



# **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\*\*

### **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, 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. Yet deindustrialization and the shift to tertiary sectors could result in increasing wage differentiation. Numerous studies on global cities, the dual city, and divided cities have 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 urban 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. Extensive deindustrialization is probably also one of the drivers of this process, and it has weakened Germany's middle-income groups in particular. One weakness of the SOEP data is the small sample size available for the analysis of regional differences. To analyze polarization at the municipal level, we use new data from microm. These data provide the number of households with very low or very high socio-economic status at the level of street sections for all municipalities in Germany. Preliminary analysis shows that the results are consistent across the two datasets, with both SOEP and microm results depicting very similar situations. The added value of the microm data lies in their potential to identify socio-spatial differentiation processes within urban agglomerations.

### **Keywords**

Polarization, household income, urban, deindustrialization, inequality, cities, Germany

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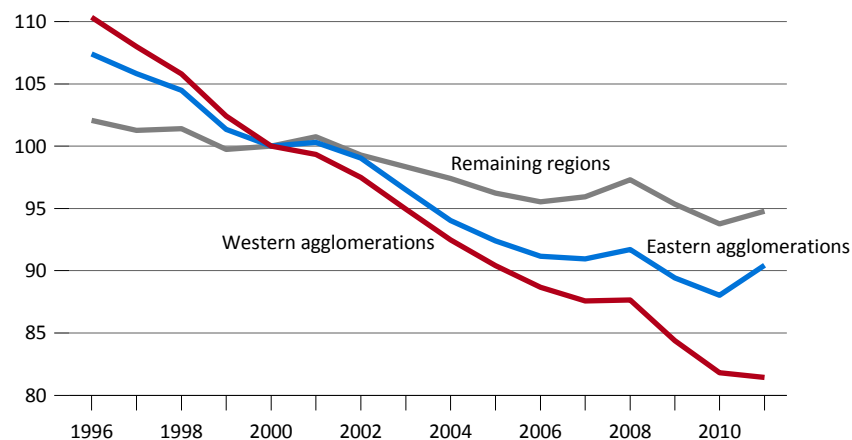
## Background and Research Questions

In western Germany, manufacturing initially declined after reunification. Over time, however, German industry focused more and more on research-intensive sectors (electrical and mechanical engineering, automobile manufacturing, the chemical industry), and in 2007 and 2008, manufacturing even became an engine for growth. But the global financial and economic crisis brought this process to a halt, at least temporarily. 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).

In 1989, the level of industrialization in East Germany was 50 percent higher than in West Germany (Gornig/Häußermann 2002). After German reunification, 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 of manufacturing. Since 2009, the share of industry in GDP in Eastern German cities has been rising again after a period of decline in the wake of reunification (see Figure 1). An analysis of how deindustrialization has affected the polarization of income in Germany must therefore differentiate between East and West. This is particularly crucial if the period under investigation starts before 2000 due to the completely different situations in East and West Germany after 41 years of the country's division.

**Figure 1: Change of Industry Shares in Western and Eastern German Urban Agglomerations 1996-2011, 2000=100**

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Source: National Accounts Statistics 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 have led to a decline in income differences over the course of the twentieth century. This enabled broad segments of the working population to enjoy 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).

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: first, a rise in demand caused by the increasing income elasticity of demand, and second, a low increase in productivity as a result of temporal and spatial consumer and producer constraints (Fisher 1939). At an early stage, limited potential for productivity increases was identified as a possible cause of 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).

From another perspective, wage polarization is seen as the result of technological change (Autor et al. 2003). It is assumed that the computerization of the economy can affect employment in various ways. Employees whose jobs entail a large share of routine tasks can easily be replaced by computers. At the same time, the new technologies involve tasks that demand flexibility, creativity, or communication. These complementary jobs usually require a high level of education and are located at the upper end of the wage distribution, whereas routinized, programmable tasks such as clerical work and trades are typically found in the middle of the education and wage distribution.

At the same time, low wage, low-skill, personal service jobs are not affected by technological rationalization and cannot be replaced by computers. This results in polarization, with employment and wage losses in the middle of the income distribution, strong growth at the top end, and medium growth at the bottom end, with workers originally employed in the middle sorting into high-end and low-end jobs (Autor/Dorn 2013). The changing demand for labor calls for parallel developments in the labor supply in terms of the qualifications and age of the workforce. Trade and migration may also impact the extent of polarization.

Aside from changes in the structure of occupations and tasks, changes in industry structure can also fuel polarization. Different Industries pay different wages for the same occupation. This may 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 has traditionally had a higher level of unionization and higher levels of rent-sharing than other sectors. Deindustrialization—which has resulted in a shift to services, leading to de-unionization—is another dimension that needs to be considered when trying to explain income polarization.

In the US, the increasing polarization of the income distribution has been virtually undisputed since the end of the 1970s (Bernstein et al. 2002). Since 2000, there has been a marked increase in income disparities in Germany and the rest of Europe as well (OECD 2011). Particularly in Europe, it is important to take into account the effects in both the primary and secondary income distribution. Reallocation arrangements play an important role in many European countries. They can weaken the effects of wage polarization as well as fuel polarizing tendencies through changes in social insurance and tax legislation. For Germany, however, empirical evidence has shown that the increase in income inequality is caused by changes in market income rather than by 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. Only a few of these were able to use representative income data—for instance, studies on London (Hamnett 2003) and Zurich (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 based on a concept proposed by Sassen (1994): extreme skill complementary. The core idea is that cities attract many highly qualified and hence highly productive workers. These workers can further enhance their productivity by handing down complementary low-skill tasks, at either the household level or at work, to lower-paid service workers, who are therefore also attracted to cities.

