

Gornig, Martin; Goebel, Jan

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# Deindustrialisation and the polarisation of household incomes: The example of urban agglomerations in Germany

**Martin Gornig**

German Institute for Economic Research (DIW Berlin), Germany

**Jan Goebel**

German Institute for Economic Research (DIW Berlin), Germany

*Urban Studies*

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## Abstract

The tertiarisation, or perhaps more accurately, the deindustrialisation 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. Industrialisation, collective wage setting, and the welfare state led to a stark reduction in income differences over the course of the 20th century. Conversely, deindustrialisation 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 polarisation as a central phenomenon in the development of major cities. Using data from the German Socio-Economic Panel (SOEP), we find an increasing polarisation of household income structures since the mid-1990s. In urban agglomerations, this income polarisation is even more pronounced than in the more rural regions. The income polarisation in Germany is likely to have multiple causes, some of which are directly linked to policies such as the deregulation of the labour market. But extensive deindustrialisation is probably also one of the drivers of this process, and it has directly weakened Germany's middle-income groups.

## Keywords

cities, deindustrialisation, Germany, household income, inequality, polarisation, urban

## 摘要

发展第三产业，或者更准确地说，经济的去工业化给城市留下了深刻的伤痕。这一点不仅体现在工业荒地和空厂房中，在收入和城市的社会结构方面也是显而易见的。在 20 世纪，工业化、集体工资制度和福利国家导致人们的收入差距明显缩小。反过来，去工业化和转向第三产业可能导致工资差异的扩大。此外，无数关于全球城市、双重城市和分化城市的研究也将收入分化确定为大城市发展的核心现象。我们运用德国社会经济事务委员会 (SOEP) 的数据，发现自 20 世纪 90 年代中期以来，家庭收入结构日益两极分化。这种收入分化在城市群中比农村地区更为明显。德国的收入分化可能有多种原因，其中一些与劳动力市场放松管制等政策直接相关。但广泛的去工业化也可能是这个过程的驱动因素之一，它直接削弱了德国的中等收入群体。

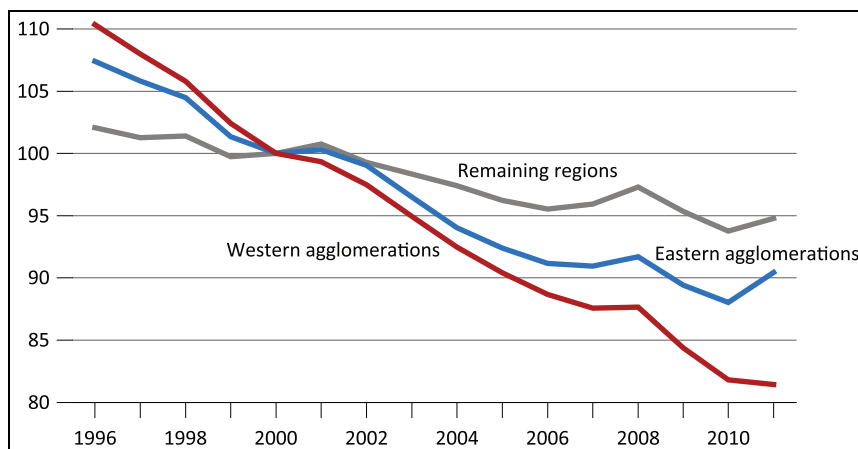
## 关键词

城市、去工业化、德国、家庭收入、不平等、两极分化、城市化

## 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 specialised industries but also in tradeable knowledge-intensive services (Beyers, 2005; Gornig, 2005; Illeris, 2005) concentrated in major cities (Geppert et al., 2008; Südekum, 2006). Despite the recovery of manufacturing, these sectors have led to further tertiarisation in western German urban agglomerations (see Figure 1).

