

Increasing Wage Inequality in Germany

What Role Does Global Trade Play?



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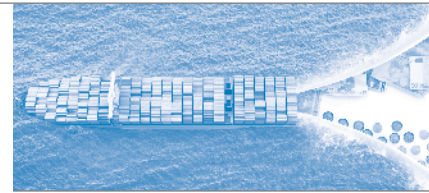
What Role Does Global Trade Play?

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1 Introduction

Germany is in the midst of a debate on economic inequality and distribution of wealth. People frequently mention a division in society: Some groups find themselves facing stagnating or even falling real wages, while others benefit from economic growth and the shifting shortages on the labor market. What factors can these developments be attributed to?

Numerous scientific studies demonstrate that the structure of labor market institutions plays a central role in the development of inequality (Dustmann et al. 2009, Di Nardo et al. 1996). Furthermore, the scientific literature refers regularly to the role of technological change as a potential driver of wage inequality (Acemoglu 2002). It was long thought that technological progress is skill-biased and therefore has a different impact on employment demand for highly-skilled and low-skilled workers. The “task-based approach” was derived from that theory and assumes that technological change leads to a substitution of routine activities through computers and machines, bringing wage changes accordingly (Acemoglu and Autor 2011, Spitz-Oener 2006). Because routine-based activities are not necessarily associated with low qualification levels but rather with primarily the middle range of the skill and wage distribution (e.g., bookkeepers), this approach has been linked to increasing wage polarization.

Alongside the above-mentioned factors, the significance of increasing international interdependence for the dynamics and structure of inequality is less obvious (Fitzenberger 2012, OECD 2011).¹ This is particularly true because the nature of the international division of labor has changed substantially over the last 30 years. Most German trade now takes place within narrowly defined industries, that is, Germany is both exporter and importer of very similar goods. Trade is thus no longer inter- but rather intra-industrial in nature. As a result, however, conventional theories on the correlation between inequality and trade, such as the Stolper-Samuelson theorem, have lost their empirical foundation.

Traditional trade theories focus on the return on education. According to such theories, the return on education rises in highly developed countries such as Germany due to the distribution of labor with less affluent countries, while the value of low educational qualifications or a lack thereof declines. However, studies show that only about 20 percent of the structure of wage inequality can be explained by this factor (Felbermayr et al., 2014). The remaining 80 percent has more to do with the characteristics of the employer. This is also consistent with new trade theory literature, where the analysis focuses on companies – the drivers of the globalization process – rather than industries.

¹ For a more detailed distinction between the dynamics and structure of inequality, see Box 1.

Box 1:

Clarification on Terminology

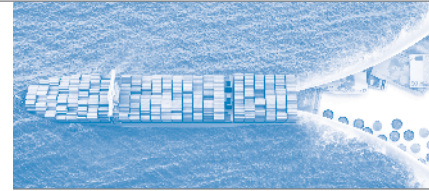
In this study, we use the terms **inequality** and **wage inequality** synonymously. In doing so, we are referring to the distribution of gross wages (see Section 2).

When we discuss the **structure of wage inequality**, we are distinguishing the contribution of individual factors to wage inequality.

When we speak of the **dynamics of wage inequality**, we are referring to the development of inequality in general, as well as the development of individual explanatory factors in particular over time.

Our objective in this study is to create a current, explicit picture of the development of wage inequality in Germany. In addition, we empirically examine in detail the correlation between the international engagement of companies and the trajectory of wage inequality in Germany. With this analysis, we aim to produce a well-founded assessment of the importance of the growing international relationships of German companies relative to other explanatory factors (such as changes in the area of collective bargaining agreements or technological change) with regard to increasing wage inequality.

The study is designed as follows: Section 2 contains a brief overview description of the subject being studied and the data used. Section 3 has a detailed analysis of the structure of wage inequality, including an analysis of individual regions and industries, as well as inequality analyzed according to demographic variables. In Section 4, we use variance decomposition to examine which group reports the largest increase in inequality. In Section 5, we turn to the effect of company characteristics and discuss in particular the role of collective bargaining agreements and the international engagement of companies. In Section 6, we quantify the contributions of individual factors to the development of wage inequality and differentiate the roles of international trade, collective bargaining agreements and investments in new technologies. Finally, in Section 7 we examine the connection between international trade and inequality on a sectoral level, before summarizing the economic policy implications in Section 8.



2 Subject overview and data used

In order to create the most comprehensive, robust and up-to-date picture of the inequality in Germany as possible, we are drawing on data sources for this study that have already been established in the academic literature for this field (Dustmann et al. 2009, Card et al. 2013). Our analysis is based on data from the Sample of Integrated Labor Market Biographies (SIAB) and the Linked Employer Employee Database (LIAB), as provided by the Federal Employment Agency (Bundesagentur für Arbeit). The majority of this data stems from legally binding social security registrations. Advantages of this database include its large sample size and its reliability due to its administrative character. Complete data was available through 2010 at the time this study was compiled.

Box 2:

Different income concepts

Market income

 Earned wages

 Capital income

+ Annuities and pensions

+ Government transfer payments

– Taxes and social insurance contributions

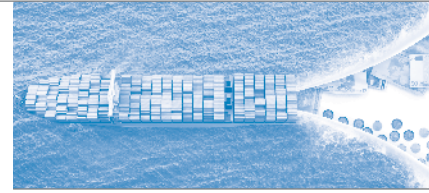
= disposable income

In addition to different types of income, a distinction can be made with respect to the individual income approach and the household income approach. The income situation of households is made comparable – consistently with international standards – by converting the total income of a household into equivalized incomes. For more information, see OECD (2011).

Our analyses of the structure and dynamics of inequality are thus based on gross wages from workers covered by social security, in other words, wages before deduction of taxes and any transfer payments. Accordingly, they reflect direct wage payments on the labor market. Using earned wages as the foundation of our analysis is sensible from our perspective because it accounts for about 75 percent of total income (Statistisches Bundesamt 2013a, OECD 2011) and we expect that the potential effects of the individual influencing factors will be felt most directly here. We use the terms inequality and wage inequality synonymously. Box 2 shows the various income concepts.

We would like to note here that – as is common in the academic literature – we are referring to wage developments for full-time workers (see also Fitzenberger 2012).² Accordingly, we only examine those effects on wage inequality that result from changes in the remuneration of employees subject to social security assessments. Not considered, therefore, are effects on inequality due to changes in working time or the employment structure (e.g., loss of employment, new employment relationships).

2 A detailed description of the databases used and their processing can be found at the end of the study.

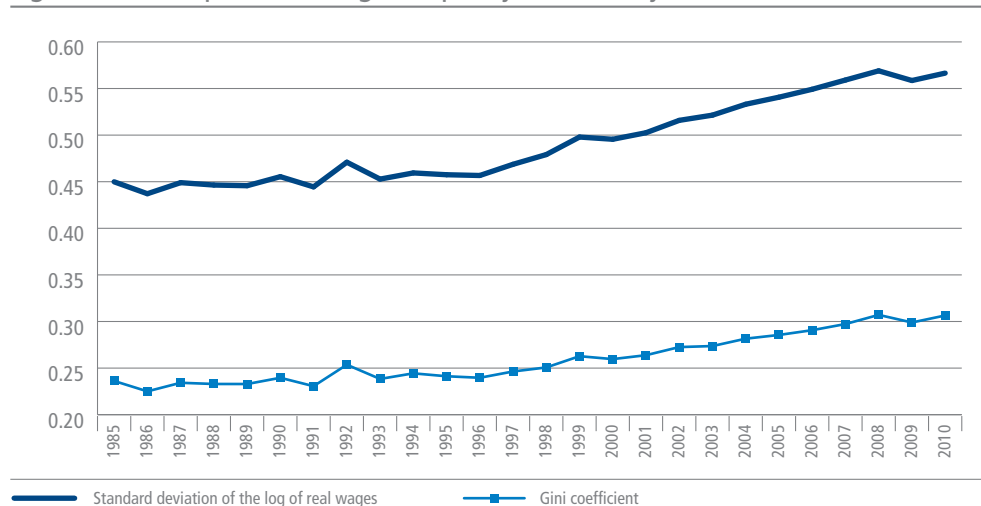


3 The trend in German wage inequality

In recent decades, inequality has risen in many developed economies (Katz and Autor 1999, Machin and Van Reenen 2008, OECD 2011). For a long time it was the prevailing opinion among economists that no comparable rise in wage inequality had occurred in Germany. This was often interpreted as a sign of the inflexibility of the German labor market and one cause of its comparatively high unemployment (Prasad 2004). More recent studies, however, show that inequality has also increased noticeably in Germany (e.g. Dustmann et al. 2009, Card et al. 2013).

The Gini coefficient is a commonly used measure for inequality. It can take values between zero and one. The higher the value, the higher the measured inequality is considered to be. More suited for analytical purposes, however, is the standard deviation of wages.³ It is derived from the variance, which itself can be more easily broken down into individual components.

Figure 1: Development of wage inequality in Germany



Source: Own calculations based on SIAB. Through 1991 the data refers to West Germany, thereafter to all of Germany. The underlying sample includes full-time employees between the ages of 18 to 65 years.

³ As is common in the literature, we use the logarithm of real wages. This prevents the measure of inequality from depending on the choice of unit of calculation.

Figure 1 shows the development of inequality for Germany using the standard deviation of log real wages and the Gini coefficient.⁴ Both measures of inequality reflect the same trend. From the mid-1980s to the mid-1990s, virtually no increase in inequality is recognizable. Starting in 1996, however, the growth rate increased noticeably. A short decline in inequality can be observed for 2009. By 2010, however, the higher level from 2008 is reached again. Based on the standard deviation of log real wages, the overall wage inequality in Germany grew by 12 log percentage points from 1985 to 2010. The majority of this rise, 11 log percentage points, occurred within just 15 years (from 1996 to 2010). Comparisons to other national economies revealed that this was indeed a considerable increase. For example, the Anglo-Saxon economies (USA, Great Britain, Canada – economies that are typically considered very unequal and associated with the greatest increases – only incurred a growth of 6 to 8 log percentage points from 1985 to 2005. As such, they remain behind Germany with regard to the rise in wage inequality in Germany. Table 1 provides an overview of the growth of inequality in the Anglo-Saxon economies.⁵ Although the level of wage inequality in Germany in 2005 was significantly lower than the USA and Canada, it was almost even with Great Britain.

Table 1: Wage inequality in Anglo-Saxon economies and Germany

	Year	Standard deviation		Year	Standard deviation
USA*	1985	0.60	Canada	1985	0.62
	1990	0.62		1990	0.62
	1995	0.66		1995	0.62
	2000	0.66		2000	0.67
	2005	0.68		2005	0.68
Great Britain	1985	0.50	Germany**	1985	0.45
	1990	0.55		1990	0.46
	1995	0.55		1995	0.46
	2000	0.57		2000	0.50
	2005	0.56		2005	0.54
				2010	0.57

*The data refers exclusively to men.

**Up to and including 1990, the data refers solely to West Germany; afterward to all of Germany.

Note: The data comes from the following sources: USA: Heathcote et al. (2010); Great Britain: Blundell et al. (2010); Canada: Brzozowski et al. (2010); Germany: own calculations.

4 Through 1991 the data refers to West Germany, thereafter to all of Germany. In section 3.3 of the study the differences between East and West Germany are examined in more detail.

5 Unfortunately, comparative data is only available through and including 2005.

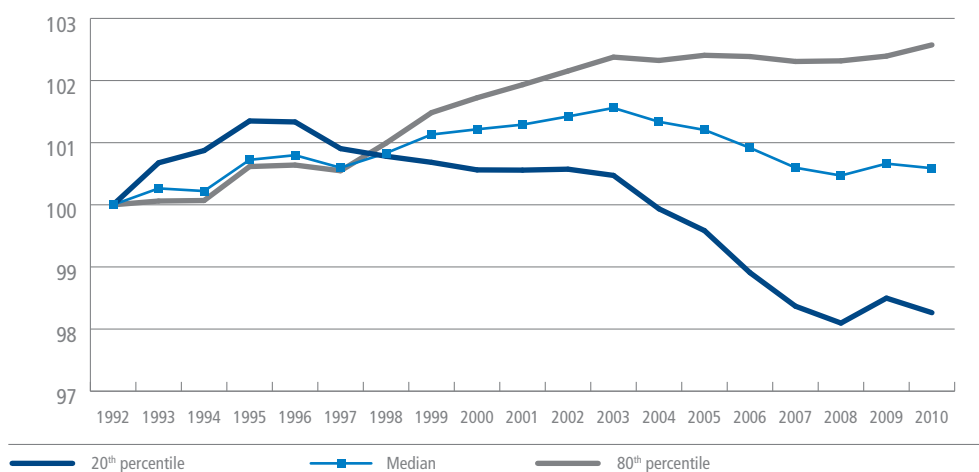


Figure 2 shows the wage development at different percentiles of the wage distribution indexed for the year 1992.⁶ The median income⁷ of full-time workers rose slightly from 1992 to the early 2000s. From 2003 to 2008, however, it declined, so that in 2008 it was back to its 1997 level. Since then, the median income has stabilized at this level. If we also look at the 20th and 80th percentiles, the corresponding developments at the lower and higher ends of the wage distribution can be seen. From 1992 to 1996, real wages in the lower part of the distribution (20th percentile) rose more sharply than in the rest of the distribution. Overall, wage inequality in this period declined slightly.

Starting in the mid-1990s, there was a reversal in this development: Income at the 80th percentile has risen sharply, while wages at the 20th percentile have fallen. Thus, this development does not indicate a polarization of wages, meaning a decline in wages in the middle of the wage distribution relative to wages at the periphery of the distribution.⁸

The lower range of income distribution is especially susceptible to the trend from 2003 through 2008, which can be linked to the creation of a comprehensive low-wage sector. Likewise, the short-term decrease in wage inequality in 2009 can be traced back to developments in the lower distribution range.

Figure 2: Indexed development of real wages



Source: Own calculations based on SIAB. The data refers to all of Germany. The underlying sample includes full-time employees between the ages of 18 to 65 years. All real wages were indexed to the year 1992 (1992=100). Note: The wage information in the original data is cut off at the social security contribution limit. Using well-established imputation procedures, we estimate the actual wages for these cases. Per year, between 9 and 14 percent of the values are cut off, so that the 80th percentile is not affected.

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6 The “X” percentile refers to the level of pay not exceeded by “x” percent of the workforce.

7 The median, also called the 50th percentile, describes the value of the income distribution that separates the better earning half of the population from the worse earning half. 50 percent of income earners are thus below this value, and 50 percent correspondingly above it.