Other regional income studies, however, see wage polarization as the direct result of technological change. In a study on the US, Autor and Dorn (2013) attribute differences in wage polarization between regions to differences in occupational structure. Regions with a large share of routine tasks show particularly strong polarization. For Germany, similar results have been reported for regions in western Germany (Dauth 2014).

To date, there has been no systematic statistical comparison of the regional development of income structures after redistribution. This is due primarily to the lack of an adequate data base. Despite the increasing number of cities—both in Germany and elsewhere—that would like to gain a clearer picture of their household income situation, this research has been conducted mainly in the form of separate, parallel studies that do not allow for comparative analysis (Aehnelt et al. 2009). The present analysis uses a unified German data base to compare income polarization between different regions. The empirical analysis aims to provide a starting point to answer the following two questions for Germany:

- Is income polarization a phenomenon specific to major metropolitan regions, or is it a general characteristic of broader social developments?
- How do patterns of development differ between Eastern and Western German metropolitan regions that showed significant disparities after reunification, not only in socio-political conditions but also in economic structures and development?
- How does the spatial pattern of polarization differ among regional levels?



# Data and Methodology

## Data Basis

We use two different data sources to analyze income polarization in Germany. The first source is micro-level data on households from the Socio-Economic Panel (SOEP) and the second stems from micromarketing data from microm. In the following, we describe these two sources in more detail.

The Socio-Economic Panel (SOEP, version 29) study is a representative longitudinal survey of socio-economic and demographic characteristics for research on the living conditions of the German population. The SOEP includes detailed regional information about the households surveyed. This enables us to analyze regional subgroups of the population and thus examine regional disparities. 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.

Although the regional indicators available in the SOEP are very fine-grained (up to the level of the geographic coordinates of the city block), the sample size sets the limit in the level of the spatial analysis. Depending on the planning region where the household resides, we categorize all households into two groups: those living in an urban agglomerations and those not. Urban agglomerations are defined as regions around major German cities with more than 500,000 inhabitants. The specific boundaries of the regions under analysis are defined according to the planning regions of the Federal Office for Building and Regional Planning (BBR 2014). The

polarization indices in the main part of our analysis are thus not calculated for each metropolitan area itself but for all households living in metropolitan areas versus for all households living in rural areas. All confidence intervals were determined using a bootstrapping procedure (500 replications) to estimate the statistical probability of error in determining the polarization measurement used.

To describe the income situation of households in the SOEP, we conducted our analysis based on the annual household income information provided in the survey. 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 households surveyed are added together, in each case referring to the previous calendar year ( $t-1$ , the income year). We applied the revised OECD equivalence scale, standardized income in Euro at 2000 prices adjusted to the respective income year. Following Frick et al. (2006), each new subsample is taken into account starting with the second survey wave in order to exclude fluctuations over time due to methodological factors influencing response behavior.

To describe polarization at the more granular community level, we make use of additional commercial micro-geographic data from the company Micromarketing-Systeme and Consult GmbH (microm). The microm data system contains various characteristics frequently used to analyze and describe customer databases or markets. This information is available at different regional levels, the smallest possible being the building level, which contains approximately 17.8 million buildings in Germany. The building level covers seven to eight households on average (with a minimum of at least five households due to data protection regulations). Buildings with fewer than five households are pooled with households in the same neighborhood that are similar in structure. However, the microm data are based on very different sources, which are available at

different territorial levels. The combination and statistical models used to project this data to the smallest regional level are not always thoroughly documented, since microm normally provides their data for commercial purposes (Goebel et al. 2007). From this smallest regional level, the data can then be aggregated to any larger regional level, such as street sections, postal codes, municipalities, or counties. Because the postal codes in Germany differ significantly in population size, microm invented an additional intermediate level, between street sections and postal codes, called the “postcode-8” level<sup>i</sup>. Similar and connected street sections within one postal code are grouped together into regions containing around 500 households each. To calculate the polarization indices at the community level, we use data on this postcode-8 level.

In the analysis of the microm data, we do not have direct data about the income of the households living in a given postcode-8 region. Instead, we make use of information based on the microm variable “socioeconomic status.” This variable is a factor score calculated by microm and based mainly on education and income. In a second step, microm calculated deciles for the 2013 distribution of Germany as a whole. These numbers, combined with the number of households living in each postcode-8 region (around 82000), are the basis for further calculations for each community (around 11,000 persons) or planning region. Although the microm data are similar to data from a representative population survey, they do contain some uncertainties due to underlying statistical estimates. It is not possible to calculate correct confidence intervals, however, because of the missing information about the model design used by microm.

## **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 estimations of the polarization effect of employment growth based on 1980 wage ranks. The major finding is that between 1980 and 2010, job polarization occurred almost exclusively in urban areas. However, this regression approach completely 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.” Classic inequality indices measure the income gap between individuals or social groups, whereas polarization not only considers the gap between incomes but also the percentage of the population with low or high incomes relative to the percentage 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, increasing polarization does not always coincide with increasing inequality. It is even possible for inequality to decrease as polarization increases. For example, differences within groups at the margins of the distribution may decline while the spread of the overall income distribution increases (Esteban/Ray 1994).