In 1989, the level of industrialisation in East Germany was 50% higher than in West Germany (Gornig and 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 deindustrialisation has affected the polarisation of income in Germany must therefore differentiate between East and West. This is particularly crucial if the period under investigation starts before 2000 because of 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.

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

### Corresponding author:

Martin Gornig, German Institute for Economic Research (DIW Berlin), Mohrenstr. 58, Berlin, 10117, Germany.

Email: mgornig@diw.de

The tertiarisation, or perhaps more accurately, the deindustrialisation of the economy has left deep scars on cities, with industrial wastelands and empty factory buildings dotting the urban landscape. The impacts of deindustrialisation are evident not only in the marked differences in growth between cities but also in urban income and social structures. The combined effects of industrialisation, collective wage setting, and the welfare state have led to a decline in income differences over the course of the 20th 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 and Kapphann, 2000).

However, the current shift to deindustrialisation and tertiarisation 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 labour costs do not need to rise. The process of tertiarisation 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 and Bluestone, 1988).

From another perspective, wage polarisation is seen as the result of technological change (Autor et al., 2003). It is assumed that the computerisation 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 routinised, 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 rationalisation and cannot be replaced by computers. This results in polarisation, 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 and Dorn, 2013; Goos and Manning, 2007). The changing demand for labour calls for parallel developments in the labour supply in terms of the qualifications and age of the workforce. Trade and migration may also impact the extent of polarisation.

Aside from changes in the structure of occupations and tasks, changes in industry structure can also fuel polarisation. 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 because of unionisation (Gerlach and Stephan, 2006). Manufacturing has traditionally had a higher level of unionisation

and higher levels of rent-sharing than other sectors. Deindustrialisation – which has resulted in a shift to services, leading to deunionisation – is another dimension that needs to be considered when trying to explain income polarisation.

In the USA, the increasing polarisation 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 (Organisation for Economic Cooperation and Development (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 polarisation as well as fuel polarising 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 and Juhasz, 2012).

On a regional level, the income polarisation issue has been part of discussions relating to global cities (Sassen, 1991), the dual city (Mollenkopf and Castells, 1991), and divided cities (Fainstein et al., 1992). The idea expressed in these hypotheses – that income polarisation is predominantly found in major cities – has prompted a multitude of studies analysing 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 and Kortteinen, 2003), Amsterdam, and Rotterdam (Burgers and 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-Schretzenmayer 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 (1991): 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 polarisation as the direct result of technological change. In a study on the USA, Autor and Dorn (2013) attribute differences in wage polarisation between regions to differences in occupational structure. Regions with a large share of routine tasks show particularly strong polarisation. 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 database to compare income polarisation between different regions. The empirical analysis aims to provide a starting point to answer the following two questions for Germany:

- (1) Is income polarisation a phenomenon specific to major metropolitan regions,

or is it a general characteristic of broader social developments?

- (2) 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?

## Data and methodology

### Data basis

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 analyse 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 categorise 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 (Bundesinstitut für Bau-, Stadt- und Raumforschung-BBSR (BBR), 2014). The polarisation 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 polarisation 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, standardised 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 because of methodological factors influencing response behaviour.

### Methodology

To date, there is no standard approach for measuring income polarisation. Dauth (2014) uses a quadratic term in a linear regression on employment growth by occupations for the estimation of polarisation of the German labour market. The quadratic term gives estimations of the polarisation effect of employment growth based on 1980 wage ranks. The major finding is that between 1980 and 2010, job polarisation occurred almost exclusively in urban areas. However, this regression approach completely ignores possible polarisation effects because of a widening wage spread. Other studies using specific indices to measure polarisation do not always make a clear

distinction between the terms ‘polarisation’ and ‘inequality’. Classic inequality indices measure the income gap between individuals or social groups, whereas polarisation 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 polarisation highlights convergences around local means (Cowell, 2000). Therefore, increasing polarisation does not always coincide with increasing inequality. It is even possible for inequality to decrease as polarisation increases. For example, differences within groups at the margins of the distribution may decline while the spread of the overall income distribution increases (Esteban and Ray 1994).