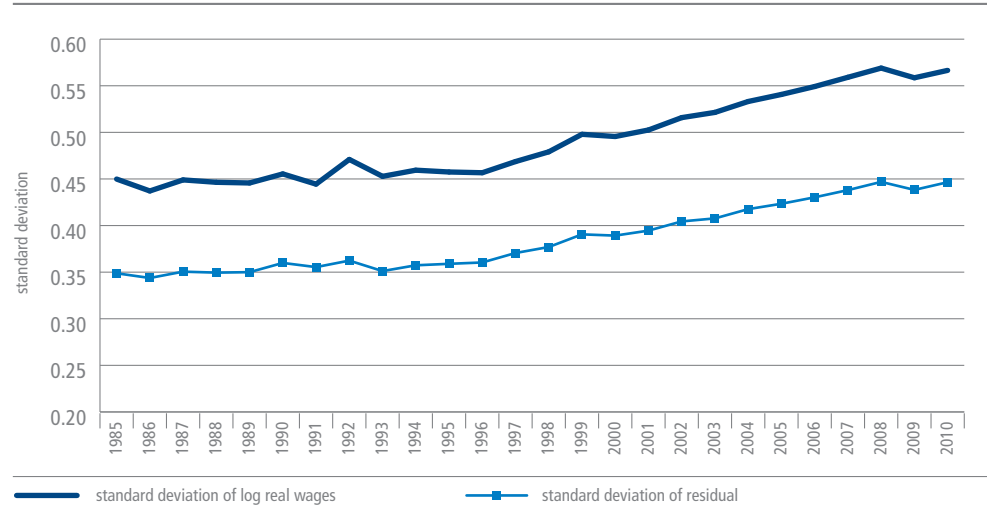
8 By contrast, the US labor market shows this type of wage polarization, see e.g., Firpo et al. (2014), Spitz-Oener (2006), Dustmann et al. (2009) and Antonczyk et al. (2009) analyze the polarization hypothesis for Germany more closely. Their evidence supports the polarization hypothesis for employment, but not for wages.

3.1 The role of residual wage inequality

What factors can explain such a continuous increase in wage inequality? In seminal works, Katz and Murphy (1992) as well as Bound and Johnson (1992) found that for the US labor market, a large portion of the rise in inequality took place within conventional skills groups. This finding has been confirmed for other economies as well,⁹ including the German labor market. Personal characteristics such as age, education and gender, as well as regional affiliation to East or West Germany, explain only about 20 percent of wage inequality over the time period from 1985 to 2010.

Figure 3 shows the standard deviation of log real wages and the trend for residual wage inequality. This measure of residual wage inequality is calculated by running regressions of log real wages on indicator variables of three education groups, five age groups, their interactions and indicators for gender and region for each year separately. We treat the standard deviation of the residual wage as a measure of the unexplained part of the entire inequality.¹⁰ What is striking is not only that the characteristics investigated explain only such a small proportion, but also that the rise in inequality actually occurred within these skills groups.

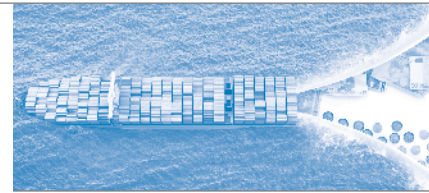
Figure 3: Trend in residual wage inequality



Source: Own calculations based on SIAB. Through 1991 the data refers to West Germany, thereafter to all of Germany. The underlying sample includes full-time employees between the ages of 18 to 65 years. We calculate residual inequality by running yearly regressions of log real wages on indicator variables of three education groups (low, medium, high), five age groups (18–25, 26–35, 36–45, 46–55, 56–65), their interaction terms and indicator variables for gender and West Germany.

9 For example, Helpman et al. (2012) for Brazil and Akerman et al. (2013) for Sweden.

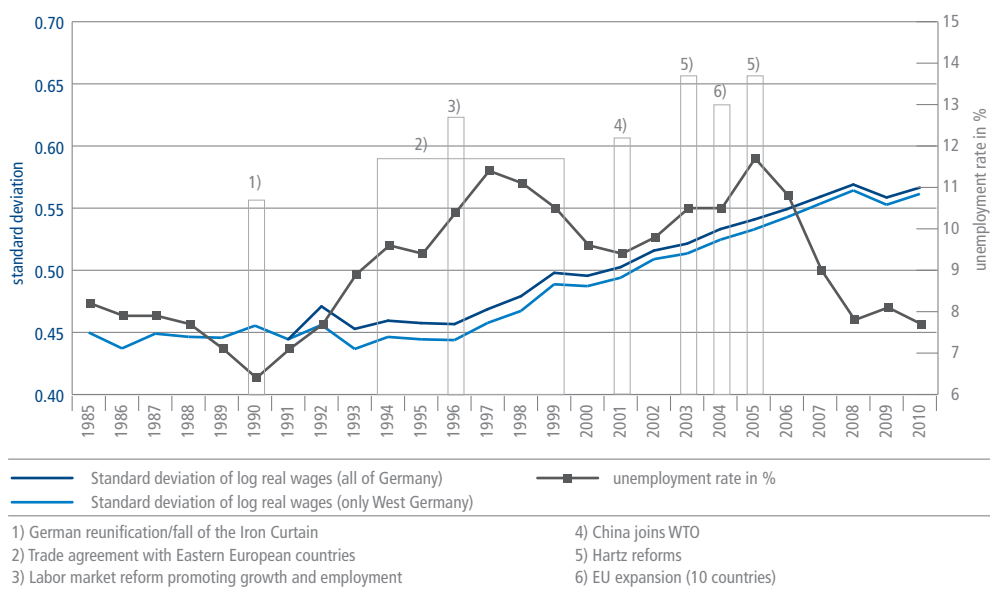
10 The observed wage thus consists of a segment that can be explained by these characteristics and a residual part.



3.2 The role of macroeconomic events

What role do macroeconomic events play in the development of wage inequality in Germany? A decisive event for the German labor market was the reunification of East and West Germany and the fall of the Iron Curtain. On the one hand, German reunification, which was completed from an economic perspective in June 1990, resulted in an enormous burden for the whole German economy (Dustmann et al. 2014). The Council of Experts estimated the amount of the net transfer payments from West to East Germany at about 900 billion EUR (Sachverständigenrat 2004).¹¹ On the other hand, reunification was related to a supply shock of new workers for the German labor market (Card et al. 2013). These developments went hand in hand with the growing opening of the central and Eastern European economies after the fall of the Iron Curtain.¹² This offered increasing opportunities for German companies to shift their production abroad. For Dustmann et al. (2014), the burden of Germany’s reunification and new opportunities for outsourcing production were key factors for generating wage restraint and increased competitiveness in Germany.

Figure 4: Macroeconomic events



Source: Own calculations based on SIAB. Shown is the standard deviation of log real wages for West Germany (1985 to 2010) and all of Germany (1992 to 2010). The underlying sample includes full-time employees between the ages of 18 to 65 years. Unemployment rate data is from the Federal Employment Agency.

¹¹ These values refer to the time period from 1991 to 2003.

¹² The free trade agreement of the EU with Poland, Hungary, Czech Republic, Slovakia, Bulgaria and Rumania came into force during the mid to late 1990s.

Figure 4 shows the development of inequality (left axis) together with the unemployment rate trend (right axis) and important macroeconomic events between 1985 and 2010.

After the German reunification, no new trend in wage inequality was observed, but there was a significant increase in the unemployment rate. The subsequent general economic recession and the continued rise in the unemployment rate led to the labor market reforms in 1996 “to promote growth and employment.” As part of this law, the duration of temporary contracts was increased from one to two years, the company size for protection against dismissal rose from five to ten employees, and sick leave payments fell from 100 to 80 percent. These measures to improve flexibility at the employer level were accompanied by a loosening of collective bargaining agreements as cited by Dustmann et al. (2014).¹³ In the aftermath of this liberalization, the unemployment rate declined, while at the same time the dispersion of wages increased.

With the economic downturn in 2001, pressure for labor market reform again increased. This occurred at the same time as China’s entry into the WTO. The Hartz reforms were subsequently implemented in 2003, 2004 and 2005, which restructured employment services and were linked to substantial changes in benefits. While clearly positive effects can be seen in the downward trend of the unemployment rate after 2005, it is also evident that in both 2003 and in 2005, wage inequality rose in the lower tail of the wage distribution. In 2004, ten new central and Eastern European economies joined the EU.

3.3 Trend in wage inequality in different regions and industries

If we examine the trend in wage inequality separately in East and West Germany, it can be seen that the regions scarcely differ (Figure 5). However, the level of wage inequality in East Germany is noticeably lower than in the West.

¹³ The structure and development of collective bargaining agreements in Germany is discussed in detail in Section 5.1

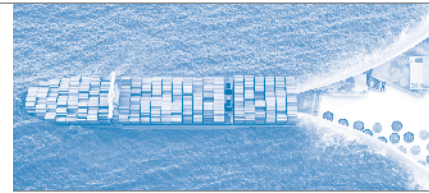
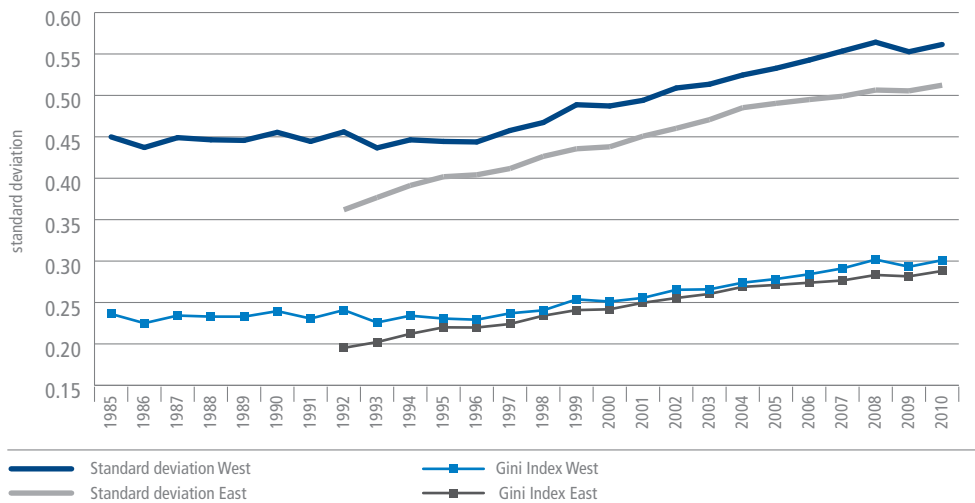


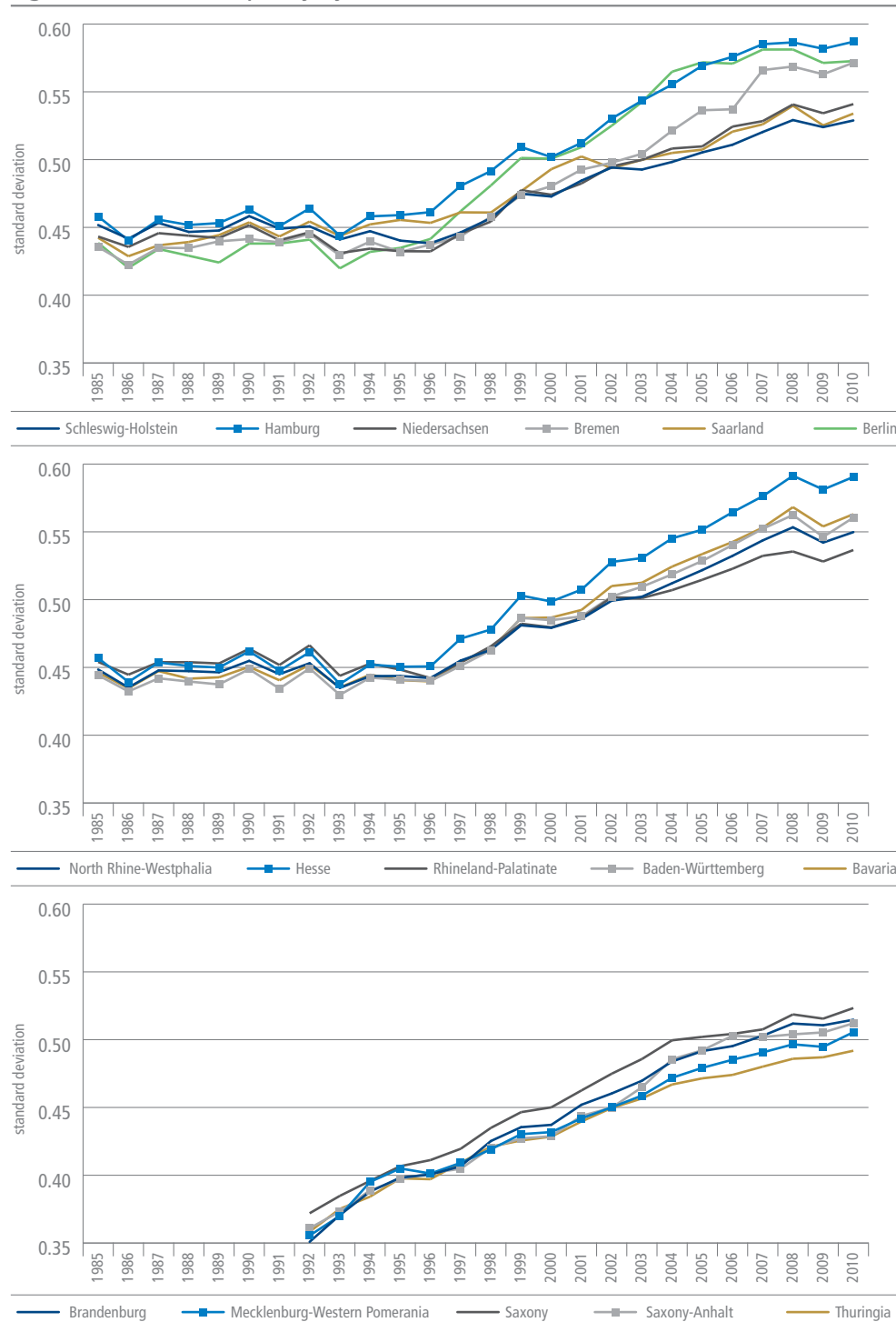
Figure 5: Trend in inequality in East and West Germany



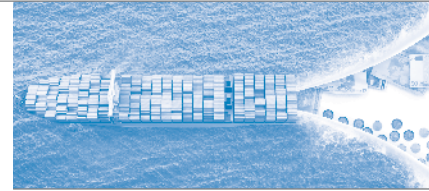
Source: Own calculations based on SIAB. The underlying sample includes full-time employees between the ages of 18 to 65 years separately by East and West Germany.