This method of measuring polarization presupposes, at least for descriptive purposes, a division of the 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. To evaluate changes in the income distribution, income polarization is generally distinguished from income inequality or income poverty based on the idea that changes in both margins of the income distribution play a particular role in relation to the center. In contrast to the poverty research, the research on income polarization focuses not only

on the lower margin and changes occurring in it, but also on the upper one. To measure the polarization of income distribution, therefore, three groups are usually formed: bottom, middle, and top. The income ranges used here for the SOEP data follow the definitions from the German Federal Government's Report on Poverty and Wealth (BMAS 2001, 2005, and 2008). This results in the following groups:

- Lower range (low income): household income  $< 70\%$  of the median income
- Middle range (middle income): household income  $\geq 70\%$  and  $\leq 150\%$  of the median
- Upper range (high income): household income  $> 150\%$  of the median

For the additional analyses with the microm data, we used the lowest and the highest decile across all of Germany for each postcode-8 level as cut-off values to count the number of households below or above these thresholds.

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 groups' median incomes increases, this is referred to as a trend toward increased polarization (which we refer to as 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 trend. 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 5 percent increase in the share of population in the lowest group with no change in average income represent stronger or weaker polarization than 3 percent growth in the lower income group with an accompanying decrease in average income?

The index that 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 need the additional information on the income gap between groups. The index can therefore be calculated both with the micom data and with the SOEP data. 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  $i$ . This index therefore reflects phenomena such as the decline in importance of the middle-income group (shrinking middle class) by focusing on the proportion of individuals in each group. But the downside of this index is that it does not use

the additional information from the analysis of income polarization (the average income gap between the groups) that we are able to do with the SOEP data

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 a simultaneously increasing sense of identification with individuals in the same (income) group. However, this does not explain how the individual components should be weighted against each other.

The index proposed by Esteban and Ray (1994) weights the ratios of the population groups to one another based on 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  $y_i$  the median income of group  $i$ . Parameter  $\alpha$  determines the degree of sensitivity of the measure to polarization, that is, 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.

The discussion of income polarization often focuses solely on changes in the percentage of the population in a given income group, thus neglecting the impacts of the distribution within and between groups. To ensure consistency in our descriptive analyses of the percentage shifts, we focus on the index originally proposed by Esteban and Ray, which maintains the boundaries of the income groups. For robustness checks, we use Esteban, Gradin, and Ray's (2007) advanced index, with variable income boundaries.

Other indices for measuring polarization include that proposed by Wolfson (1994 and 1997) and Duclos et al. (2004), neither of which, however, is as well suited to addressing the issues raised here. On the one hand, the Wolfson index (also called bi-polarization index) 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.



## Results

### *Germany Overall*

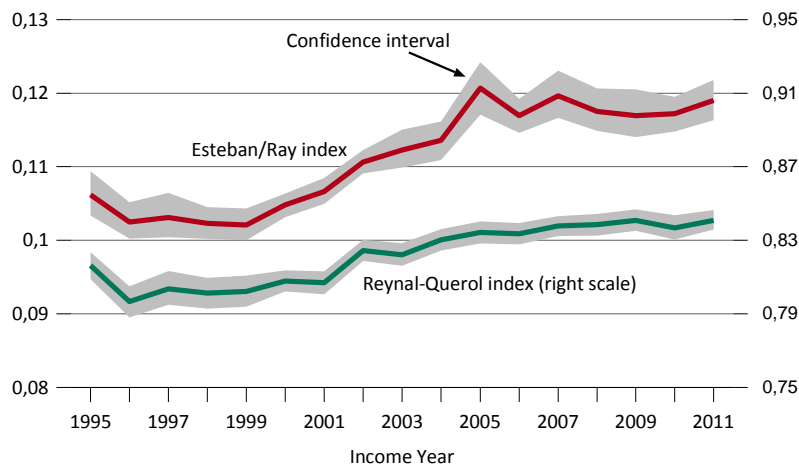
In Europe, the phenomenon of increasing income differences has long been overlooked (OECD 2011). In Germany, however, it was assumed that there were no clear trends in changes in income distribution up to the late 1990s (Hauser 2003). Since the turn of the millennium, however, income differentiation has increased noticeably in Germany (Goebel et al. 2010). Our results indicate at least a quantitative polarization of the 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.

This percentage shift is clearly reflected in the Reynal-Querol index (see Figure 2). The percentages of the population on the margins of the 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 5 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 2). 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 2: Polarization Indices in Germany, 1995 to 2011: Esteban-Ray (left axis) and Reynal-Querol (right axis)**



Source: SOEP v29; own calculations.

## Urban vs. Rural Areas

The idea that income polarization is an important indicator of developments in major cities was popularized by Saskia Sassen in her description of “global cities” (Sassen, 1994). However, there is no specific empirically verifiable definition of this type of region. The present analysis considers all of the major cities in Germany with more than 500,000 inhabitants. It includes not only the cities themselves but also the larger

metropolitan areas to capture all relevant spatial economic units (see Map 1). The specific boundaries of the regions under analysis here are defined according to the planning regions of the Federal Office for Building and Regional Planning (BBR 2014).