This method of measuring polarisation 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 (Eurostat Task Force, 1998). To evaluate changes in the income distribution, income polarisation 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 centre. In contrast to the poverty research, the research on income polarisation focuses not only on the lower margin and changes occurring in it, but also on the upper one. To measure the polarisation of income distribution, therefore, three groups are usually formed: bottom, middle, and top. The income ranges used here follow the definitions from the German Federal Government’s Report on Poverty and Wealth (Bundesministerium für Arbeit und Soziales (BMAS), 2001, 2005, 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.

A number of approaches can be used to identify and measure income polarisation, each of which focuses on a different dimension thereof. One approach is to analyse 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 polarisation has occurred (quantitative polarisation). This approach forms the basis for the proposition that the middle-income groups have declined over time (see, e.g. Goebel et al., 2010; Grabka and Frick, 2008). 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 polarisation (which we refer to as qualified or qualitative polarisation). A third approach is to consider absolute changes in income. If the poor become poorer and the rich become richer, this reflects an absolute polarisation 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 polarisation.

The method that appears most suitable for representing the different dimensions of income polarisation is to analyse 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 polarisation. This is all the more important if the two aforementioned

dimensions are to be combined in the analysis. If the analysis of the polarisation 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 polarisation. Does a 5% increase in the share of population in the lowest group with no change in average income represent stronger or weaker polarisation than 3% 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 polarisation 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 groups. Formally, the index is defined as:

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

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 polarisation (the average income gap between the groups).

Attempts to merge the two dimensions of polarisation 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: polarisation 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:

$$ER(\pi, y) = \sum_{i=1}^n \sum_{j=1}^n \pi_i^{1+\alpha} \pi_j |y_i - y_j| \quad (2)$$

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 polarisation, that is, how much more the polarisation 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 polarisation measure corresponds to the Gini coefficient for measuring inequality.

The discussion of income polarisation 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 et al.'s (2007) advanced index, with variable income boundaries.

Other indices for measuring polarisation include that proposed by Wolfson (1994, 1997) and Duclos et al. (2004), neither of which, however, is easily understandable to match the three-way split we have chosen. On the one hand, the Wolfson index (also called bi-polarisation index) specifically limits the focus to two groups around the



median. The other extreme is the index proposed by Duclos et al., which completely omits group dispersion and assesses the polarisation 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 polarisation 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 grey zone around the line for the index value marks the range of statistical uncertainty with an error probability of 5%. In a longer-term context, the percentage shifts are statistically significant.

Income polarisation does not just mean the percentage shifts between income groups, however. Qualified (qualitative) income polarisation only exists when the development of the mean income of the three defined groups also diverges. Both components of income polarisation are reflected in the Esteban-Ray polarisation index. This polarisation index increased particularly strongly between 2000 and 2006

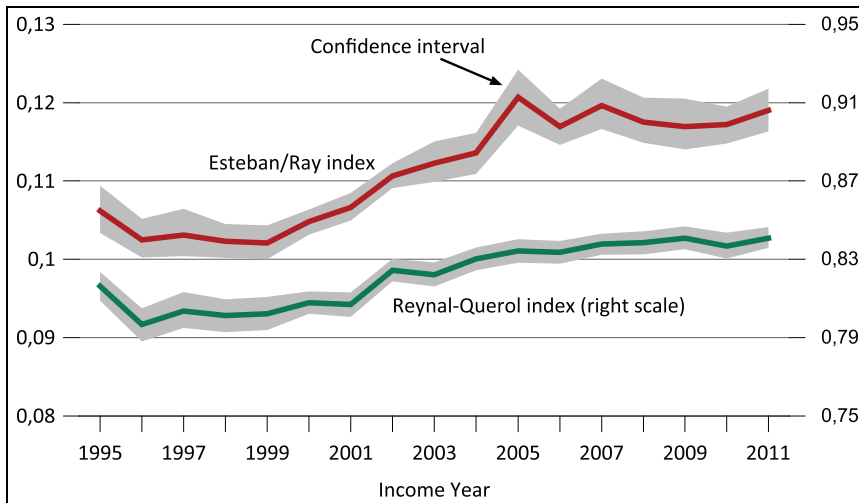
(see Figure 2). Income polarisation in Germany increased by 18% over this period. The Esteban-Ray index shows no clear statistically significant increase or decrease in income polarisation in previous or subsequent periods (see also Grabka and Goebel, 2014).

