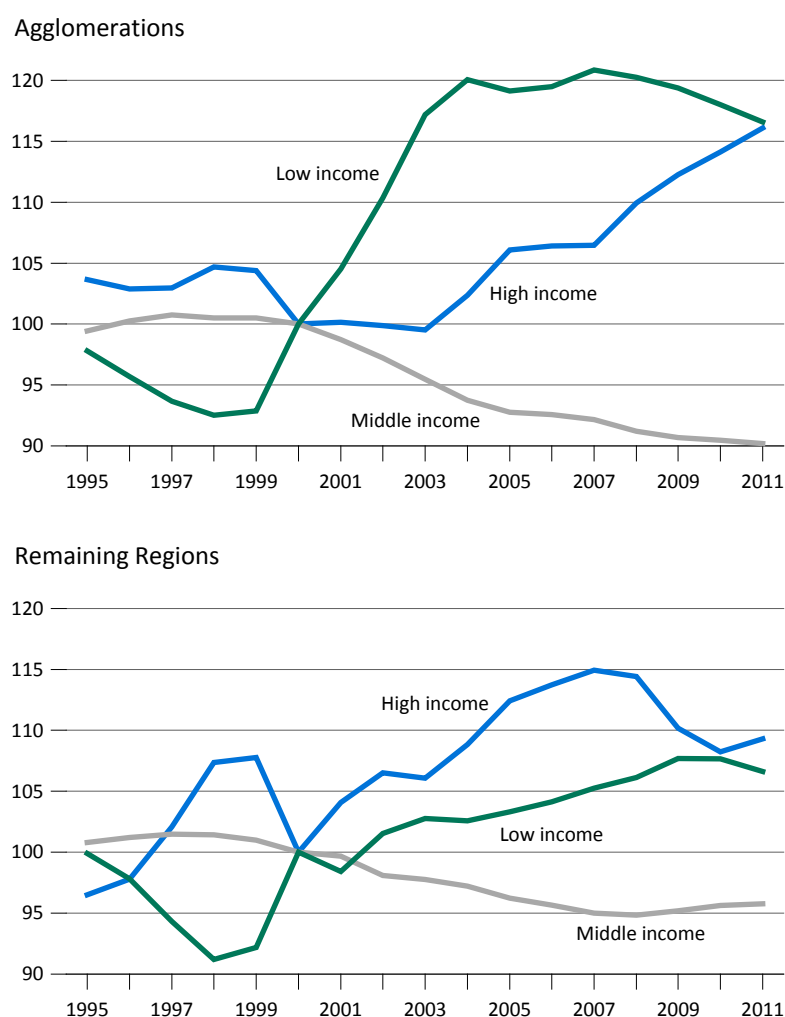


Figure 4 shows the share of households in the three income groups from 1995 to 2011 for urban agglomerations and the rest of Germany (defined here in contrast to urban agglomerations as rural area). The trend towards the decline in importance of the middle-income group (quantitative income polarization) does not appear to be a phenomenon specific to major cities. The share of households with high and low income has increased since 2000 and that of middle-income households has fallen. This applies to the average for urban agglomerations as well as for the remaining regions.