**Map 1: Urban Agglomerations in Germany 2011**

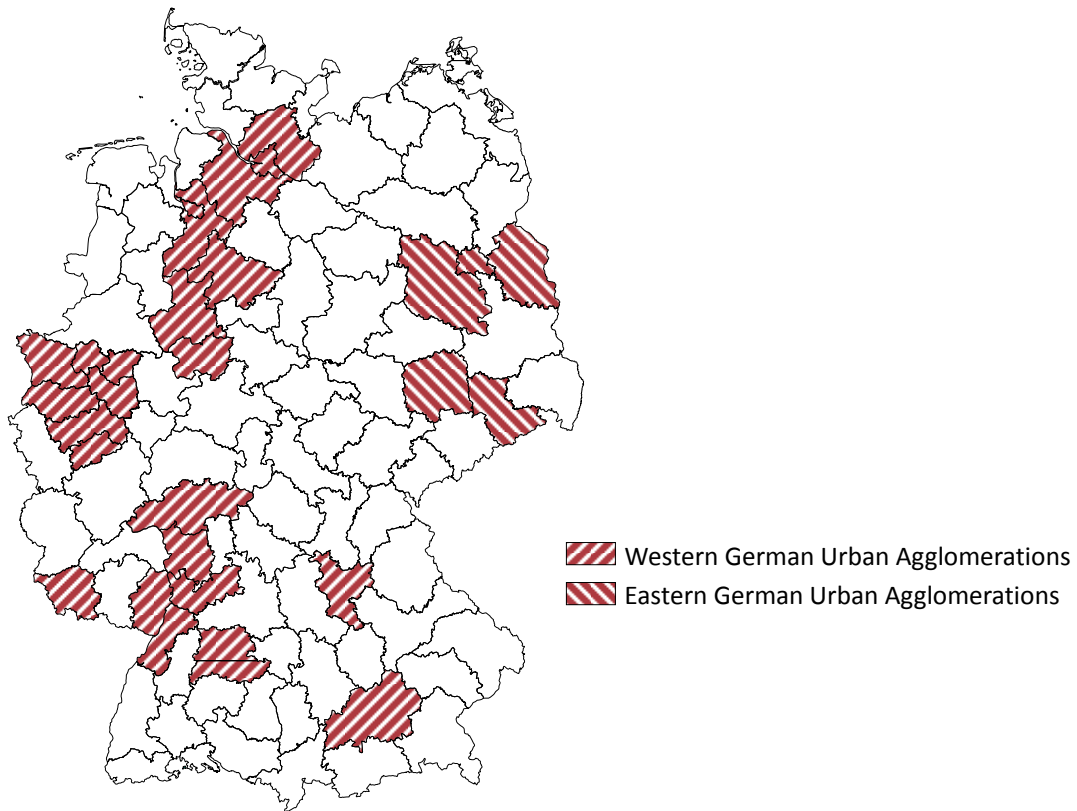
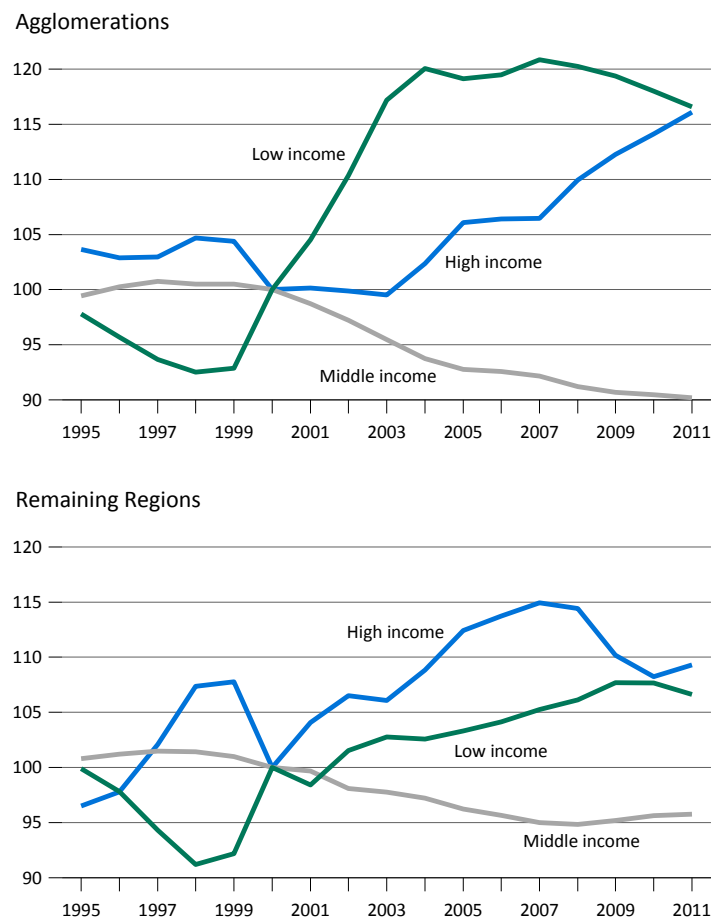


Figure 3 shows the share of households in the three income groups from 1995 to 2011 for urban agglomerations and the rest of Germany (defined here in contrast to urban agglomerations as rural area). The declining importance of the middle-income group (quantitative income polarization) does not appear to be a

trend specific to major cities. The share of households with high and low income has increased since 2000 and that of middle-income households has decreased. This applies to the average for urban agglomerations as well as for the remaining regions.