An analysis of individual federal states shows that Berlin recorded the sharpest rise in wage inequality in the period from 1992 to 2010 (Figure 6). A similar trend is found for Hamburg, while a high level of wage inequality is also present in Bremen, with a sharp rise in the mid-2000s. Regarding the more populous federal states, the wage dispersion in Hesse is much greater than in other states. If we look at the development of wage inequality in various sectors of the economy, it is striking that the tele-communications industry, which includes the postal and telecommunications services, shows by far the sharpest rise in inequality. A sharp rise in wage dispersion can also be seen in the aviation industry. The trends in wage inequality in the various industries are presented in the Appendix.

Figure 6: Trend in inequality by federal state



Source: Own calculations based on SIAB. The underlying sample includes full-time employees between the ages of 18 to 65 years by federal state.

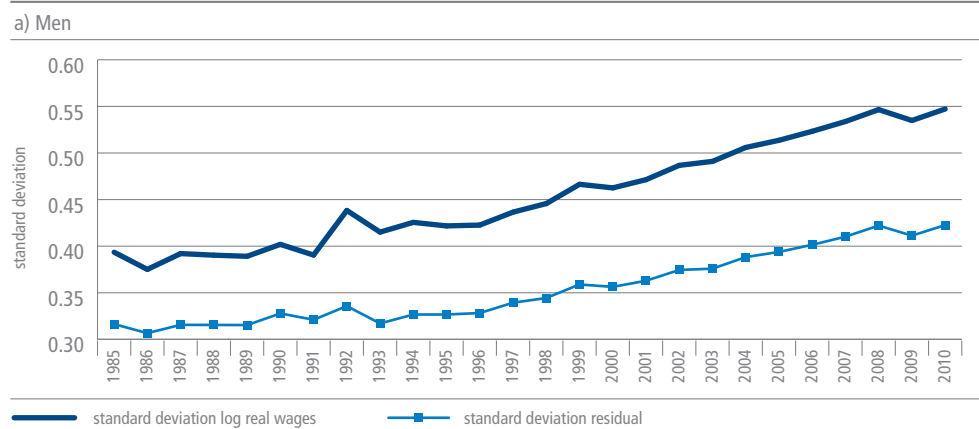


3.4 Trend in wage inequality across demographic variables

Besides the regional and industry-specific analysis of wage inequality, it is also interesting how wage inequality has developed across demographic variables such as gender or education.

Figure 7 shows the trend separately for men and women. For male employees, there was a continuous rise in inequality even during the 1980s and more seriously since the early 1990s. For female employees, on the other hand, the level of wage inequality remained fairly constant from the mid-1980s to the mid-1990s. Only since 1996 has there been a clear rise in inequality among women. Moreover, it becomes clear that for a long time, the level of inequality among women was always greater than that among men. In 2008 and 2010, both groups showed a similarly high level.¹⁴

Figure 7: Total and residual wage inequality in men and women



¹⁴ The differences presented between men and women cannot be explained by differences in full-time and part-time work, because the analysis exclusively considers full-time workers.

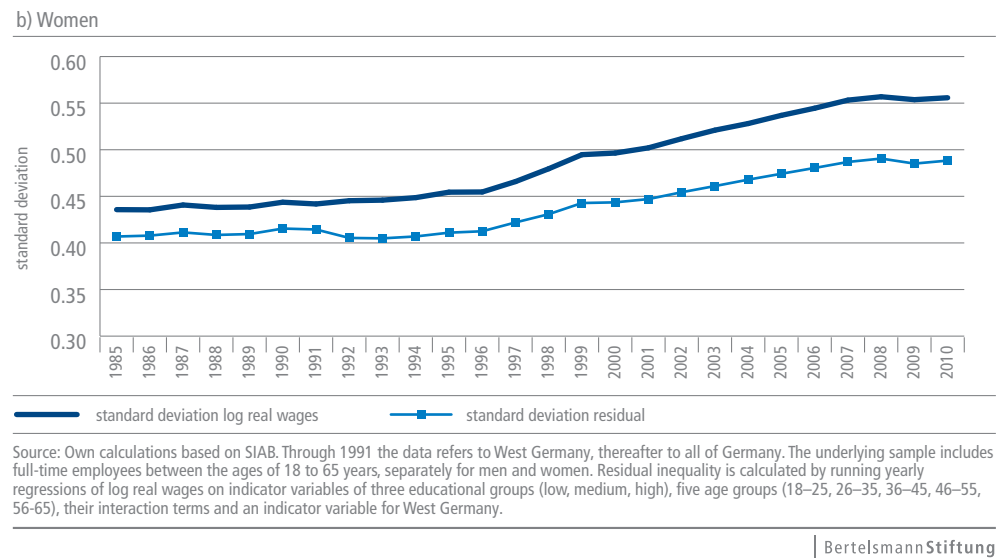
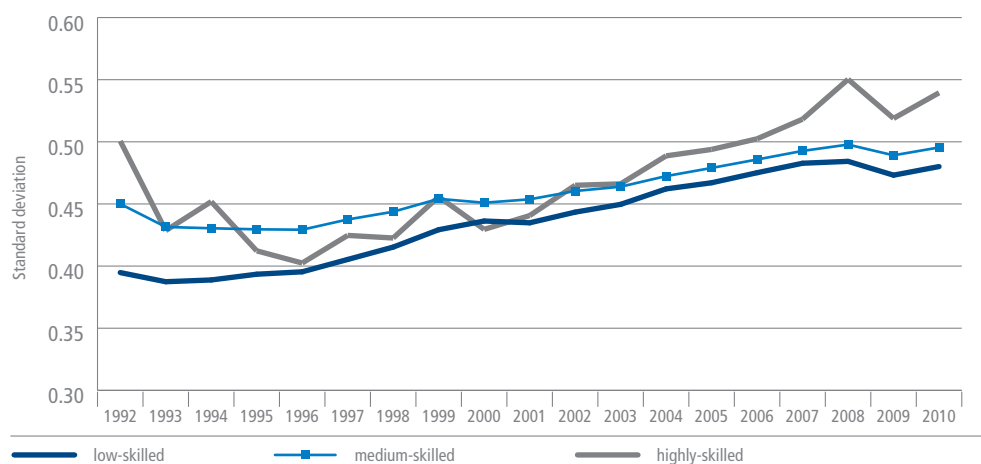


Figure 7 also shows how residual inequality for men and women follows a similar trend to overall inequality. This implies that a large portion of the rise in wage inequality cannot be explained by age and education but occurs within age and educational groups. One difference, however, is that for women, age and education variables explain far less of the structure of wage inequality than for men.

Next, we look at the trend in inequality for individual education groups separately (Figure 8). We distinguish between low-skilled, medium-skilled and highly-skilled workers (Box 3).



Figure 8: Inequality across educational groups



Source: Own calculations based on SIAB. Data refers to all of Germany. The underlying sample includes full-time employees between the ages of 18 to 65 years, separated by level of education. In the specification shown, we look at the trend for "unconditional" inequality by group. In other specifications, we control for age group, gender and region. The resulting structure is similar.

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The lowest level of wage inequality was found among low-skilled workers. However, wage dispersion increased more sharply in this group starting in the mid 1990s than among medium-skilled workers. While inequality among highly-skilled employees in 1990s was partially lower than among medium-skilled employees, wage dispersion among graduates of technical colleges and universities starting in the year 2000 has grown sharply and now exceeds the level of the other two groups.¹⁵ If we control for age, gender and region, the results remain qualitatively the same (not shown).

A corresponding analysis can be done using the variable of nationality (Figure 9). Here we differentiate between German and non-German employees. We first look at the trend in wage inequality separately for these two groups, without controlling for other characteristics, (Specification A). In this case, the dispersion of wages of German citizens from the early 1990s to the mid 2000s has been higher than that of those without German citizenship. However, from 2006 onwards, the level of inequality among non-German citizens is higher than that of German citizens, suggesting that inequality among non-German citizens has had a significantly greater dynamic. Controlling for additional variables of age, education status, gender and region of Germany (Specification B), the level of wage inequality among German and non-German citizens is the same between 1993 and 1999, but thereafter, the group of non-German citizens sees a larger rise in inequality.

¹⁵ Since wages are cut off at the social security contribution limit, a large share of wages within the group of highly-skilled workers is subject to our imputation procedure.

Box 3:

Classification of educational groups

Low-skilled workers:

High-school diploma at most and no vocational training

Medium-skilled workers:

High-school diploma at most and vocational training

or

“Abitur” qualification for university entrance without vocational training

or

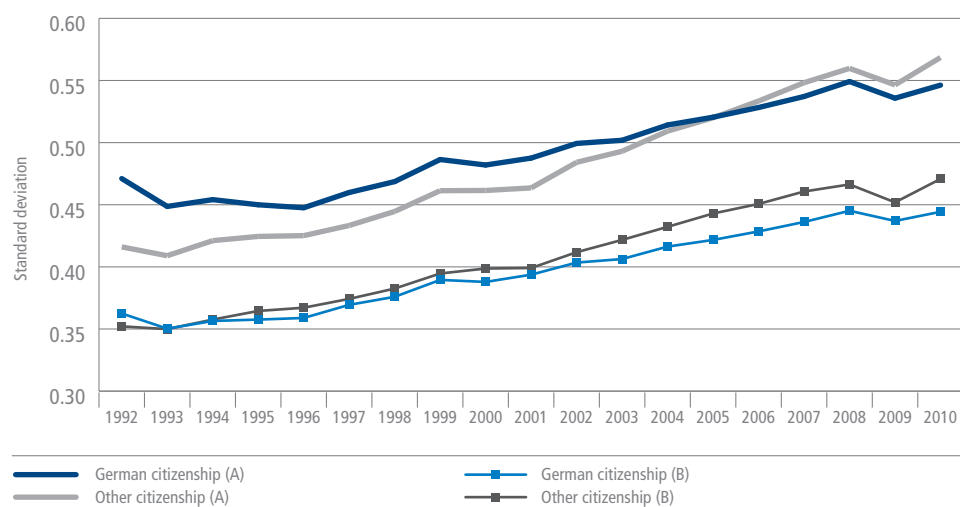
“Abitur” qualification for university entrance with vocational training

Highly-skilled workers:

University diploma

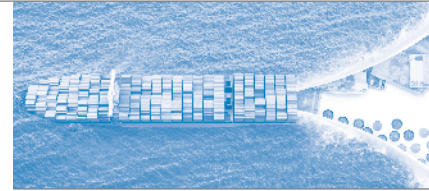
or technical college diploma

Figure 9: Inequality by citizenship



Source: See comments to Figure 8. Specification (A) reflects the “unconditional” trend in inequality per group; in specification (B), we control for age group, education group, gender and region.

These results suggest that the demographic shifts in Germany could explain a portion of the rise in total inequality, because the share of groups as a percentage of the total workforce within which inequality is comparatively high (skilled workers, women and worker with foreign citizenship) has risen over time. In the next section, we will examine total inequality.

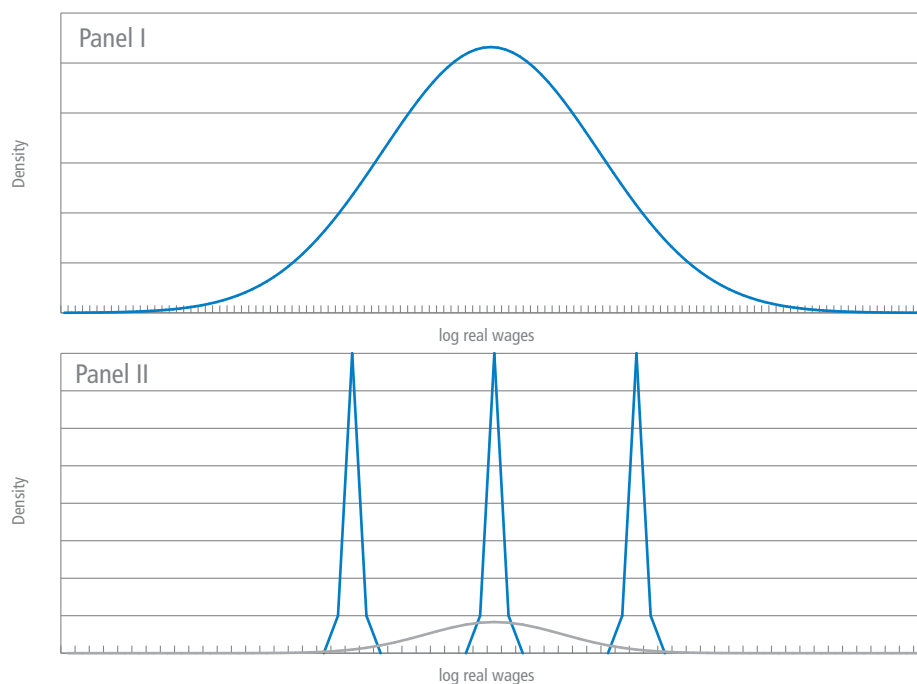


4 Analysis of wage variance

To gain better insight into the contribution of single variables to explaining inequality, we can analyze the wage variance. The advantage of the variance as a measure of inequality is that it can be exactly decomposed into two different parts. One part refers to the dispersion within a certain group and the other part refers to the variation between different groups. Figure 10 clarifies this concept using a fictitious example of companies.

In Panel I, all companies are identical, so that the variance in wages within each company is the same as the overall variance of the economy. Accordingly, the overall variance is entirely explained by the dispersion within companies. In Panel II, all companies are different, and the specific variance within companies is very small. The overall variance is thus the result of the wage dispersion within every company and the differences in the individual mean values between the different companies.

Figure 10: Wage distribution within and between companies



Source: Own representation modeled according to Lazear and Shaw, 2009.

Formally, the decomposition of the total variance can be written as follows:

$$\sigma^2 = \sum_{j=1}^J p_j \sigma_j^2 + \sum_{j=1}^J p_j (\bar{w}_j - \bar{w})^2$$

in which p_j represents the share of all employees in group (here company), j , σ_j^2 is the variance within group (company) j , \bar{w}_j describes the average wage in group (company) j and \bar{w} represents the average wage in the whole economy. This means that the variance of wages in an economy is large if (1) the mean wage is very different between companies or (2) when the variance in wages within companies is high or (3) if both are the case.

We conducted a respective decomposition for 2000 and 2010 along different dimensions or groups. In particular, we look at what share of the wage variance can be attributed to a dispersion between skill groups and what share reflects the dispersion within skill groups.¹⁶ Accordingly, we analyze the wage variance along occupational groups and companies.¹⁷ Table 2 shows in each case the share of the complete variance that can be explained by the variation within each of the groups and between the groups. In addition, we also show the share of the particular components in the change in total wage inequality.

First of all, as we observe the decomposition across skill groups it becomes apparent that the dispersion between skill groups has increased by 37 percent, but the major share of the rise in total wage inequality has taken place within age and education groups (63 percent). A similar pattern results for occupational groups. 45 percent of the total rise in wage inequality can be traced to the dispersion between occupational groups, while 55 percent of the rise is explained by an increase in the dispersion within occupational groups.