### *Urban versus rural areas*

The idea that income polarisation is an important indicator of developments in major cities was popularised by Saskia Sassen in her description of ‘global cities’ (Sassen, 1991). 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. 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).

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 polarisation) 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.

The severity of quantitative income polarisation 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% from 2000 to 2011. The corresponding figure is only about



**Figure 2.** Polarisation indices in Germany, 1995 to 2011: Esteban-Ray (left axis) and Reynal-Querol (right axis).

Source: SOEP v29; own calculations.

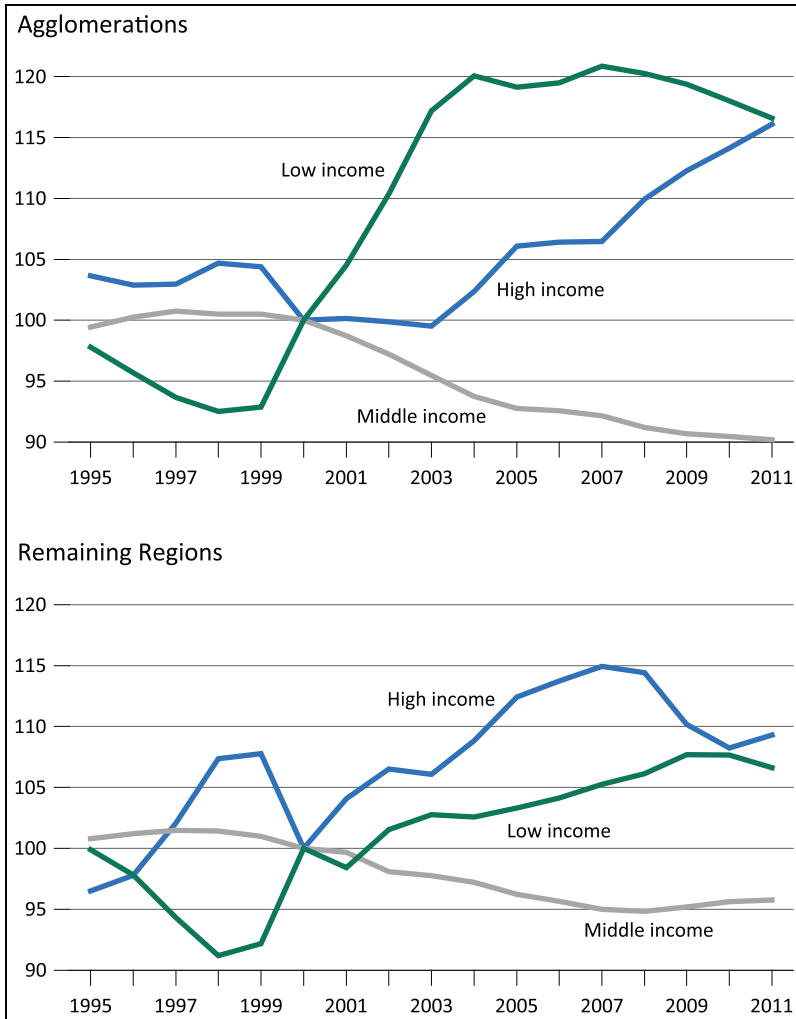
5% in rural areas. Gains at the upper and lower margins are significantly higher in the urban agglomerations, at 15% compared with the remaining areas (approximately 8%). In addition, the changes in the relative size of the income groups over time differ significantly. Between 2000 and 2006, income polarisation 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 polarisation 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% 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%. Significant absolute income polarisation 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.