**Figure 3: Change of Shares of Population in Income Groups in Urban Agglomerations, 1995 to 2011, 2000=100**

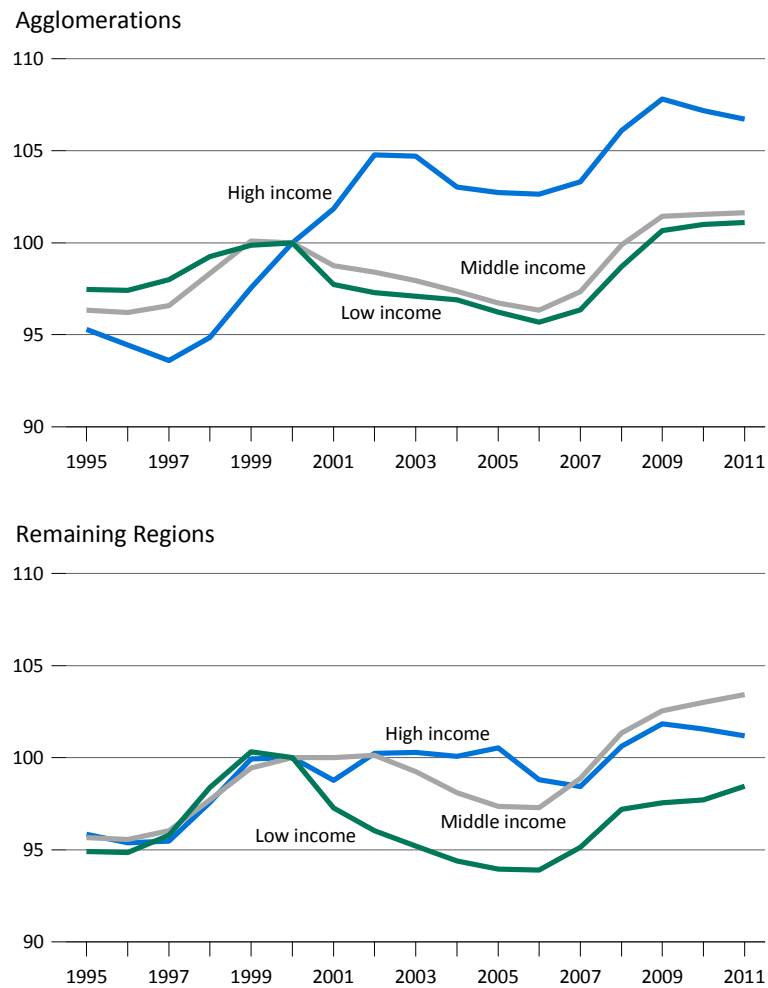


Source: SOEP v29; own calculations.

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 5 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 4). In urban agglomerations, incomes in the upper income group rose by 7 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 2 percent. Significant absolute income polarization was evident in the period from 2000 to 2006 in urban agglomerations. In this period, not only did the margins of income distribution increase quantitatively (see Figure 3); the mean income in the top income group also increased and that in the low-income group decreased (see Figure 4). In other words, “the rich got richer” and “the poor got poorer.” The lower and middle-income groups only reached 2000 income levels in 2009.

**Figure 4: Change of Mean Income of Income Groups in Urban Agglomerations 1995 to 2011, 2000=100**

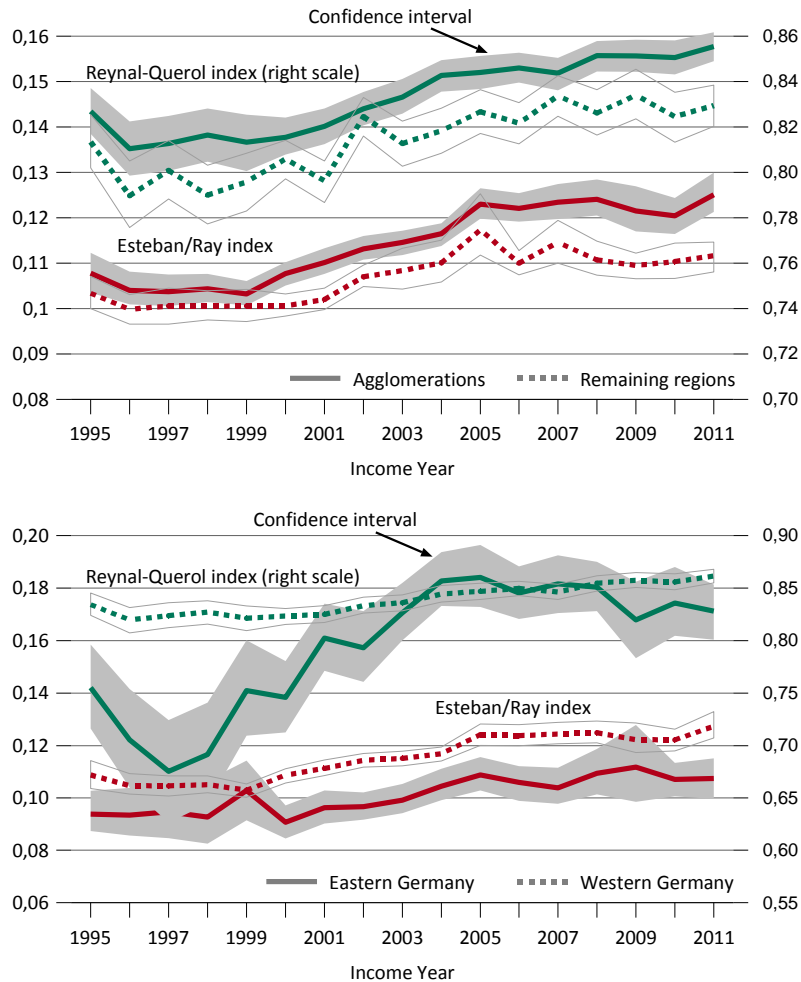


Source: SOEP v29; own calculations

In the more rural regions, the differences in income development between income groups are significantly lower than they are in the urban agglomerations. Differences in the middle and upper income groups, in particular, are only minor. The middle-income group grew by just under 3 percent in real terms between 2000 and 2011 and the upper income group by only 1 percent during the same period. Income in the lower income group has decreased only slightly relative to 2000 thanks to the income 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 5, top). 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 was 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 5: Polarization Indices in Urban Agglomerations and Rural Areas and 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.