Another picture results, however, if we look at the company component. Here the portion that reflects the variance between businesses is clearly larger: Nearly three-quarters of the rise in inequality during the period observed has taken place between companies, and only one quarter within companies. Thus differences between companies seem to play an important role for the wage inequality trend in Germany. Similar results were already reported by Baumgarten (2013) for 1996 and 2007. Card et al. (2013) also suggest in their work the importance of the company component in explaining the rise in wage inequality in Germany. We will take a detailed look at the company components in the following.

¹⁶ Skill groups are defined by the interaction of five age groups and three education groups.

¹⁷ In the dataset used, we have information exclusively about businesses. Companies can consist of several businesses. However, in the following, we use the terms business and company synonymously.

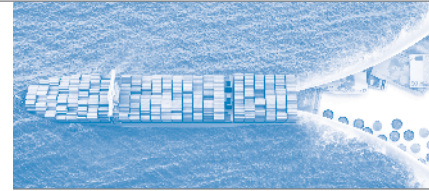


Table 2: Variance decomposition: inequality trends

	2000	Share of variance	2010	Share of variance	Change	Share of change
Total variance	0.232		0.301		0.069	
Between skill groups	0.044	19	0.070	23	0.026	37
Within skill groups	0.187	81	0.231	77	0.043	63
Between occupational groups	0.081	35	0.112	37	0.031	45
Within occupational groups	0.151	65	0.189	63	0.038	55
Between companies	0.141	61	0.192	64	0.051	74
Within companies	0.090	39	0.108	36	0.018	26

Source: Own calculations based on SIAB and LIAB. The underlying sample includes full-time employees between the ages of 18 to 65 years in all of Germany. Skill groups result from the interaction of five age and three education groups. Using the 1988 occupations classification, we distinguish 343 different occupational groups.

5 The role of company characteristics

Which company characteristics are relevant for the rise in wage inequality in Germany and can explain the significance of company components in the previous variance decomposition? In the following sections, we will take a detailed look at two essential developments at the company level that occurred in parallel to the rise in wage inequality in Germany: changes in the way wages are negotiated and the integration of German companies into the global market.

5.1 Trends in collective bargaining

Free collective bargaining is practiced in Germany, in which unions and employer associations have a constitutionally-guaranteed right to negotiate agreements with a normative effect and free of government intervention through labor and economic conditions (Bispinck 2007). This applies in particular to collective bargaining agreements. Unlike many other economies, wage policy in Germany is not created in a “government policy” process, but rather is based on contracts and mutual agreements between employer associations, unions and works councils. Fundamentally, there are two different forms of collective bargaining in Germany: association or industry-wide collective agreements and company-level agreements (Bispinck 2007).

As Table 3 shows, the role of industry collective agreements in Germany has steadily declined since the mid-1990s – a development explained primarily by the decrease in these agreements.¹⁸ While in 1996, some 70 percent of all (full-time) employment relationships were tied to such collective agreements; in 2010 it was only 50 percent. The share of employees tied to such agreements sank during this period from 12 to 10 percent.¹⁹ In addition to this general decline of collective bargaining agreements, escape and hardship clauses have become more common since the mid-1990s, giving greater bargaining leeway to even those companies tied to collective bargaining agreements (Brändle et al. 2011, Bispinck et al. 2010).

Overall, therefore, the importance of collective bargaining agreements has decreased sharply. Dustmann et al. (2014) call this process of decentralization of wage bargaining from the industry to the individual firm the “increasing localization” of the wage-setting process (p. 168). This corroborates the increasing importance of company-specific components in wage setting.

¹⁸ Information on collective bargaining agreements is available starting in 1996.

¹⁹ Consideration of the company level paints a similar picture, see Table 2.



Table 3: Trends in collective bargaining agreements in Germany

	Company Level			Employee level		
	Industry collective agreement (in %)	Company level agreement (in %)	Collective agreements overall (in %)	Industry collective agreement (in %)	Company level agreement (in %)	Collective agreements overall (in %)
1996	49	11	60	70	12	82
1997	49	11	60	68	14	82
1998	47	5	52	67	9	76
1999	43	4	47	64	9	73
2000	44	3	47	63	8	70
2001	43	4	47	60	8	68
2002	43	3	45	60	8	68
2003	41	3	45	60	9	69
2004	41	3	43	59	8	67
2005	38	3	41	57	9	66
2006	37	3	40	55	10	65
2007	35	3	38	55	9	64
2008	34	3	37	53	10	62
2009	35	4	39	52	11	63
2010	33	3	35	52	10	62

Source: Own calculations based on LIAB. The underlying sample includes all branches of the economy for all of Germany. Weighting factors are considered.

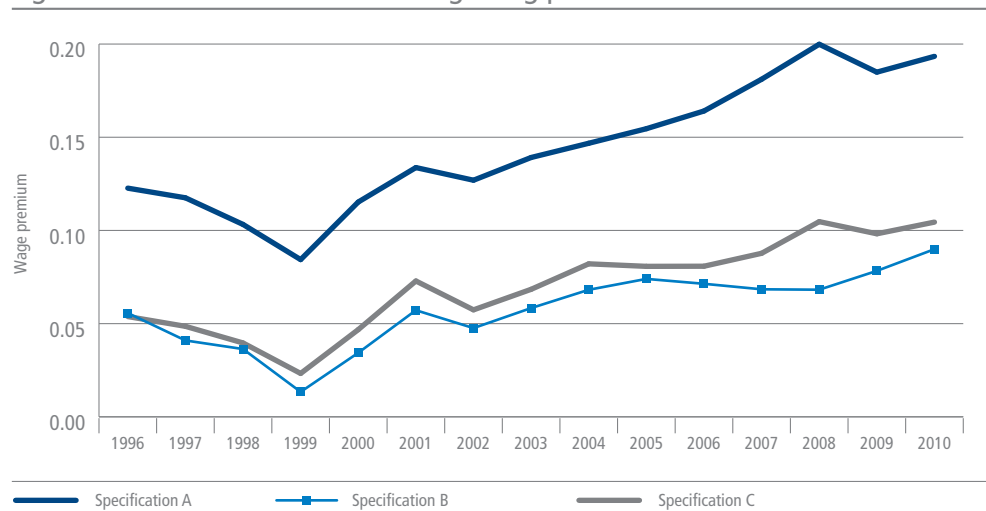
5.2 The role of collective agreements for wage payments

As existing studies show, collective bargaining agreements can affect the average wage level of covered employment relationships relative to uncovered relationships (Card 1996). Through this channel, wage inequality is influenced by the different average wages between employment relationships secured by a collective bargaining agreement and those that are not. In addition, collective wage agreements reduce the dispersion of wages within the group of covered employment relationships. Consequently, this channel also exercises an influence on the total wage dispersion.

In the following, we consider the first channel and examine the extent to which collective bargaining agreements are associated with a higher average wage – a wage premium. We conducted simple wage regressions in which we ran for each year a separate regression of the log real wages on individual characteristics and other indicator variables for region, industry and nationality (Specification A). By doing this, the wage premium indicates the percentage supplement to the wages of a comparable employee in a company without a collective agreement. This wage supplement from collective agreements in the period from 1996 to 2010 lies between eight and 19 percent and shows a clear rise since 1999 (Figure 11).

If we additionally control for other company characteristics (sales (Specification B), number of employees (Specification C)), the premium is much lower (between one and ten percent) but still rose during the period. The lower wage premium may be partially due to the fact that larger companies are more likely to be subject to collective agreements. However, as company size is already associated with higher wages, if we only compare the wages at companies of similar size against each other, the pay differential between companies with collective agreements and ones without is smaller.²⁰

Figure 11: Trend in the collective bargaining premium



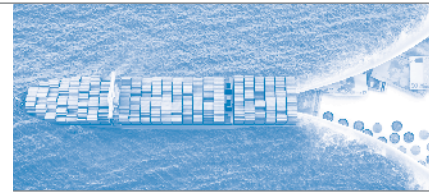
Source: Own calculations based on LIAB. The sample includes male full-time employees from the manufacturing sector. The calculations of the premiums below are based on this sample (men, manufacturing sector). First, because the trends in collective agreements and export participation hold especially in the manufacturing sector, and second, in order to be comparable with other studies, like Baumgarten (2013), which used the same dataset. Weighting factors are taken into account. Statistical significance: Until 1999 (Specifications B and C), all values were significantly different from zero at least to the five percent level.

5.3 Trends in exports

While the importance of collective bargaining has noticeably declined in German companies over the last two decades, international interdependence has become substantially more significant. In particular in Germany, exports have assumed a central role as the driver of economic growth. In the period from 2000 to 2010 alone, total export volumes rose by nearly 60 percent (Federal Statistical Office, 2014).

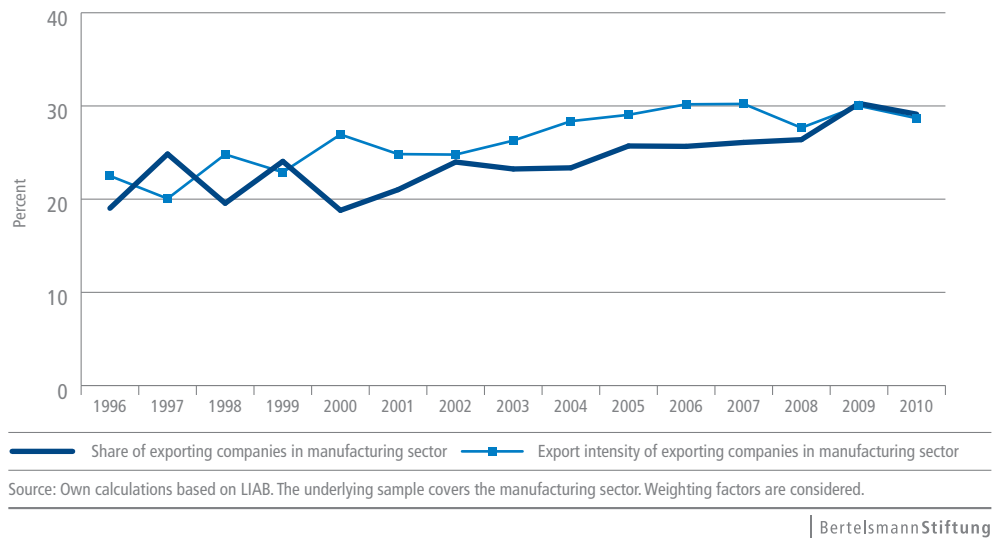
This trend is also reflected at the company level in the manufacturing industry. Whereas in 2000, 19 percent of all companies in the manufacturing sector earned a portion of their sales abroad, by 2010 nearly 30 percent did so. But not only has the number of exporting companies in the

²⁰ Addison et al. (2014) is a current study that looks at the wage premium in Germany and differentiates between industry agreements and company-level agreements.



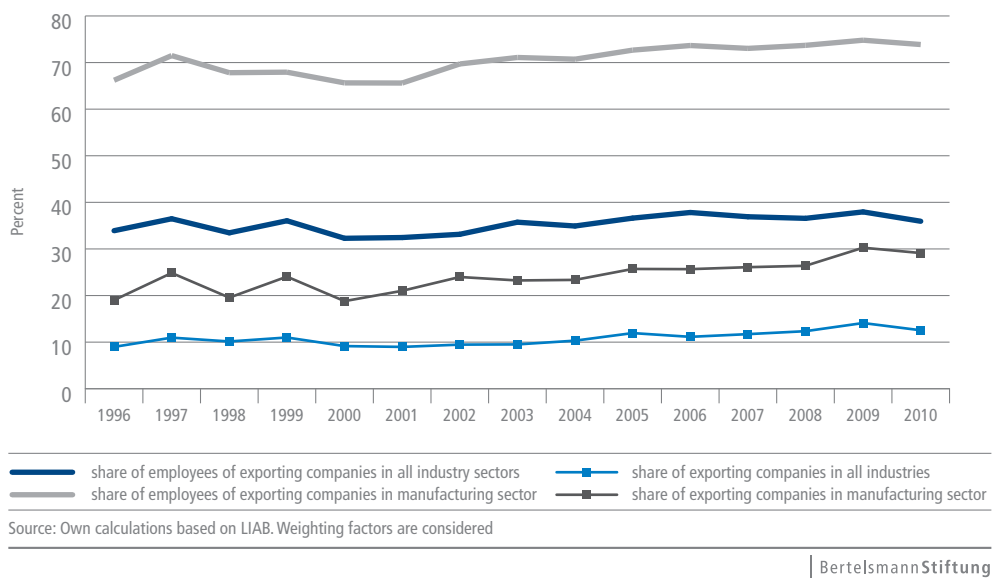
manufacturing industry increased during the period observed – so has the export intensity, i.e., the average share of sales made abroad (Figure 12).

Figure 12: The importance of exporters



Furthermore, exporting companies are important employers. Figure 13 shows that about every third employee works in a company that makes some portion of its revenue abroad. In the manufacturing sector, the employment share of exporting companies is more than 70 percent (2010).

Figure 13: Share of exporting companies, share of employment



5.4 The role of exports for wages

In current theoretical works, economists (Helpman et al. 2010, Egger and Kreikemeier 2009, Felbermayr et al. 2014), argue that the connection between global trade and wage inequality runs via the wage difference between exporting and non-exporting companies. According to this, frictions in the labor market result from more productive exporters paying higher wages than less productive non-exporters. An exporter wage premium was reported in numerous empirical studies across various economies. For example, Bernard and Jensen (1995, 1999, 2004) found in various studies of US businesses that exporting companies pay between four and nine percent higher wages than exclusively domestic companies.

Greenaway and Yu (2004) show evidence from companies in the United Kingdom and identify an exporter wage premium of 4.5 to 6.4 percent. Studies of companies in Taiwan find premiums in the range of 14 to 30 percent (Aw and Batry 1999, Liu et al. 1999, Tsou et al. 2002). Schank et al. (2007) provide a comprehensive overview of studies that use company data to calculate the exporter wage premium. Studies based on company data, however, are subject to the restriction that they cannot differentiate whether higher wages at exporters reflect a higher quality of workers or comparable workers earn more if they are hired by an exporting company. To make this determination, there must be data about the companies and their employees: Munch and Skaksen (2008) consider linked employer-employee data for Denmark and come to the conclusion that a ten percent increase in export intensity leads to 0.5 percent higher wages.²¹ Schank et al. (2007) find similar results based on the LIAB dataset for Germany: A ten percent rise in export intensity leads to 0.2 to 0.8 percent higher wages.²²

Analogous to our analyses of the significance of collective bargaining agreements for wages, we examine below a simple Specification (A), in which we regress separately for each year the log real wages on an indicator variable for the export status of the company. We control for both demographic characteristics (age group, educational group, their interaction) as well as for the corresponding industrial sector and region. Figure 14 shows the trend for exporter wage premiums. From 1999 to 2007, the premium rose almost continuously, from eleven to 16 percent, before it dropped in 2008 and then reached 15 percent again in 2010.