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% in real terms between 2000 and 2011 and the upper income group by only 1% 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 polarisation indices, there is a clear long-term trend toward statistically significant increases in income polarisation in both

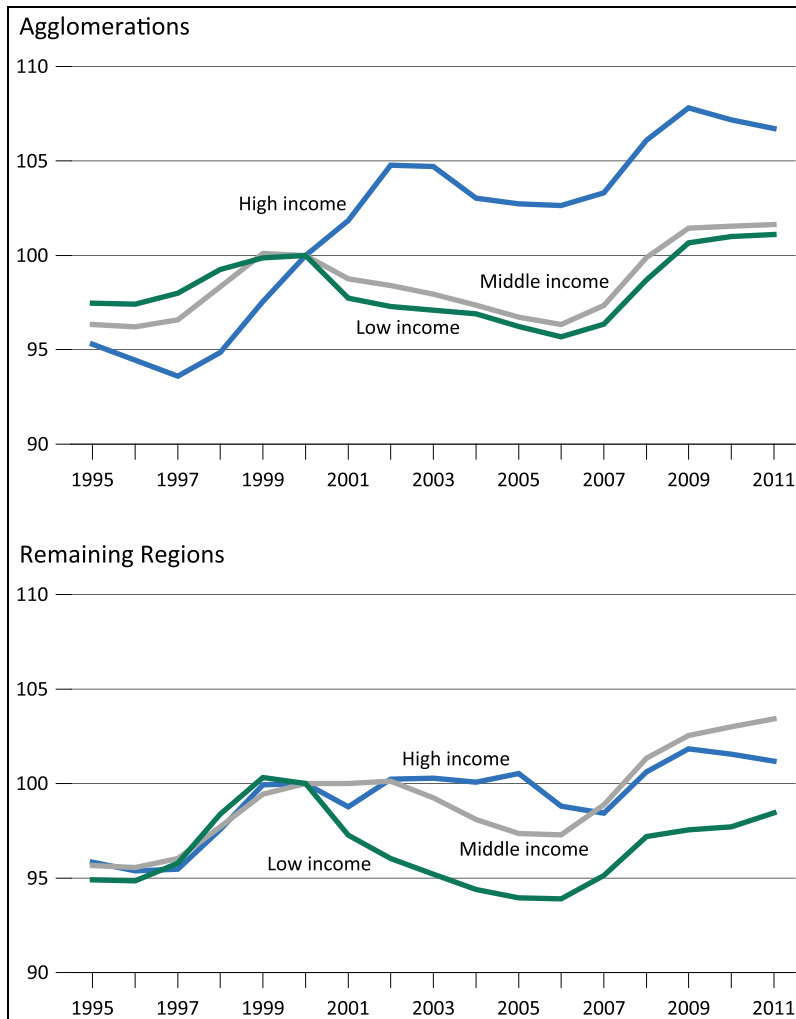


**Figure 3.** Change of shares of population in income groups in urban agglomerations and rural areas, 1995 to 2011, 2000 = 100.

Source: SOEP v29; own calculations.

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 polarisation – increased in both regional groups, especially after 2000. On the other hand, this also applies to qualified income polarisation. The Esteban-Ray index, which takes into

account changes in percentage shares and averages, also indicates a noticeable increase in polarisation. But, above all, the polarisation indices show that both quantitative and qualified income polarisation 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