## ***Western vs. Eastern German Urban Agglomerations***

Economic and social conditions in Western and Eastern Germany and their urban agglomerations differ widely due to the differing histories of the two parts of Germany. 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 relative to the western German levels by 2004. Since 2000, the difference between the values at the 95 percent level has not been as large. 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 5, bottom).

From 2000 to 2006, Eastern and Western German urban agglomerations followed virtually identical evolutionary paths, with income polarization rising sharply in both. The importance of the middle-income group as an indication of a shrinking middle class declined statistically significantly in both Eastern and Western German urban agglomerations. The percentage of the population in the upper and especially in the lower income groups grew considerably. As a measure of quantitative polarization, the Reynal-Querol index increased statistically significantly. The qualified polarization in East and West also followed close to parallel paths. Despite declining income in the upper income groups in Eastern Germany, the Esteban-Ray index shows no significant differences between agglomeration types.

However, from 2006 on, the differences in income polarization between Eastern and Western German urban agglomerations rose substantially. For example, the polarization indices indicate that in the West, income

polarization has continued to grow while in the East it has remained high or has even been decreasing slightly. The percentages in the low-income group have dropped significantly and those in the middle-income group have increased slightly.

There are many similarities between the trajectories of income polarization and economic structures (see Figure 1). Between 2000 and 2006, the period with the strongest income polarization, the shares of industrial employment in East and West decreased significantly. Even after this period, both income polarization and the role of manufacturing continued to decline in Western German urban agglomerations, while in Eastern Germany, industrial employment began to increase again and the percentage of industrial workers in total employment continued to rise. At the same time, income polarization plateaued.

### ***Spatial differentiation by planning regions***

So far, we have only analyzed urban agglomerations versus rural areas, without differentiating among specific regions. In the following panel regression conducted at the level of the environmental planning regions, we calculate the polarization indices for all 90 German planning regions.<sup>ii</sup> This finding confirms the time invariant influence by region type irrespective of the data source (see Table). Urban agglomerations show significantly higher values for both quantitative polarization (Reynal-Querol Index) and qualified polarization (Esteban-Ray Index). The latter result also holds when using fixed as well as variable income boundaries (see values in Columns 2 and 3).

**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; National Accounts Statistics of *Länder*; own calculations.

Whether a region was located in the West or the East only partially determined the income polarization results. The quantitative polarization does not show significant differences between the regions of East and West, considering the Reynal-Querol Index alone. When considering differences in income between the groups in the dependent variable with the SOEP—as is the case with the Esteban-Ray Index—the regions in the East show considerably lower levels of income polarization than those in the West.

Moreover, when controlling for differences in regional growth (changes in GDP) and changes in the shares of the business service sector and manufacturing, regions with a relatively prosperous manufacturing sector show lower levels of polarization. This is true at least for qualified polarization when using the Esteban-Ray Index. There is no statistically significant evidence that changes in the share of the business service sector have affected polarization. At the same time, the year dummy shows that the process of increasing income polarization is not continuous. There was no evidence of a significant increase in the polarization indices during the 1990s compared to the base year 1996, and the coefficients show a substantial increase, reaching a peak in 2006 relative to the base year.

### ***Spatial differentiation by municipalities***

The microm data offer further insight into the spatial differentiation of polarization in Germany, beyond that provided by the SOEP data. Map 2 below shows the polarization measured by the Reynal-Querol index, mapped either on the spatial level of municipalities or on the district level of Berlin and Hamburg. The overall pattern is largely consistent with the results of the SOEP data at the level of planning regions (ROR). Polarization is particularly pronounced in the urban agglomerations Rhine-Ruhr, Rhine-Main, Stuttgart, Munich, Hamburg, and Berlin. Within these agglomerations, however, interesting differences appear. Often, the areas exhibiting peak values for polarization are the downtown areas or specific inner city districts but certain outlying areas or suburbs.