**Figure 4: Shares of Population in Income Groups in Urban Agglomerations, 1995 to 2011**



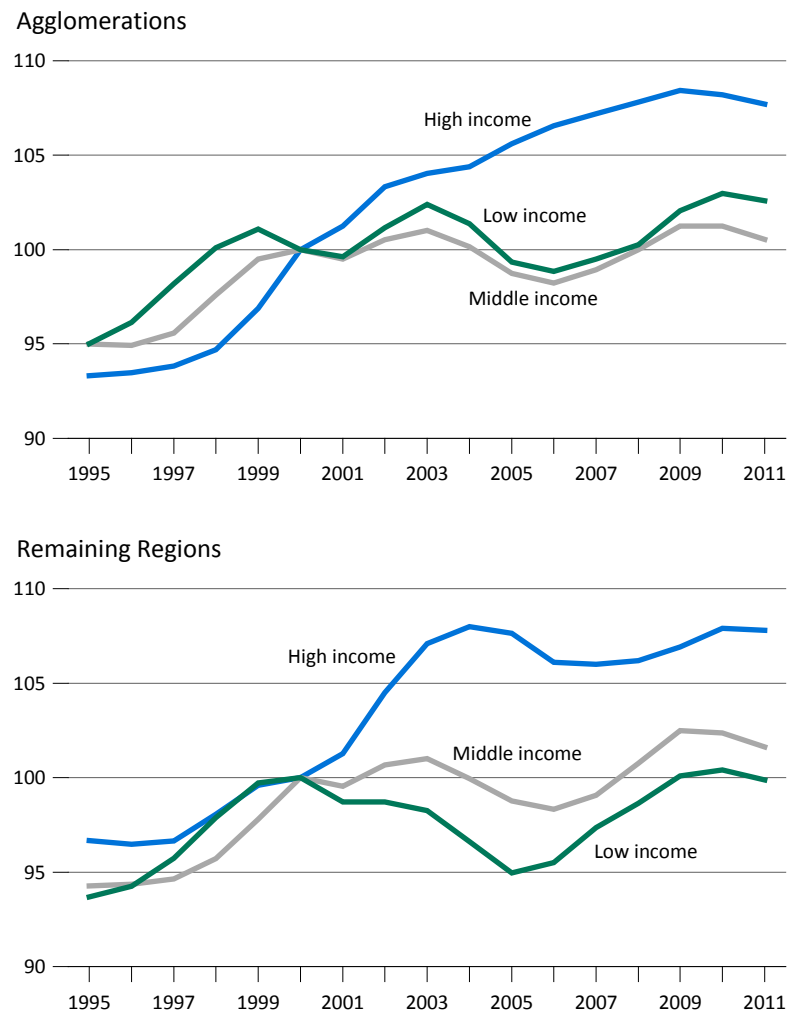
Source: SOEP v29; own calculations.

The severity of quantitative income polarization is, however, far more pronounced in urban agglomerations. As a result, the share of the population in the middle-income group fell by around 10 percent from 2000 to 2011. The corresponding figure is only about five percent in rural areas. Gains at the upper and lower margins are significantly higher in the urban agglomerations, at 15 percent compared to the remaining areas (approximately 8 percent). In addition, the changes in the relative size of the income groups over time differ significantly. Between 2000 and 2006, income polarization in urban agglomerations was driven, in particular, by an increased share of the lower income group. In the rural areas, however, percentage gains in the upper income group dominate during the same period.

The differences in income polarization between urban agglomerations and rural areas are even more evident when the development of the mean income is taken into account (see Figure 5). In urban agglomerations, incomes in the upper income group rose by seven percent in real terms between 2000 and 2011; those in the lower- and middle-income groups,

on the other hand, only increased by just under two percent. Even a significant absolute income polarization was evident in the period from 2000 to 2006 in urban agglomerations. In this period, not only do the margins of income distribution become quantitatively increasingly larger but “the rich get richer” and “the poor get poorer.” The lower- and middle-income groups only reached 2000 income levels in 2009.