**Figure 4.** Change of mean income of income groups in urban agglomerations and rural areas, 1995 to 2011, 2000 = 100.

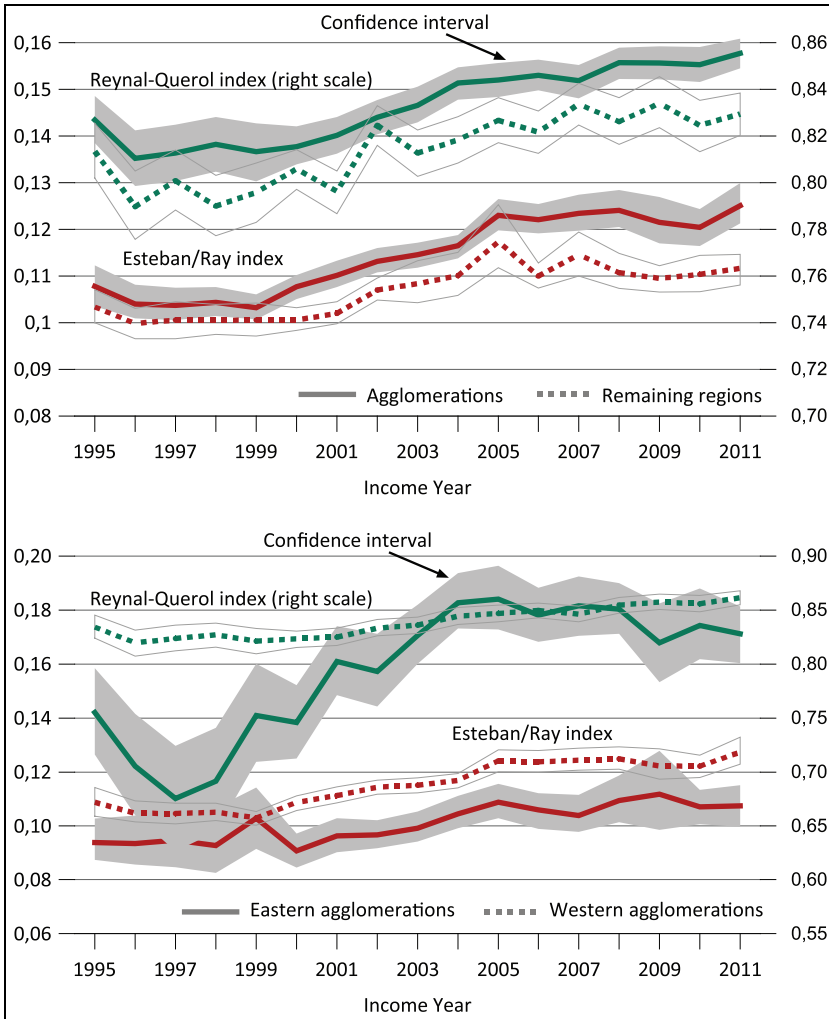
Source: SOEP v29; own calculations.

significant at an almost constant level of 95%.

### *Western versus Eastern German urban agglomerations*

Economic and social conditions in Western and Eastern Germany and their urban agglomerations differ widely because of the differing histories of the two parts of

Germany. The Eastern German conurbations, in particular, were characterised by a much larger income differentiation than their western German counterparts. For example, the Reynal-Querol polarisation indices for quantitative polarisation indicate a rise in the income polarisation of Eastern German cities relative to the western German levels by 2004. Since 2000, the difference between the values at the 95% level has not been as



**Figure 5.** Polarisation 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.

large. The same applies to qualified polarisation, 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 polarisation 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 polarisation, the Reynal-Querol index increased statistically significantly. The qualified polarisation 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 polarisation between Eastern and Western German urban agglomerations rose substantially. For example, the polarisation indices indicate that in the West, income polarisation 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 polarisation and economic structures (see Figure 1). Between 2000 and 2006, the period with the strongest income polarisation, the shares of industrial employment in East and West decreased significantly. Even after this period, the rise of income polarisation and the decline of manufacturing continued 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 polarisation plateaued.