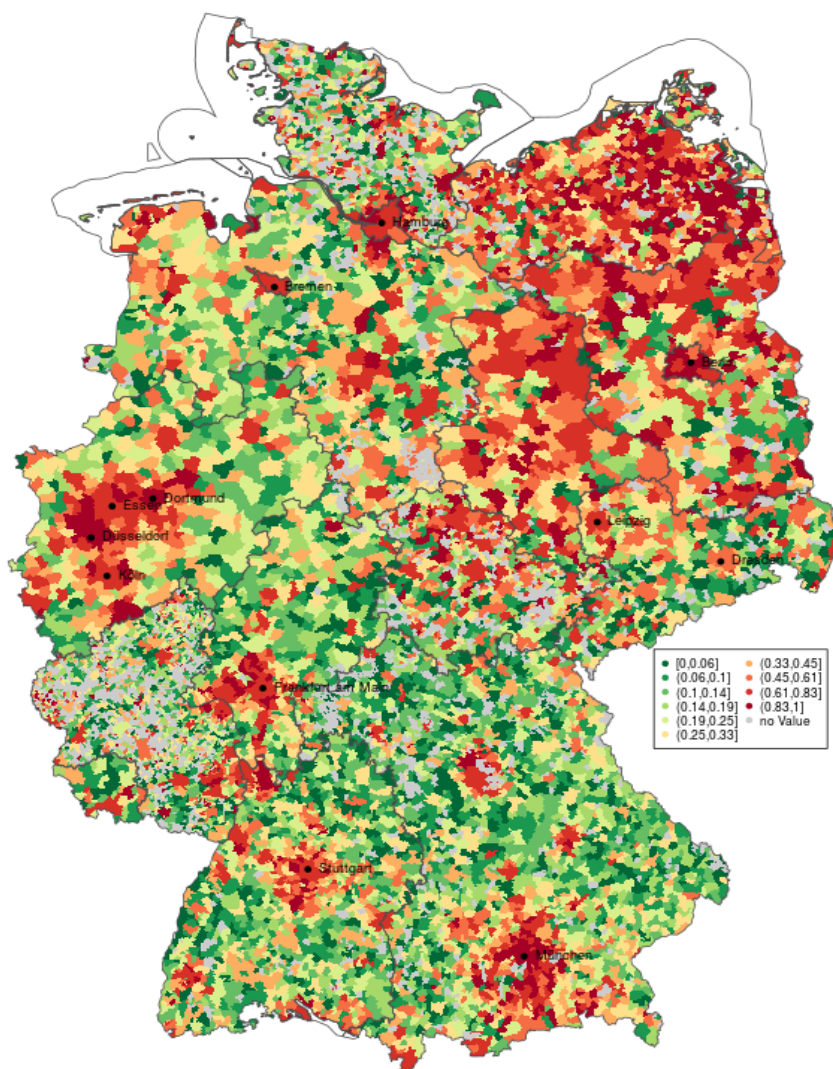
Conversely, municipalities with very little polarization can be found in rural areas far from the major economic centers. This spatial pattern is particularly pronounced in the states of the former West Germany. Examples can be found eastern Bavaria and western North Rhine-Westphalia. However, the states of Saxony and Thuringia in south of the former GDR also exhibit this distinctive urban-rural gap in polarization. In Mecklenburg-Vorpommern, northern Saxony-Anhalt, and Brandenburg, all in the north of the former GDR, polarization is often as pronounced as it is in metropolitan areas, although there are almost no large cities in these areas and the population density is the lowest in all of Germany.

On average, for all municipalities in Germany, however, there is a clear relationship between the size of the municipality and the level of polarization (Figure 6). The 14 cities in Germany with more than 500,000 inhabitants exhibit the highest polarization values with a median index slightly above 0.8. In the second-largest size class of municipalities, with populations between 100,000 and 500,000 residents, the median polarization index is still above 0.75. In small municipalities of less than 20,000 inhabitants, the median polarization index reaches not even half of these values. None of the three relevant municipality size classes shows a median index above 0.35.

The correlation between municipality size and polarization index is positive but surprisingly low, with a correlation coefficient of 0.22. This is influenced by the high level of polarization in small municipalities, and can be found in both urban agglomerations as well as in the rural areas in the northeast of Germany, as can be seen in the high number of extreme values at the upper area in the two smallest municipality size classes in Figure 6.

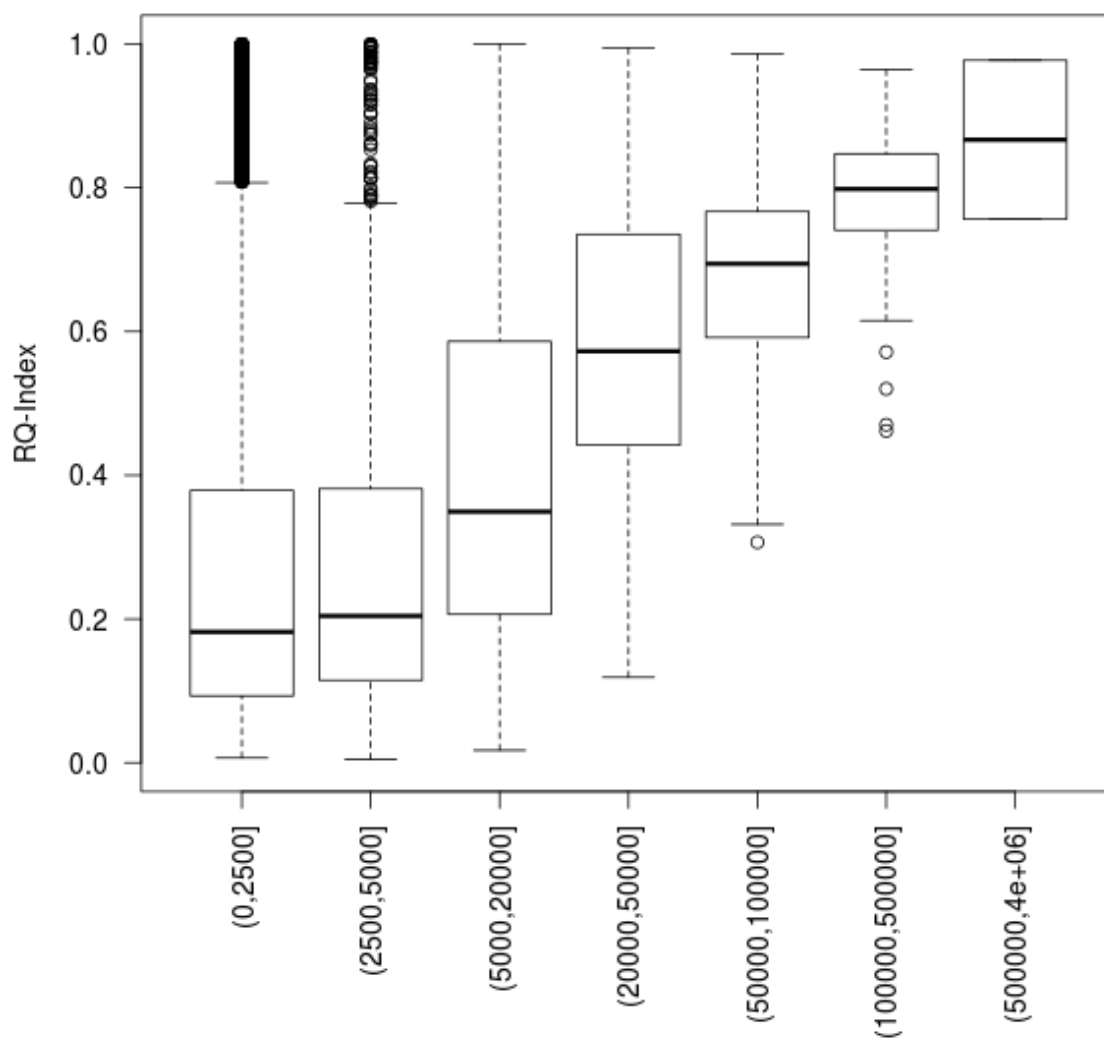
**Map 2: Reynal-Querol polarization index at the level of communities**