If we additionally control for the size of the company (in terms of revenue (Specification B) or employment (Specification C)), the wage premium shrinks noticeably to values between zero and three percent (B), or two and four percent (C). This is due to the fact that exporting companies are on average larger, and size itself is already linked with higher wages; thus only a small exporter wage premium above and beyond the size premium can be identified. This finding is consistent with trade theoretical literature based on the model by Melitz (2003). It suggests that it is the productive companies that can afford to enter export markets. The prospect of big sales markets

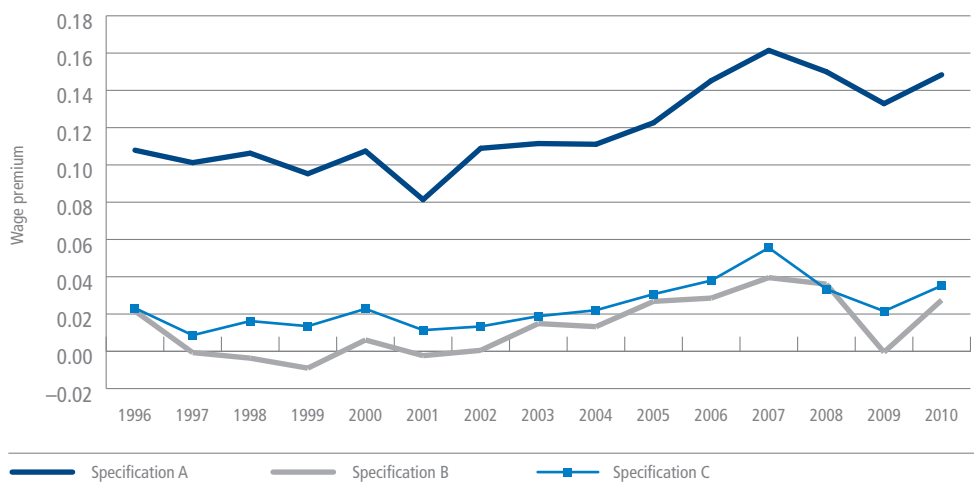
²¹ There is only very limited comparability of the calculated exporter wage premiums across different studies and countries. The reason is the use of different databases (especially company data vs. personal data), the application of different econometric procedures and the examination of different time periods.

²² Additional studies about Germany include Bernard and Wagner (1997), Arnold and Hussinger (2005) and Klein et al. (2013).



lets companies grow and makes paying higher wages seem profitable. The fact that international trade changes the size distribution of companies is why the effect between trade and wage premium occurs mainly through company size.

Figure 14: Trend for the exporter wage premium



Source: Own calculations based on LIAB. The underlying sample includes male full-time employees in companies in the manufacturing sector. The values of the exporter wage premium result from year-specific regressions in which the log real wages are regressed on individual characteristics, indicator variables of the industrial sector and the federal states (Specification A), revenue (Specification B) and employment (Specification C). Weighting factors are considered. Statistical significance: Except for the values from 1997 to 2002 and 2009 of Specification B, all values are significantly different from zero to at least the five percent level.

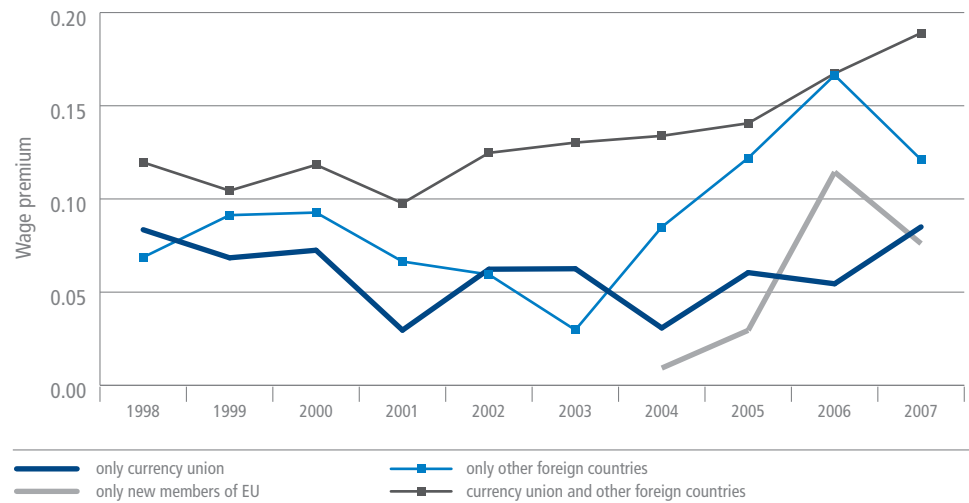
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A more extensive analysis of the exporter wage premium shows that the premiums are also different, depending on which target market a company exports to. It is clear that the wage premiums by companies that export exclusively to the European Currency Union are generally lower than the premiums of companies that export only to the rest of the world (Figure 15, here only Specification A).²³ The highest premiums, however, are paid by those companies that earn a portion of their revenue both within the currency union and the rest of the world. For the years 2004 to 2007, there is also information about the newly joining Eastern European countries. This gives a more conclusive picture: Companies that export exclusively to these (nearby) markets pay a relatively small exporter wage premium.²⁴

23 In the LIAB dataset there is information about export destinations for 1998 to 2007. The exact question reads "What percentage of your revenue was earned in countries of the European Currency Union/other foreign markets/the new EU countries." Questions about the new EU countries were asked only from 2004 to 2007.

24 For an extensive discussion of the exporter wage premium in terms of different destination markets, see Schmillen 2011.

Figure 15: Trend of the exporter wage premium by destination market



Source: Own calculations based on LIAB. The underlying sample includes male full-time employees from companies in the manufacturing sector. The values of the exporter wage premium result from year-specific regressions in which the log real are is regressed on individual characteristics as well as on indicator variables of the industrial sector and the federal state. Weighting factors are considered. Statistical significance: except for the value for "new EU members" in 2004, all values are significantly different from zero at least to the five percent level.

5.5 The role of imports for wages

Aside from the steep rise in exports, German companies have also significantly increased their imports. Over the period between 2000 and 2010, Germany's imports grew by nearly 50 percent (Federal Statistical Office, 2014). Just how strongly companies' import behavior affects wages cannot be clearly derived from economic theory. A potential decrease in wages due to greater opportunities for substitution for domestic workers is just as conceivable as wage growth due to increased productivity.

We analyze below the role of import activity in German companies on their wages and distinguish between exclusively importing companies, exclusively exporting companies, companies that both import and export and companies that are exclusively active on the domestic market (see also Baumgarten 2013). Companies that both import as well as export have been demonstrated to pay the highest wages.



Interestingly, it can additionally be noted that exclusively importing companies also pay a wage premium that is about as large as the one paid by exclusively exporting companies. Employees in importing companies thus profit from the trading behavior of their company. A possible explanation for this could be that imported inputs reduce production costs and thus increase productivity in the domestic companies. These can then be reflected in higher wages for the domestic staff.²⁵ What is important, however, is that we cannot draw any conclusions about the employment effects on importing or exporting companies. Table 4 shows the wage premiums for the different types of trade.

Table 4: Wage premium by type of trade

Year	Exporter	Importer	Exporter and Importer
1999	0.07***	0.10***	0.13***
2001	0.08***	0.09***	0.12***
2003	0.11***	0.12***	0.16***

*** shows significance at the one percent level. The underlying sample consists of male full-time employees from companies in the manufacturing sector. Only for 1999, 2001 and 2003 does the dataset have information available on the import activity of companies. For those years, we regress log real wages on the trade type variable, individual characteristics and indicator variables for the industrial sector and federal state. Weighting factors are considered.

Source: Own calculations based on LIAB.

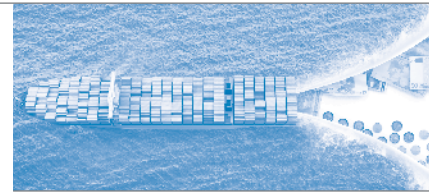
²⁵ Kohler (2004) and Grossman and Rossi-Hansberg (2008) show, for example, the positive productivity effects for domestic companies of outsourcing production abroad.

6 What factors are driving the change in inequality?

In the previous analyses presented in this report, we showed the dynamics of wage inequality along individual dimensions and pointed out the importance of selected company characteristics for the wage structure. These factors have so far been considered in isolation, and there has been no analysis of the quantitative explanatory contribution of the different factors to the dynamics of wage inequality. The goal of this section is thus to quantify the significance of individual factors and their respective contributions to the dynamics of wage inequality in a comprehensive model. Here it is crucial to separate the possible contribution of international trade to the development of wage inequality from the traditional influencing factors, such as institutional changes and technological change.

Various aspects are of central importance to this analysis. First, it is key to have a model available that allows considering several factors at the same time, in order to measure the contribution of one factor as distinct from others. So, for example, a univariate analysis might suggest that the decline of collective bargaining agreements has made an important contribution to the rise in wage inequality. To the extent that the decline in collective agreements could be at least partially due to structural economic changes, where industries with (traditionally) low collective bargaining coverage have become relatively more important, this univariate “collective bargaining effect” would partially include a “sector effect” and would thus possibly be overestimated. In order to distinguish these two potential influences from each other, it is therefore important to integrate the industrial sector as well as the form of wage negotiation in the analysis. The same applies analogously to other explanatory factors.

In addition, it is crucial to be able to distinguish the “wage structure effect” from the “composition effect.” The wage structure effect can be understood as a “price effect,” and the composition effect as a “quantity effect.” These are based on the consideration that individual explanatory factors can have an influence on the dynamic of wage inequality through two different channels. A possible positive contribution by education to the rise in wage inequality may be due to the fact that the share of highly skilled employees (with a possible constant return on education) has increased over time (composition effect). This is the case, for example, when wage dispersion is comparatively high within the group of highly skilled workers. At the same time it is possible that the return on education (with possible constant shares of employees from the individual skill groups) has increased (wage structure effect) or the wage inequality within the education group has increased (likewise wage structure effect). Among the individual explanatory factors, the two channels ought to be of different importance. Both channels could work in different directions on the individual explanatory factors.



Finally, it is likewise of great interest to quantify the influence of the individual explanatory factors at different parts of the wage distribution. A decline in collective bargaining coverage may, for example, have a different influence on the lower end of the wage distribution than on the upper tail. In the following section, we provide a quick sketch of a model that satisfies these requirements.

6.1 Methodological aspects

In order to determine the explanatory contribution of different factors to the dynamic of wage inequality, we apply a decomposition analysis suggested by Firpo et al. (2009), based on RIF (recentered influence functions) regressions. Using this technique, first, the rise in wage inequality can be broken down into a total composition effect and a total wage structure effect. Then, the various contributions of the individual explanatory factors to both components can be identified.²⁶ The decomposition is applicable to very different measurements of inequality. Here it is applied to the 85-15 wage differential²⁷ (as the inequality measure for the total wage distribution), the 85-50-wage differential (as the inequality measure of the upper tail of the wage distribution) and the 50-15 wage differential (as the inequality measure for the lower tail of the wage distribution).²⁸

The decomposition analysis provides valuable clues to the meaning of the various explanatory factors but is also subject to some limitations that must be considered in interpretation. First, it is important to emphasize that the applied method completely ascribes the changing of wage inequality over the time period to the factors considered. As a model, therefore, it is assumed that the total of all composition and wage structure effects reflects the total change in wage inequality over time.²⁹

In addition, the identified wage structure effects reflect both the changed wage differentials between different groups (explained inequality) as well as a changed wage inequality within groups (residual wage inequality). A sharp distinction between explained and residual inequality, as we have so far examined them in the framework of this study, is thus not possible using this method. Through this decomposition analysis, on the other hand, it becomes clear which groups have experienced a shift in the underlying compositional structure that affects the wage distribution (composition effect) and which groups have seen a change in the compensation structure (wage structure effect).

26 Since decomposition analysis is a statistical procedure and includes a certain lack of clarity, it is accompanied by an additional error term (reweighting error and specification error).

27 This refers to the difference between the 85 percent percentile and the 15 percent percentile.

28 We select here the 85-15 differential (instead of the 80-20 differential, as earlier in the report), in order to obtain a more accurate impression of the extent of the inequality. Moreover, in this way, the results are more comparable with other studies based on the same data (Dustmann et al. 2009, Baumgarten 2013).

29

Since changes in quantities (composition) are contemplated in isolation from the changes in prices (wage structure), general equilibrium effects are also ignored in this analysis. This means, for example, that a change in the staff share of highly skilled workers is viewed as entirely independent from the change in the return on education. In addition, the wage structure effect of the individual explanatory factors determined depends on the choice of basic categories used. We proceed with the greatest possible neutrality and define the categoric variables of the individual modal category from 1996 as the baseline category.³⁰ An additional limitation is that no causal effects can be identified by decomposition analysis.

In our analysis we consider the following individual and company-specific explanatory factors to provide the most precise picture of the drivers of wage inequality. At the individual level, we differentiate between three education groups, five age categories and more than 300 different occupational groups. At the company level, we look at collective bargaining agreements by checking for three different forms of wage setting (industry collective agreement, company-level agreement or no collective agreement), recording the international engagement of companies by checking the export status of individual businesses and taking into account potential effects of technological progress by checking whether a company has invested in new technologies.³¹ Furthermore, we also capture any possible structural business change by checking for additional industry branches.

We first conducted the decomposition analysis for the entire period from 1996 to 2010 for full-time male employees in the manufacturing sector. The manufacturing sector is of special interest in this respect because two of the explanatory factors considered, (decline of) collective bargaining and international trade, are of outstanding importance to this sector. The limitation to men, like the choice of the wage inequality standard used, serves to increase comparability with other studies that had also applied this restriction (see Baumgarten 2013). We subsequently performed the decomposition analysis separately for the two subperiods – 1996 to 2003 and 2003 to 2010 – to gain a better insight into the dynamics of wage inequality and its driving factors.

6.2 Results

Figure 16 presents the results of the decomposition analysis in a graph.³² For all explanatory factors considered, the contributions to the composition effect (upper part of the figure) and the wage structure effect (lower part of the figure). The three columns next to each other depict the results of the different inequality standards. They are shown as increases in log percentage points.

It becomes clear that wage inequality has risen by about 13 log percentage points over the observation period. A majority of that rise can be traced back to an increase in the lower wage

³⁰ With binary variables, the base group is “naturally” occurring.

³¹ Investments in new technologies refer to investments in communication and data processing.