### **Contrasting results**

So far, we have only analysed 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 polarisation indices for all 90 German planning regions.<sup>1</sup> This finding confirms the time invariant influence by region type (see Table 1). Urban

agglomerations show significantly higher values for both quantitative polarisation (Renal-Querol Index) and qualified polarisation (Esteban-Ray Index). The latter result also holds when using fixed as well as variable income boundaries (see values in columns 2 and 3).

Whether a region was located in the West or the East only partially determined the income polarisation results. The quantitative polarisation does not show significant differences between the regions of East and West, considering the Renal-Querol Index alone. When considering differences in income between the groups in the dependent variable – 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 polarisation. This is true at least for qualified polarisation when using the Esteban-Ray Index. There is no statistically significant evidence that changes in the share of the business service sector have affected polarisation. At the same time, the year dummy shows that the process of increasing income polarisation is not continuous. There was no evidence of a significant increase in the polarisation 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.

### **Conclusion**

Since the 1990s, Germany has experienced a substantial increase in the polarisation of household incomes. In major metropolitan areas, income polarisation is significantly more pronounced than in more rural

**Table 1.** Panel regression on polarisation indices by German planning regions.

	Reynal-Querol index		Esteban/Ray index		Esteban/Ray index var <sup>a</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>b</sup>	-0.244	-1.12	-0.037	-0.92	-0.040	-0.98
Manufacturing <sup>b</sup>	-0.191	-1.00	-0.066 <sup>o</sup>	-1.84	-0.072*	-2.27
Growth of GDP	-0.072	-0.88	-0.005	-0.26	-0.002	-0.11
<i>Time</i>						
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 <sup>o</sup>	1.80	0.001	0.64	0.002	1.10
2000	0.024 <sup>o</sup>	1.89	0.003	1.12	0.003 <sup>o</sup>	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

Notes: <sup>a</sup>Variable income boundaries; <sup>b</sup>changes in the shares of business services and manufacturing industries.

<sup>o</sup> $p < 0.1$ , \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

Source: SOEP v29; National Accounts Statistics of Länder; own calculations.

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’.

Urban agglomerations show significantly higher values for both quantitative polarisation (Renal-Querol Index) and qualified polarisation (Esteban-Ray Index) and generally support Sassen’s (1991) idea about global cities as well as the study by Eeckhout et al. (2014) on extreme skill complementaries in US cities. Additionally, in Germany, historic differences between regions in the East and West also still have some influence on the development (see also Stich, 1999).

The income polarisation seen in Germany from 1996 to 2010 is likely to have multiple

causes (Biewen and Juhasz, 2012). Some of these may be directly linked to policy changes such as the deregulation of the labour market, cuts in social transfers, and the reduction of the top income tax rate. Looking at the changes in income polarisation over time within the scope of a panel regression, one can assume a policy effect, especially for qualified polarisation (see Table 1).

For qualified polarisation, which considers the income gap using the Esteban-Ray 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 and Hauser, 2006). The most important changes were introduced in the so-called Hartz

reforms. The main goal was to significantly deregulate the labour market to reduce unemployment rates, especially for the long-term unemployed (e.g. tighter regulations on the unemployed, 'mini-jobs', contingent work, and subcontracted labour). 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% to 42% and in 2007 a tax rate of 45% was introduced for the highest income group.

Changes in household income are also associated with structural changes in the economy. When analysing 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 polarisation, as wages vary across sectors because of differences in the level of unionisation and rent-sharing. Our results show that regions with a relatively strong manufacturing sector display lower qualified polarisation.

The results connecting changes in sectoral structures with income polarisation 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 polarisation 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 tertiarisation, income polarisation has continued to increase up to the present date.

When looking at possible future developments, two opposing trends can be identified. On the one hand, the accelerating digitalisation of the economy may further aggravate the trend toward polarisation. In Germany, this might occur to an increased degree as deindustrialisation continues (Buhr, 2015). On the other hand, the recently introduced policy measures in Germany might counteract an increase in the income spread, particularly with the recent introduction of the general minimum wage (Möller, 2012).

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### Note

1. Owing 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.

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