2013



3 microm status groups (lowest vs. highest decile)  
Regional level: PLZ8 (2013)

Figure 6: Mean Reynol-Querol index by municipality size classes



## Conclusion

Since the 1990s, Germany has experienced a substantial 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 did the spread of the income distribution increase quantitatively but also “the rich got richer” and “the poor got poorer.”

The income polarization seen in Germany from 1996 to 2010 is likely to have multiple causes (Biewen/Juhasz 2012). Some of these may be directly linked to policy changes such as the deregulation of the labor market, cuts in social transfers, and 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 policy effect, especially for qualified polarization (see Table before).

For qualified polarization, which considers the income gap using the Esteban-Rey Index, there is a peak in 2007 and values continue to stay significantly above the base year. This development is paralleled by major policy changes (see Becker/Hauser 2006). The most important changes were introduced in the so-called Hartz reforms. The main goal was to significantly deregulate the labor market to reduce unemployment rates, especially for the long-term unemployed (e.g., tighter regulations on the unemployed, “mini-jobs,” contingent work, and subcontracted labor). In 2004 and 2005, changes in social transfers followed. The former unemployment benefits for the long-term unemployed (“Arbeitslosenhilfe”) and social assistance were combined but the overall level was on the low end of the social assistance provided previously. Besides these



Hartz reforms, between 2001 and 2005 the top tax rate was also gradually lowered from 51 percent to 42 percent and in 2007 a tax rate of 45 percent was introduced for the highest income group.

Changes in household income are also associated with structural changes in the economy. When analyzing wage structures, other studies have focused on changes in the task structure (for Germany, see Dauth 2014). In this paper, however, we focused more on changes in sectoral employment structures. Changes in industry structure can also cause polarization, as wages vary across sectors due to differences in the level of unionization and rent-sharing. Our results show that regions with a relatively strong manufacturing sector display lower qualified polarization.

The results connecting changes in sectoral structures with income polarization follow the ideas of Harrison and Bluestone (1988) about the importance of manufacturing for the stability of the income distribution. The observed overall decline in polarization accompanied by 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 has continued to increase up to the present date.

Urban agglomerations show significantly higher values for both quantitative polarization (Renal-Querol Index) and qualified polarization (Esteban-Ray Index) and generally support Sassen's (1994) idea about global cities as well as the study by Eeckhout et al. (2014) on extreme skill complementarities in US cities. Additionally, in Germany, historic differences between regions of the East and West also still have some influence on development (see also Stich 1999).

The analysis at the municipal level shows that the quantitative polarization, measured with the Reynal-Querol index, is particularly pronounced in the sparsely populated northeast of the former GDR. This could be due to the low density of manufacturing industries in this area and the resulting lack of specialized craftspeople, who are employed largely in manufacturing and form the core of Germany's middle class. The income gaps between income groups, however, still appear significantly lower in East Germany than in the West. Accordingly, the results for qualitative polarization, measured with the Esteban-Ray index on the level of planning regions, exhibit noticeably lower values in East Germany.

The example above clearly demonstrates the advantages of combining these two complementary data sets. While the SOEP data permit observation of income levels and their development, they only allow for a certain degree of regional differentiation. With the microm data, however, small-scale developments can be observed that can help to identify areas with pronounced social disparities and point to segregation processes. The research results presented here are consistent where the two data sets depict similar situations.

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<sup>i</sup> The German postal system uses five-digit postal codes, and microm added three additional digits at the end for further differentiation. The name therefore refers to the length of the identifier with eight digits.

<sup>ii</sup> Due to the low number of households in some of the smaller rural regions, for our robustness analysis we combined them with some adjacent rural regions such that all of the resulting regions have at least 120 households averaged over time. Twenty-five regions were collapsed into 11 regions, resulting in a total of 76 regions for the robustness analysis. All results were stable and are available on request.