³² A comprehensive table of the results, which also includes standard errors, can be found in Table A1 in the Appendix.



distribution range. Furthermore, we recognize that the increase in inequality is connected primarily to composition effects, meaning shifts in the underlying employer structure: They explain around 80 percent of the total increase. By contrast, the aggregated wage structure effect is of lesser significance.³³

When we consider the individual composition effects in detail, we see that the decline in collective bargaining agreements has primarily promoted inequality and is associated with an increase of around 6 log percentage points. If we compare the effects across the ranges of wage distribution, it reveals that the decline in collective bargaining agreements promoted inequality especially in the lower range of wage distribution (increase of around 5 log percentage points). This illustrates that the binding force of collective wages is strongest in the lower range of wage distribution so that a decline in these types of agreements chiefly impacts wage distribution in this range. In addition, changes in the workers' education and age structures promote inequality and are associated with an increase in wage inequality of 1.33 log percentage points (education) and 2.75 log percentage points (age). Their effects are greatest in the upper range of wage distribution. These results reflect the development that a shift to higher education and age groups occurred during the time period being studied. In particular, the share of highly-qualified workers and those in the 46–55 and 56–65 age groups increased. Wage distribution within these specific groups is traditionally high. We were unable to identify a statistically significant effect on composition effects for our export and technology variables. This also applies to the explanatory factors, sector and occupation.

Looking at the wage structure effects in detail, these show very different directions of effect for the individual factors. An overall effect that is not statistically different from zero is the result. Regarding the interpretation of the wage structure effects of the individual factors, we reiterate that these depend on the choice of the base category. Therefore, the specific factor's contribution to a change in the wage structure is reflected relative to its base category. Moreover, direct changes in the return for individual factors are reflected in the wage structure effects as well as changes in the residual inequality within the group being studied relative to the base group.³⁴ Nevertheless, interesting overall conclusions can be drawn from the derived results on the development of the relative wage structure of the individual explanatory factors and their significance for the increase in wage inequality. For example, it becomes clear that changes in the wage structure for employment relationships covered by collective bargaining agreements during the study period had a negative effect on equality and can be associated with a rise in inequality of almost 11 log percentage points. This encompasses an increase in both the collective bargaining premium as well as the residual inequality within such employment relationships relative to those in employment relationships not covered by these agreements.³⁵ It is also evident that workers at the lower end of the wage distribution are especially affected here. Further, the education-wage

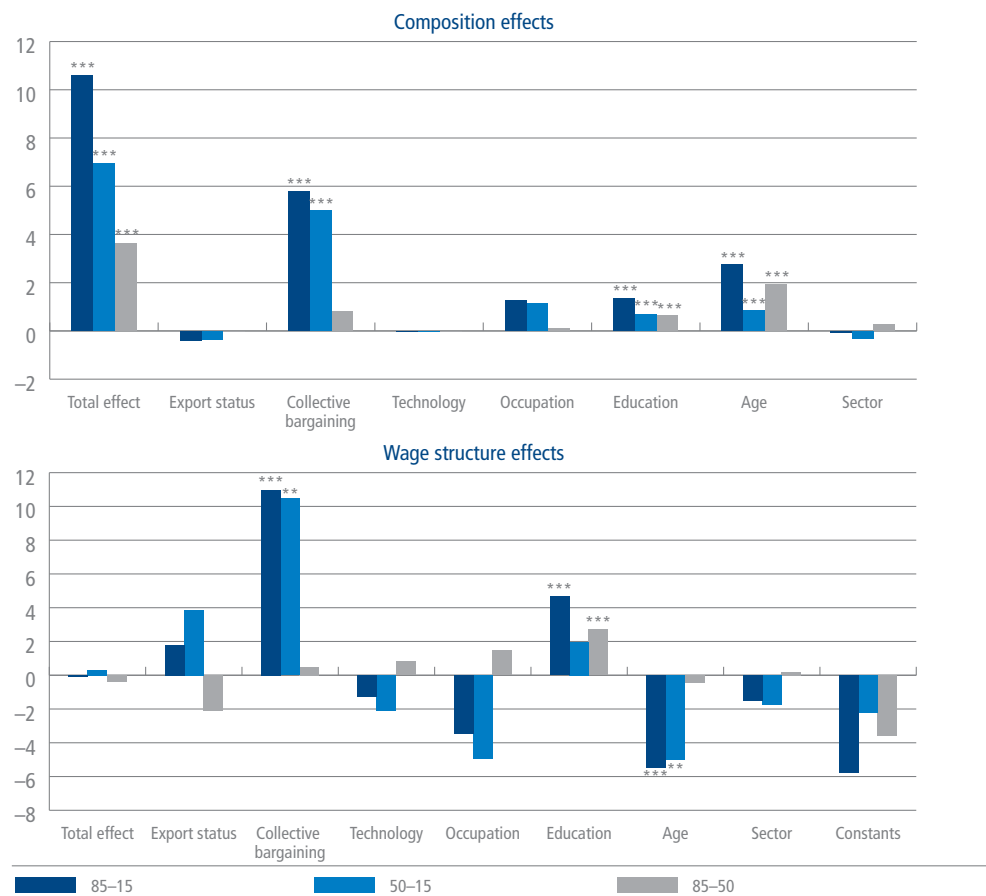
³³ The difference between the total change and the sum of composition and wage structure effects is the result of the specification and weighting errors. These are presented in the table in the Appendix.

³⁴ In our analysis, the base category is defined through the following categories: education – average qualification levels; age group – 26–35; occupation – metalworkers, non-exporting company, no collective bargaining agreement, no investment in new technologies; industry – metalworking. The wage structure effect of the constants can also be interpreted as a change in the residual wage inequality for the base category.

³⁵ See also Dustmann et al. (2014).

structure effect that promotes inequality indicates a change in the return on education or a change in the wage dispersion within the education groups, which particularly impacts the upper range of wage distribution. Additionally, our findings reveal that the wage spread in most age groups has dropped relative to the base group (workers from age 26 to 35).³⁶ This results in an overall effect associated with the age factor that reduces inequality.

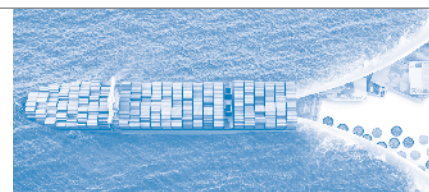
Figure 16: Decomposition results in detail, 1996–2010



Source: LIAB. The sample includes men between the ages of 18 and 65 employed full-time in the ma-nufacturing industry. Weighting factors are considered. ***, **, * statistically significant at the one, five or ten percent level. Increases are shown in log percentage points.

Thus far our decomposition analysis has underscored the significance of traditional factors for increasing wage inequality: Changes in collective bargaining agreements and the corresponding wage structure, as well as changes in the education and age structure for workers and their individual wages all influence the development of wage inequality. We could not identify a statistically significant influence on the increase in wage inequality for either our export channel

36 In fact, our data confirms that the wage dispersion within the base group increased the most.



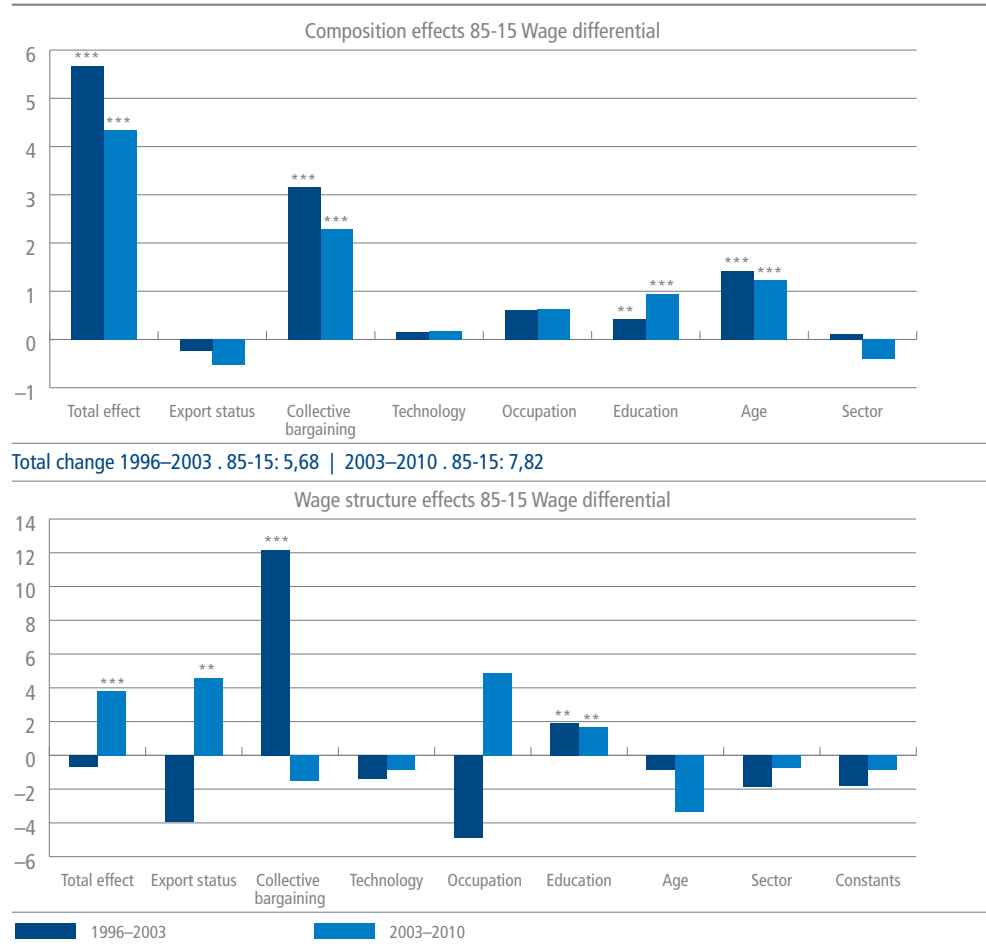
or the technological change factor. However, it is conceivable that the relatively long period of time under consideration (from 1996 to 2010) might conceal new and potentially interesting trends. For that reason, we conducted a decomposition analyses for two time segments. We separated the entire time period into two equally long sub-periods and analyzed the years 1996 to 2003 and 2003 to 2010. Fundamental labor market reforms were introduced between 2003 and 2006 as part of the Hartz legislation, and therefore fall into the second time period. However, it is not clear a priori how this could affect the significance of the individual factors for the development of wage inequality.

Figure 17 illustrates the results of the decomposition analysis for both time periods. We compare the development of the composition and wage structure effects of both time periods and concentrate on the results of the 85-15 wage differential.³⁷

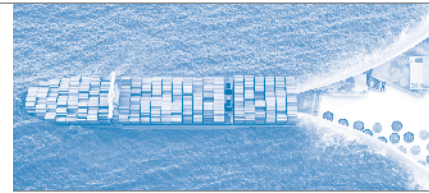
It becomes clear that wage inequality increased more sharply during the second period of time. However, it is plausible that this increase could be due at least in part to the expansion of the low-wage sector in Germany and therefore linked to the above-mentioned Hartz reforms (see also Section 3). A comparison of the detailed composition and wage structure effects further shows that the decisive differences between the two time periods can be traced back to changes in the wage structure (and not to changed composition effects). While changes in the collective bargaining premium or the associated wage structure only promoted inequality during the first subperiod, no influence could be identified in the second subperiod. By contrast, the results indicate that a change in the exporter wage premium had an inequality-promoting effect during the second time period, but not in the first. Therefore, these results point toward the growing importance of companies' export status for the development of wage inequality in Germany. One potential approach for explaining this change is that wage flexibility has increased sharply in Germany due to the documented decline of (industry) collective bargaining agreements. As such, company characteristics relevant to business success, such as export status, have a stronger effect on paid wages. This greater company wage differentiation, which was also documented by Card et al. (2014), impacts the development of total wage inequality accordingly.

³⁷ A detailed representation of the results in table form that also contains the statistical standard error can be found in Table A2 in the Appendix.

Figure 17: Detailed results of the decomposition analysis, 1996–2003, 2003–2010



Source: LIAB. The underlying sample includes full-time male employees between the ages of 18 to 65 years who are employed in the manufacturing sector. Weighting factors are considered. ***, **, * statistically significant at the one, five or ten percent level. Increases are shown in log percentage points.



6.3 Assessment and summary

The results of our decomposition analysis show that the majority of the increase in wage inequality can be traced back to composition effects. According to the analysis, changes in the underlying structure for workers can be linked to around 80 percent of the increase in inequality between 1996 and 2010. The decline of collective bargaining agreements plays the most important role here. It particularly increases inequality in the lower range of wage distribution and explains around 43 percent of the entire increase during the period of time in question. It is accompanied by a change in the wage structure that also promotes inequality in the lower segment of the distribution.³⁸ However, our observations of the different time periods show that these changes provided an explanatory contribution to the rise in wage inequality exclusively in the period from 1996 to 2003. Aside from changes in the collective bargaining structure, the shift in the workers' structure toward higher education and age groups played an important role for rising wage inequality. This can be traced back to the fact that highly-qualified and older workers traditionally exhibit a higher wage dispersion than other skill groups. The shift to higher education and age groups explains around 10 and 20 percent respectively of the total rise in wage inequality from 1996 to 2010. Furthermore, the results of our decomposition analysis revealed a change in the return for highly-qualified workers or the residual inequality within this group. This development promotes inequality in the upper portion of the wage distribution, comprising a total of around 34 percent of the observed total rise in inequality.

Investments in new technologies, our measure for technological change, had no immediate influence on the growth of inequality according to our analysis. Company export behavior also plays a subordinate role. Changes in the exporter wage premium only had an inequality-promoting influence during the more recent time period of 2003 to 2010.

Therefore, our analysis confirmed the overall significance of traditional factors as drivers of wage inequality. By contrast, international trade had a very moderate direct effect on the development of wage inequality within the export channel considered in this analysis. Table 5 provides a summary of the results.

³⁸ These changes in the wage structure are connected to around 80 percent of the total increase. It becomes clear that changes which are solely associated with the collective bargaining structure in Germany – viewed in isolation – would have had an even stronger effect than those actually observed. When considering the individual percentages overall, we must first take into account that some explanatory factors have an inequality-reducing effect (such as the wage structure effect of age) and therefore that percentages exceeding 100 percent are mathematically possible. Second, we must also take into account that constants as well as weighting and specification errors must be included in the calculation (please see the detailed table in the Appendix).

Table 5: Central results of the decomposition analysis

Composition effect	The share of jobs not covered by collective bargaining is increasing, which increases inequality. This affects the lower range of wage distribution.
	The share of highly skilled and older employees is rising. Since the wage differential within both of these groups is high, this increases inequality. This affects the upper range of the wage distribution.
Wage structure effect	The wage structure effect related to collective bargaining promotes inequality. However, this only occurs during the first subperiod (1996-2003). This affects the lower range of wage distribution.
	The return on education for the highly-skilled relative to the medium-skilled has increased. Moreover, the wage gap within the highly-skilled group has increased. Both of these increase inequality. This affects the upper range of the wage distribution.
	The exporter wage structure effect promotes inequality in the second subperiod (2003-2010).