**Figure 5: Mean Income of Income Groups in Urban Agglomerations 1995 to 2011**

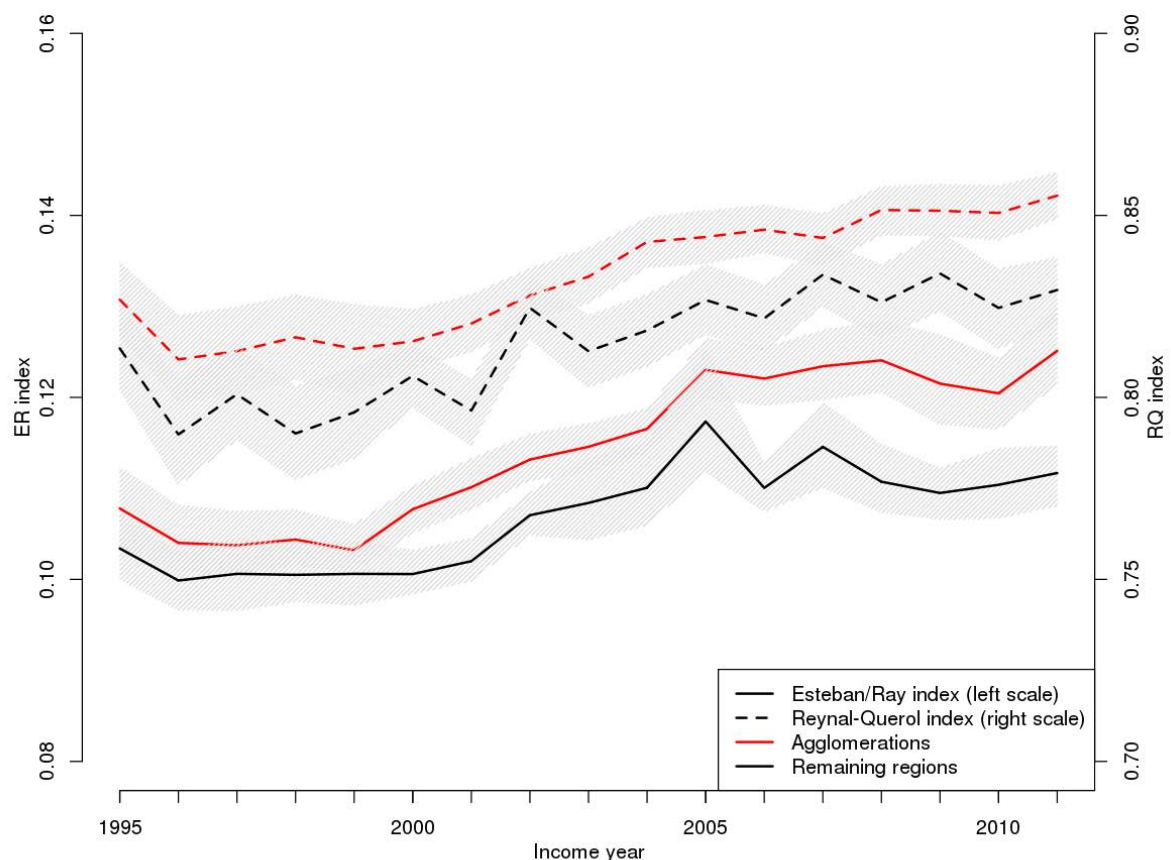


Source: SOEP v29; own calculations.

In the more rural planning areas, the differences in income development between income groups are significantly lower than in the urban agglomerations. The differences in income development in the middle- and upper-income groups, in particular, are only minor. The middle-income group grew by just under three percent in real terms between 2000 and 2011 and the upper income group by only one percent during the same period. Income in the lower income group has only decreased slightly compared to 2000 thanks to the gains made since 2007.

Looking at the development of the polarization indices, there is a clear long-term trend toward statistically significant increases in income polarization in both urban agglomerations and rural areas (see Figure 6). On the one hand, this applies to the decline in importance of the middle-income group. The Reynal-Querol index—as a measure of quantitative income polarization—increased in both regional groups, especially after 2000. On the other hand, this also applies to qualified income polarization. The Esteban-Ray index, which takes into account changes in percentage shares and averages, also indicates a noticeable increase in polarization. But, above all, the polarization indices show that both quantitative and qualified income polarization in urban agglomerations were significantly higher than in the remaining regions. The difference between urban agglomerations and rural areas since 2004 has also been statistically significant at an almost constant level of 95 percent.

**Figure 6: Polarization Indices in Urban Agglomerations and Rural Areas 1995 to 2011:** according to the Esteban-Ray (left axis) and Reynal-Querol (right axis) indices