Source: Own representation.

In the next section we will conduct a supplementary analysis in which we consider the correlation between international trade and inequality at an aggregated level. We will measure sectoral openness using data that assesses added value and therefore are also taking into account the interdependence structures within the national economy. Unlike the analysis in this section, an examination at the aggregated sectoral level also considers possible indirect effects from international trade that arise from the exporter wage premium and the share of employment by export companies. For example, it is conceivable that supplier companies that do not export themselves may also benefit from increasing export opportunities, and this trickles down to the wages of their employees. Moreover, this analysis enables us to consider both the export channel as well as the import channel and thereby examine the flipside of increased trade integration and greater import competition.



7 International trade und inequality on a sectoral level

We will now examine the connection between international trade and inequality at the sectoral level using openness as a measure of an industry's import and export activities. To perform this analysis, we are using the standard deviation of log gross wages as the measure of inequality.

We will measure the different sectors' openness by the share of the exported value added of each sector's total value added. This has a decisive advantage compared to other measures of openness because it allows indirect exports to also be taken into consideration. These are created when sectors that export little or nothing themselves deliver inputs to other, more export-oriented sectors. Moreover, in the measure used, imported inputs are deducted because they do not create any domestic value. The measure is the share of the sector's value added that is absorbed (consumed or invested) abroad. In addition, we are working with an analogous measure of import openness, which expresses the foreign value added absorbed domestically as a share of the domestic sectoral demand.³⁹

The measures of openness were calculated based on the World Input Output Data (WIOD)⁴⁰ and compiled for our analysis with the aggregated inequality measures from the SIAB dataset. This correlation yielded information for a total of 34 sectors (15 manufacturing, 17 services, one agricultural and one mining), over a period of time from 1998 to 2010, providing us in the end with 432 observations. Figure 18 shows the data.

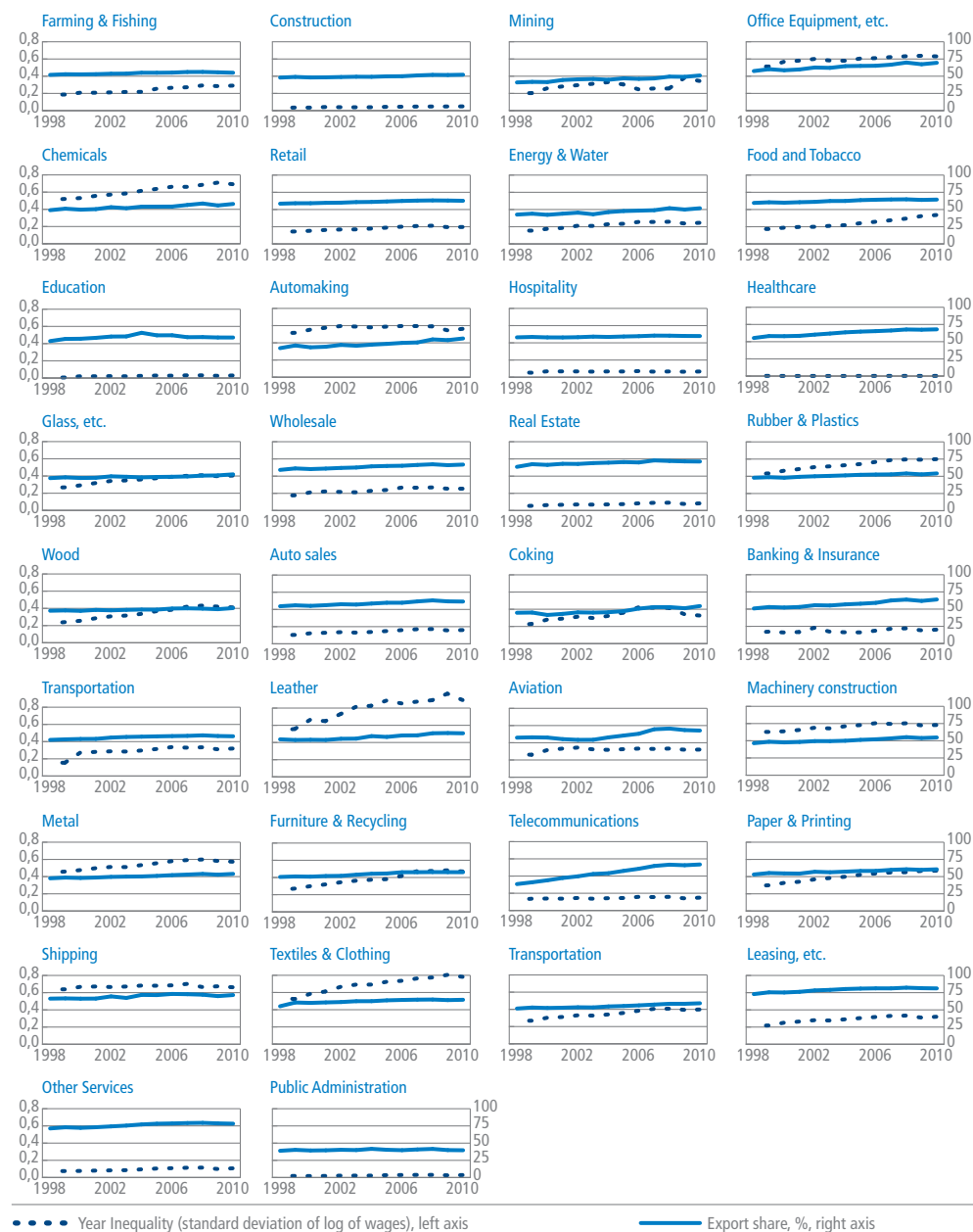
We consider a simple regression model for our analysis. The central challenge consisted of distinguishing the influence of openness from the influence of other sectoral characteristics. As a result, besides the variables of interest, our regression model takes the following control variables into account: a complete set of industry indicators (to isolate constant heterogeneity between sectors), a complete set of annual indicators (to represent the macroeconomic trends) as well as linear and quadratic sector-specific time trends. This design is intended to help ensure that the correlations between openness and inequality are not driven by factors other than the two variables of interest. Unfortunately, no aggregated data is available on the development of collective bargaining agreements at the sectoral level, so we cannot examine it directly in our analysis.⁴¹ However, we can assume that the majority of change in collective bargaining is captured by taking into account the annual indicators as well as time trends.

39 The methodology used as well as the underlying data are presented in Aichele et al. (2013). Additionally, all measures of openness were calculated within the context of Aichele and Heiland (2014) and made available to us.

40 For details, please see http://www.wiod.org/new_site/home.htm

41 The information on collective bargaining agreements available from LIAB data can only be aggregated in a different, very rough industry classification that is not helpful in this case.

Figure 18: Inequality and openness over time at the sectoral level



Source: Own calculations based on the SIAB and WIOD.



Table 6 shows the results of our regression analysis. Because in most specifications, the calculated R^2 (the share of the variance of inequality explained by our model) is about 95 percent. This shows that our specification allows little room for distortions that could be caused by the non-modelled determinants of inequality. Nevertheless, the effects shown in the table should not be interpreted as causal, because it is conceivable that a random increase in inequality leads to an increase in the export quota (reverse causality).

Table 6: Inequality and openness at the sector level

	All sectors				only PG	only DL
	(1)	(2)	(3)	(4)	(5)	(6)
Export openness	0.067**	0.089*	0.084***	0.115***	0.085**	0.001
	(0.030)	(0.050)	(0.017)	(0.036)	(0.034)	(0.102)
Export Openness, 2		-0.02		-0.029		
		(0.03)		(0.031)		
Import Openness			-0.050	-0.138		
			(0.064)	(0.194)		
Import Openness, 2				0.082		
				(0.127)		
R2	0.9489	0.9489	0.9495	0.9499	0.9547	0.9512
Root MSE	0.0062	0.0062	0.0062	0.0061	0.0051	0.0068
F-Test (P-Wert)	0.0264	0.0298	0.1563	0.1055	0.0399	0.0000
Number of industries	34	34	34	34	15	17

Quelle: All regressions consider sector dummies, year dummies and linear and quadratic sector-specific time trends. Standard errors are adapted to the industry level. Columns (1)-(8): Number of years 13. PG: manufacturing industries, DL: services. ***, **, * statistically significant at the one, five or ten percent level.

Column 1 shows the results of the basic specification. Here, besides the control variables mentioned, a regression is conducted of the standard deviation of log real wages on export openness. In so doing, we consider all sectors. The effect of 0.067 is statistically significant at the five percent level. This suggests that on average across all sectors considered from 1998 to 2010, the wage dispersion increased from 0.42 to 0.48 by 0.06 log points. The export share rose by 13 percentage points from 31 to 44 percent. The model suggests that the rise in export openness enabled inequality to rise by 0.00871 log points ($0.067 \cdot 0.13$). That corresponds to about 15 percent of the observed total rise in inequality ($0.00871/0.06$).

An increase in export activities is therefore associated with an increase in inequality; the measured explanatory contribution, however, amounts to only 15 percent of the measured rise in inequality. If average export openness were to rise by another 10 percentage points, the estimate suggests a rise in inequality of 0.0067 log points. It would then rise from just over 0.48 to 0.49, an increase of about 1.5 percent. However, this extrapolation is justified only when the relationship between export openness and wage inequality is linear. This must not necessarily be the case and is examined in variations of the basic model, shown in columns 2 to 4. Here the squared export share, as well as single and squared import shares, are considered in the regression.

The results demonstrate that the importance of exports for inequality is unaffected (it increases marginally), while the import share has no measurable effect on the inequality (all coefficients are statistically insignificant). The squared export openness is likewise statistically meaningless but shows a negative coefficient. This is interesting because theoretical studies (Helpman et al., 2010; Felbermayr et al., 2014) postulate that inequality first increases with a rise in share of exports, but then declines after exceeding a maximum.

Columns 5 and 6 show the results of the relevant analyses separated by the manufacturing sector (PG) and the service sector (DL). It can be seen that an increase of openness is associated with higher wage inequality only in the manufacturing sector. If import openness is used instead of export openness, the picture remains the same.⁴² Including squared terms does not change the result, either.

To summarize, our analysis shows that a connection can be established between openness and wage inequality at the sectoral level. Over the period of time from 1998 to 2010, the increase in openness explains about 15 percent of the measured increase in wage inequality, and therefore should not be neglected. In keeping with our results from Section 6, however, the picture emerges here as well that the influence of international trade on the increase of wage inequality is only moderately significant relative to the other factors.

⁴² The two openness measures are highly correlated. The correlation coefficient is 83 percent in the manufacturing sector and 95 percent in the service sector.



8 Economic policy implications

Gross wage inequality in Germany has risen sharply in recent decades, with a new trend emerging primarily in the mid-1990s. Our detailed decomposition analysis showed that a majority of this increase correlates with changes in collective bargaining in Germany: Around 43 percent of the total rise in wage inequality can be linked to the decline in collective bargaining. Workers in the lower range of wage distribution – where the binding force of collective wages is strongest – are especially impacted by these developments.

The role of international trade on the development of wage inequality is significantly more moderate by contrast. According to the results of our sectoral analysis, approximately 15 percent of the increase in wage inequality measured between 1998 and 2010 can be linked to the increased openness of a sector. This contribution should not be neglected, but it is of secondary importance in relation to the influence of other explanatory factors. We were only able to identify a very limited influence for companies' international engagement on the growth of wage inequality in our decomposition analysis as well. However, the influence did increase during the more recent time segment.

Yet even if the determined direct effect of international trade on the inequality trend turns out to be moderate, it is conceivable that increased international integration through interdependencies with the changed institutional environment has an indirect relevance for the development of inequality. It is thoroughly plausible that the decline of collective forms of wage bargaining as well as the widespread usage of escape clauses and other measures to increase wage flexibility at the company level were set into motion with the process of growing international interdependence.

Our analysis further shows that shifts in the workers' structure toward higher education and age groups are relevant for the rise of inequality and can be associated with around 30 percent of the total increase. This can be attributed to the fact that higher skill groups traditionally exhibit a higher wage dispersion. Moreover, our results show a change in the wage structure for highly-qualified workers that promoted inequality as well.

However, the results of our variance analysis also show the majority of the rise in wage inequality occurred within skill groups rather than between those groups. This could indicate that aside from other factors, the “softer” forms of qualification not visible in the data (e.g., real-world occupational experience, work habits, etc.) have increased in importance.

Further possible drivers for wage inequality include other aspects of a changing institutional landscape (e.g., Hartz reforms) and other forms of globalization, such as international migration and foreign direct investments, which we have not examined in this report.

For economic policy, it is important to put our results properly in context. We have examined wage inequality among dependent employees in Germany and found it has clearly increased. We were able to show in our analysis that primarily changes in collective bargaining agreements played a key role in this development. However, economic policymakers should not draw a hasty conclusion that strengthening collective bargaining should be their objective in order to reduce inequality. Rather, we need to take into consideration in this context that in addition to the increase in wage inequality, we must also see an increase in the number of dependent workers during the same period of time. It is plausible that both phenomena are connected: Inequality rises among employees, especially when the employees who earn a low income are newly hired.

Think for example of the stay-at-home parents who are today dependently employed and earn an income (even if a small one) but were previously without any income subject to social security assessments and thus were not included in our statistics. If the employment opportunities for such people were to be limited, for example through overly rigid wage setting, it would reduce the measured wage inequality – but total income inequality could actually rise if they no longer earn any income at all.

The central economic policy conclusion of our work should be that the challenge from an increasingly unequal distribution of gross wages should be solved using distribution policy instruments. The goal is to achieve a balance between objectives for distribution and employment policy.

Finally, in this context we should note that the question of what degree of inequality should be considered desirable in an economy is not an economic but a social question. Its answer depends not least on what measurement is used as a standard. For example, international comparative studies (see OECD 2011) show that the inequality in Germany has risen, but is still moderate in an international comparison.⁴³

⁴³ In the OECD study, however, inequality is analyzed on the basis of disposable income, i.e., tax and transfer payments are already taken into account.

Data Sources

SIAB

The sample of integrated labor market biographies (SIAB) is a two-percent sample of the population of all persons who were employed in the period from 1975 to 2010 in Germany and were obligated to pay social security assessments, received benefits in accordance with the Social Code III (recorded starting in 1975) and Social Code II (recorded starting in 2005), were registered with the Federal Employment Agency as seeking jobs or took part in some labor market policy measures (recorded starting in 2000). Not included were persons performing community service, members of the civil service and the self-employed. In 2010 some 695,593 persons were observed. Information about all of Germany was officially available starting in 1991, but was used for this study only starting in 1992 (cf. Riphahn and Schnitzlein 2011). SIAB makes use of various data sources. A detailed description can be found in Vom Berge et al (2013).