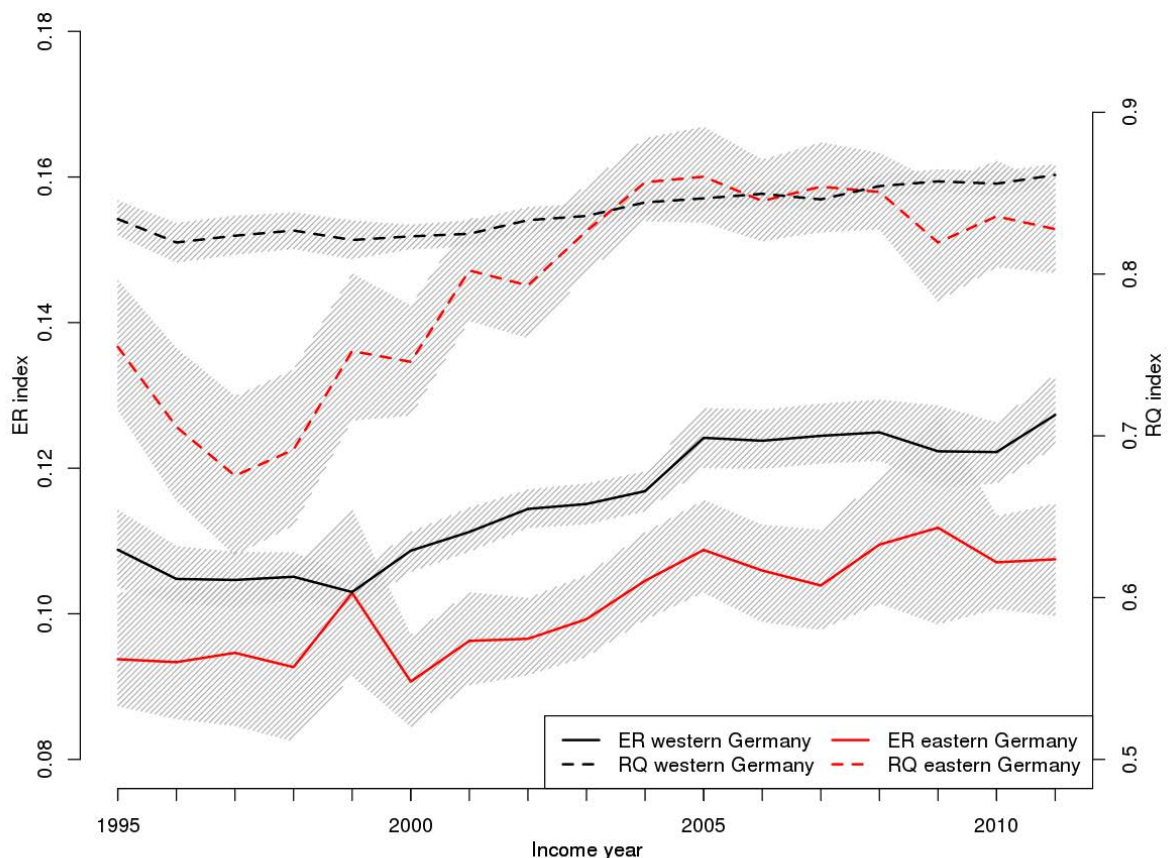


Source: SOEP v29; own calculations.

### 3.3 Western vs. Eastern German Urban Agglomerations

Western and eastern Germany and their urban agglomerations have very different economic and social conditions due to their differing historical developments. The eastern German conurbations, in particular, were characterized by a much lower income differentiation than their western German counterparts. For example, the Reynal-Querol polarization indices for quantitative polarization indicate a rise in the income polarization of eastern German cities to the western German level by 2004. Since 2000, there has no longer been such a large difference between the values at the 95-percent level. The same applies to qualified polarization, taking into account the income gaps between income groups, which are depicted by the Esteban-Ray index (see Figure 7).

**Figure 7: Polarization Indices in Western and Eastern German Urban Agglomerations, 1995 to 2011:** according to the Esteban-Ray (left axis) and Reynal-Querol (right axis) indices



Source: SOEP v29; own calculations.

From 2000 to 2006, eastern and western German conurbations followed a virtually identical evolutionary path. Income polarization rose sharply in both agglomeration types. The importance of the middle-income group as an indication of a shrinking middle class declined significantly in both eastern and western German urban agglomerations. The percentage of

population in the upper and, above all, in the lower income groups grew considerably. As a measure of quantitative polarization, the Reynal-Querol index increases significantly. There is also a high degree of parallelism in the qualified polarization. Despite adverse income development in the upper income groups in eastern Germany, the Esteban-Ray index shows no significant differences between the agglomeration types.

However, after 2006, the differences in income polarization between eastern and western German conurbations rose noticeably. For example, the polarization indices indicate that income polarization in western German agglomerations has tended to continue to grow while in eastern Germany it has remained at a high level or has even tended to decrease slightly. In particular, the percentages in the low-income group have dropped significantly and those in the middle-income group are increasing slightly.

There are many similarities between the developmental trajectories of income polarization and changes in economic structures (see Figure 1). Between 2000 and 2006, the period with the strongest income polarization, the shares of industrial employment in eastern and western German conurbations have decreased significantly. Even after this period, income polarization as well as the importance of manufacturing continued to decline in western German agglomerations, while in eastern Germany, industrial employment began to increase again and the percentage of industry workers of all employed people continued to rise. At the same time, income polarization there stopped increasing.

## 4. Conclusion

Since the 1990s Germany has experienced a notable increase in the polarization of household incomes. In major metropolitan areas, income polarization is significantly more pronounced than in more rural regions. Between 2000 and 2006 not only the spread of the income distribution increased quantitatively, but “the rich got richer” and “the poor got poorer.”

Our panel regression confirms this time-invariant influence by region type (see table above). Agglomerations show significantly higher values for both quantitative polarization (Renal-Querol-Index) and qualified polarization (Esteban-Ray-Index). The latter is confirmed for the use of fixed as well as variable income boundaries (see values in 2nd and 3rd Column). These results generally support Sassen’s (1994) idea about global cities or the study conducted by Eeckhout et al. (2014) looking at extreme-skill-complementaries in US-Cities.

**Table: Panel Regression on Polarization Indices by German planning regions**

	Reynal-Querol index		Esteban-Ray index		Esteban-Ray index var <sup>1)</sup>	
	Coefficient	t-Value	Coefficient	t-Value	Coefficient	t-Value
Agglomeration	0.019*	2.43	0.008**	3.26	0.007**	2.84
East Germany	0.014	1.32	-0.011***	-4.42	-0.013***	-5.51
Business services <sup>2)</sup>	-0.244	-1.12	-0.037	-0.92	-0.040	-0.98
Manufacturing <sup>2)</sup>	-0.191	-1.00	-0.066°	-1.84	-0.072*	-2.27
Growth of GDP	-0.072	-0.88	-0.005	-0.26	-0.002	-0.11
Time						
1997	0.009	1.66	0.000	0.28	0.000	0.52
1998	0.013	1.41	0.000	0.02	0.000	0.14
1999	0.020°	1.80	0.001	0.64	0.002	1.10
2000	0.024°	1.89	0.003	1.12	0.003°	1.76
2001	0.027*	2.10	0.004	1.58	0.005*	2.52
2002	0.035**	2.81	0.006*	2.31	0.007***	3.71
2003	0.043***	3.80	0.007**	2.92	0.009***	4.42
2004	0.045***	3.90	0.008**	3.36	0.010***	4.55
2005	0.055***	4.73	0.012***	5.13	0.012***	5.89
2006	0.062***	4.73	0.014***	5.52	0.014***	6.32
2007	0.065***	4.36	0.014***	5.00	0.015***	6.13
2008	0.055***	3.80	0.011***	3.46	0.011***	4.73
2009	0.067***	5.23	0.012***	4.52	0.012***	5.48
2010	0.070***	4.80	0.013***	4.81	0.014***	5.82
R squared	0.13		0.23		0.28	
Observations	1275		1275		1275	

1) Variable income boundaries; 2) Changes in the shares of business services and manufacturing industries

°p<0.1, \*p<0.05, \*\*p<0.01, \*\*\*p<0.001

Source: SOEP v29; NAS of *Länder*; own calculations.

In Germany, historic differences between East and West German regions also still have some influence on the development (also see Stich 1999). When only considering the Renal-Querol-Index, controlling for the lower urban concentration in East Germany, the quantitative

polarization does not show significant differences between the regions in East and West Germany. When considering differences in income between the groups, as with the Esteban-Ray-Index, the regions in the East show considerably lower levels of income polarization.

Income polarization in Germany from 1996 until 2010 is likely to have multiple causes (Biewen/Juhasz 2012). Some of which are directly linked to policy changes such as the deregulation of the labor market, cuts in social transfers or the reduction of the top income tax rate. Looking at the changes in Income polarization over time within the scope of a panel regression one can assume a political effect, especially for qualified polarization (see table below). While during the nineties there is no evidence for a significant increase of the polarization indices compared to the base year 1996, the coefficients show an abrupt increase in 2001 and 2002. Compared to the base year they subsequently rise steadily.

For the qualified polarization, which considers the income gap using the Esteban-Ray-Index, there is a climax in 2007 and values continue to stay significantly above the base year. This development is paralleled by relevant policy changes (Becker/Hauser 2006). 2002 the first step of the so called Hartz reforms got introduced with major deregulations on the labor market (e.g. tighter reasonability regulations for unemployed, “mini-jobs”, contingent work and subcontracted labor). 2004 and 2005 changes in transfer rules followed. Additionally between 2001 and 2005 the top tax rate gradually decreased from 51% to 42%. 2007 a tax rate of 45% gets introduced for the highest income group.

Changes in Household income are also associated with structural changes in the economy. When analyzing the wage structures other studies particularly focus on changes in the task structure (for Germany Dauth 2014). We, however, are more focused on changes in sectoral employment structures (see table). Changes in industry structure can also cause polarization, as wages vary across sectors, due to differences in the level of unionization and rent-sharing. Controlling for differences in regional growth (changes in GDP) there is a tendency that regions with a relatively prospering manufacturing will show smaller polarization. At least this is true for qualified polarization. There is no significant evidence for the influence of business service sectors.

The results connecting the change in sectoral structure with income polarization follow the ideas of Harrison/Bluestone (1988) about the importance of the manufacturing industry for the stability of income distribution. The overall decline in polarization with renewed growth in manufacturing also points in the same direction. As a result of this growth, Eastern German metropolitan areas (Berlin, Leipzig, and Dresden) have been able to avoid a further widening of the income gap. In the Western German metropolitan areas, which show a much higher rate of tertiarization, income polarization, however, has continued to increase up to the present date.

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