For our analysis, the employment information is of major interest. Every employer is required to report annually, for each of his employees, the exact term of the employment relationship and the total compensation paid. Total compensation is limited to the amount up to the social security assessment cutoff. However, there are established methods to determine wages in these cases as well in sufficient approximations, see Dustmann et al. 2009 and Card et al. 2013. In addition to information on the length of employment and compensation there is additional information, such as a company identification number, the educational level of the employee and his or her occupation.

We concentrate in our analysis on full-time employees between 18 and 65 years old, for the years 1985 to 2010, earning a daily wage of at least ten euros. The focus on full-time employees is based on the fact that there is no information on the number of hours worked, since the number of hours worked by part-time workers can vary substantially. Marginal employment relationships and those working very little are also excluded from our analysis. Information about these employment relationships is available only starting in 1999 and therefore does not allow time-consistent examination. The selection of the sample follows Card et al. 2013 and Baumgarten 2013.

LIAB

The Linked-Employer-Employee-Data of the IAB (LIAB) allows the simultaneous analysis of the supply and demand sides of the labor market, i.e., companies and employees. For this, a connection is established between the data of the IAB establishment panel and the personnel data of the IAB. This is possible because in both data sets, the same company identification numbers are used. The IAB establishment panel is an annual, representative company survey. Bellmann 2002 gives a general introduction to the dataset.

Companies in the old federal states have been surveyed since 1993, and companies in the new federal states since 1996 as well. In 2010, some 16,296 companies took part in the survey. They represent a random sample sorted by industry, company size and federal state, and by using the grossing-up factors, can be seen as representative for the population. This population consists of all companies that on June 30 of the previous year employed at least one person who was subject to social security assessments. The personal data is taken from the same data sources as the SIAB. Accordingly, the data set is designed according to the same criteria as the SIAB.

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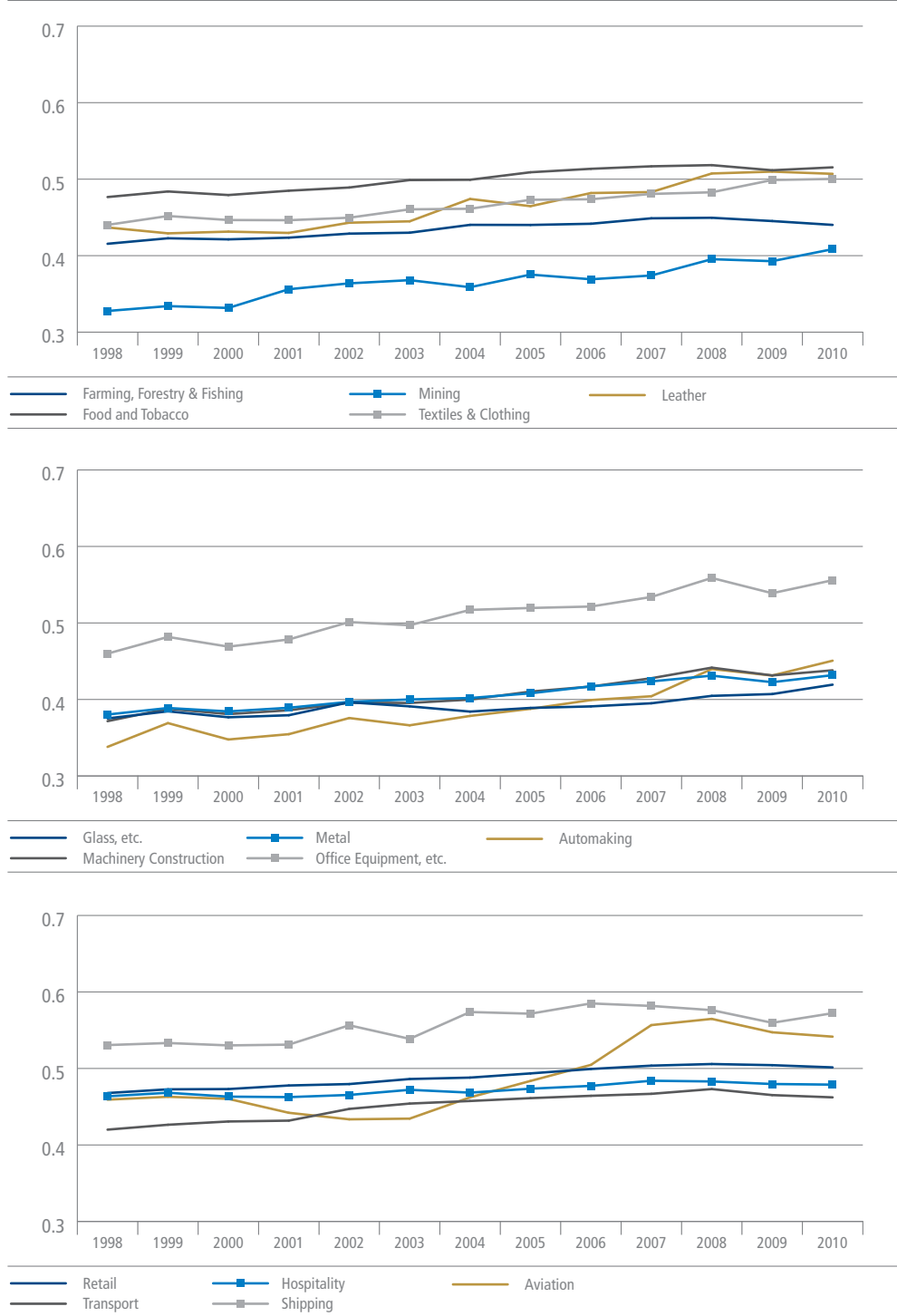
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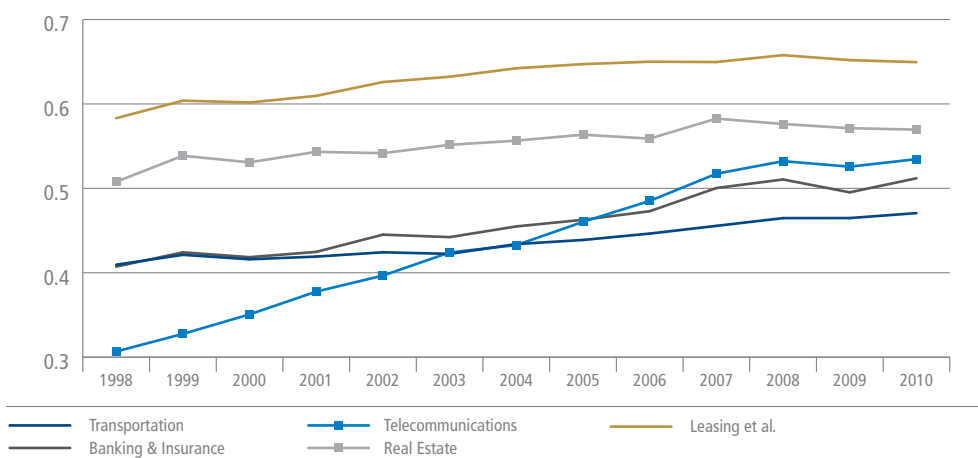
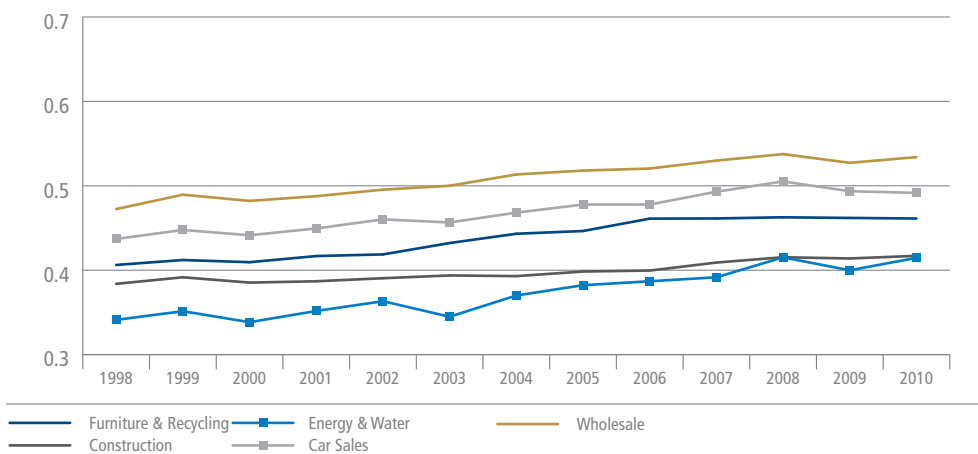
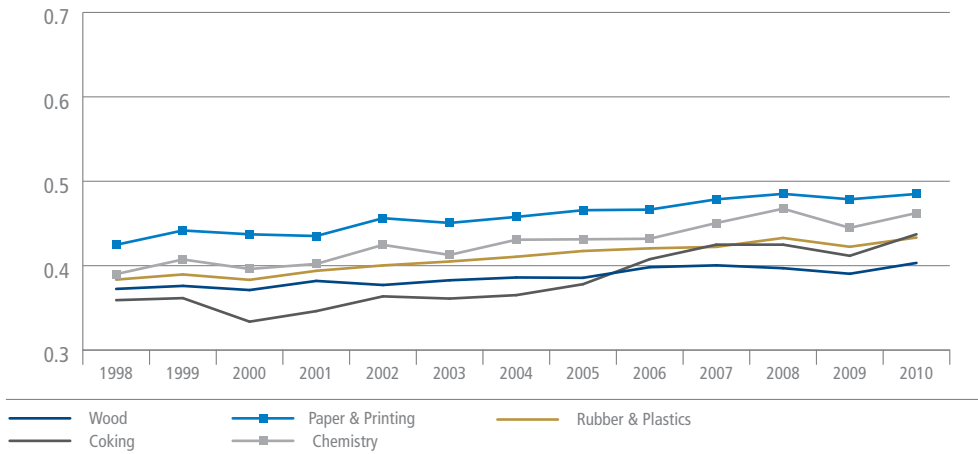
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Appendix

Figure A1: Wage Inequality by industry





Source: Own calculations based on SIAB. The underlying sample includes full-time employees from 18 to 65 years old separated by industry. Shown is the standard deviation of log real wages by industry.

Table A1: Results of the decomposition analysis, 1996–2010

1996–2010			
Wage differential	85-15	50-15	85-50
Measurable change	13.49***	10.15***	3.34
	(2.17)	(1.23)	(2.03)
Composition effects			
Export status	−0.40	−0.36	−0.04
	(0.26)	(0.23)	(0.31)
Collective bargaining	5.77***	4.98***	0.79
	(1.86)	(1.64)	(0.61)
Technology	−0.04	−0.03	−0.01
	(0.08)	(0.06)	(0.04)
Occupation	1.26	1.16	0.10
	(1.24)	(0.71)	(0.88)
Education	1.33***	0.70***	0.63*
	(0.44)	(0.21)	(0.35)
Age	2.75***	0.83***	1.92***
	(0.48)	(0.17)	(0.39)
Sector	−0.08	−0.33	0.25
	(0.38)	(0.29)	(0.24)
Total effect	10.59***	6.95***	3.64***
	(2.85)	(2.05)	(1.29)
Wage structure effect			
Export status	1.79	3.87	−2.09
	(6.07)	(4.89)	(3.07)
Collective bargaining	10.96**	10.46**	0.49
	(3.95)	(3.73)	(1.62)
Technology	−1.28	−2.10	0.82
	(2.8)	(2.22)	(1.41)
Occupation	−3.45	−4.93	1.48
	(14.75)	(14.34)	(4.69)
Education	4.65***	1.96	2.7***
	(1.58)	(1.17)	(0.84)
Age	−5.47*	−5.03**	−0.44
	(2.93)	(2.2)	(1.65)
Sector	−1.52	−1.72	0.20
	(16.84)	(9.36)	(10.6)
Constants	−5.78	−2.20	−3.58
	(23.18)	(16.35)	(10.82)
Total effect	−0.10	0.31	−0.41
	(2.39)	(2.28)	(0.97)
Weighting error	−0.04	−0.12	0.08
	(0.71)	(0.57)	(0.47)
Specification error	3.04*	3.01**	0.03
	(1.47)	(1.25)	(0.87)

Source: LIAB. The underlying sample includes full-time male employees between the ages of 18 to 65 years who are employed in the manufacturing sector. Weighting factors are considered. The values in parentheses reflect the standard error. ***, **, * statistically significant at the one, five or ten percent level.

Table A2: Results of the decomposition analysis, 1996–2003, 2003–2010

	1996–2003	2003–2010
Wage differential	85-15	85-15
Measurable change	5.68***	7.82***
	(1.72)	(1.66)
Composition effects		
Exporter	-0.24	-0.52
	(0.17)	(0.35)
Collective bargaining	3.17***	2.30***
	(0.82)	(0.67)
Technology	0.16	0.18
	(0.26)	(0.28)
Occupation	0.61	0.63
	(0.62)	(0.98)
Education	0.42**	0.95***
	(0.19)	(0.31)
Age	1.43***	1.23***
	(0.33)	(0.17)
Sector	0.11	-0.41
	(0.30)	(0.44)
Total effect	5.67***	4.35***
	(1.66)	(1.34)
Wage structure effects		
Exporter	-3.96	4.58**
	(3.8)	(2.06)
Collective bargaining	12.18**	-1.51
	(4.65)	(3.2)
Technology	-1.39	-0.84
	(2.29)	(1.89)
Occupation	-4.87	4.89
	(12.67)	(7.88)
Education	1.90**	1.69**
	(0.78)	(0.80)
Age	-0.84	-3.36
	(1.46)	(2.43)
Sector	-1.88	-0.77
	(15.02)	(16.49)
Constants	-1.83	-0.88
	(22.01)	(19.87)
Total effect	-0.68	3.80**
	(1.28)	(1.55)
Weighting error	-0.29	-0.03
	(0.34)	(0.20)
Specification error	0.98	-0.31
	(0.72)	(0.60)

Source: LIAB. The underlying sample includes full-time male employees between the ages of 18 to 65 years who are employed in the manufacturing sector. Weighting factors are considered. The values in parentheses reflect the standard error. ***, **, * statistically significant at the one, five or ten percent level.

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About the Project “Global Economic Dynamics” (GED)

The Global Economic Dynamics (GED) project of the Bertelsmann Foundation contributes to improving the understanding of the growing complexity of global economic developments. By using the most up-to-date tools and methods for measuring, forecasting and modeling global economic dynamics, the project seeks to make globalization, its economic effects and its political consequences more transparent and understandable.

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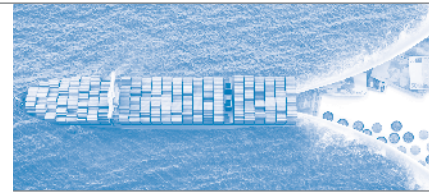
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