Changes in the German Wage Structure: Unions, Internationalization, Tasks, Firms, and Worker Characteristics[1]

Martin Biewen (University of Tübingen, IZA Bonn)

Matthias Seckler (University of Tübingen)

Abstract. This paper provides a comprehensive assessment of the quantitative importance of the factors associated with the rise in male wage inequality in Germany over the period 1995-2010. In contrast to most previous contributions, we rely on the German Structure of Earnings Surveys (GSES) which allow us to focus on hourly wages (rather than daily earnings) uncensored by the social security contributions threshold. We consider a large number of covariates including personal characteristics, measures of internationalization, task composition, union coverage, industry, region, and firm characteristics. Our results suggest that recent changes in the distribution of hourly wages in Germany look different from the polarizing patterns found for the US, and that most of the observed rise in inequality was associated with compositional effects of de-unionization and personal characteristics. We also find some moderate effects linked to internationalization, firm heterogeneity and regional convergence, but these were much smaller.

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Correspondence: Martin Biewen, School of Business and Economics, University of Tübingen, Mohlstr. 36, 72074 Tübingen, Germany, Fax: +49-7071-295013, martin.biewen@uni-tuebingen.de

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1 Introduction

There is a clear consensus in the literature documenting a steady increase in wage inequality since the early 1980s in many countries around the world (see Katz and Autor, 1999, and Acemoglu and Autor, 2011 for surveys, and Dustmann et al., 2009, for the German case). The literature has considered a large number of possible explanations for this trend. The most prominent explanation are changes in demand and supply across skill groups connected to skill-biased technological change (Katz and Murphy, 1992, Juhn et al., 1993, Katz and Autor, 1999, Goldin and Katz, 2008, among others). Observing that more recent changes in US wage distribution were not uniformly favoring higher skills, the basic SBTC hypothesis was refined by the task-based approach (Autor et al., 2003, 2008, Acemoglu and Autor, 2011). This more refined version of the SBTC hypothesis explains further inequality increases by falling demand for non-manual routine occupations in the middle of the distribution which fall back compared to manual routine occupations at the bottom and non-manual analytic occupations at the top of the distribution. At the same time, a number of researchers have criticized the focus on the SBTC hypothesis suggesting that compositional and institutional changes such as de-unionization and changes in the minimum wage account for a substantial part of the inequality increase (DiNardo et al., 1996, Card and DiNardo, 2002, Lemieux, 2006). The third line of explanation, international trade, was identified as less important in earlier studies (e.g. Katz and Murphy, 1992) but has been taken up again as a potentially important factor more recently (Autor et al., 2014, Ebenstein et al., 2014, Firpo et al., 2014). Finally, a number of recent contributions have emphasized the potential role of growing heterogeneity between firms for the rise in wage inequality (e.g., Card et al., 2013, Barth et al, 2016, and Baumgarten et al., 2016).

In order to evaluate these explanations in a more general sense, it is important to look at the relevance of these factors for a range of countries. A particular interesting case is Germany, given its large degree of integration in the world economy and its relative economic importance within the European Union. Adding to previous research on the German wage distribution (Dustmann et al., 2009, Antonczyk et al., 2010, Card et al., 2013, Baumgarten et al., 2016, see more detailed literature review below), this study aims to make the following contributions. First, to our best knowledge, this is the first study using information from four waves (1995, 2001, 2006, 2010) of the mandatory *German Structure of Earnings Surveys (GSES)* conducted by the German Federal Statistical Office. In contrast to the widely used *Linked Employer-Employee Data*

(LIAB), the *GSES* includes information on hourly wages and is not subject to censoring at the social security contributions threshold, allowing one to study the whole distribution of wages.[2] Moreover, hourly wages better reflect prices paid in the labor market than daily or monthly earnings which are confounded with labor supply decisions and differences in hours worked. They are thus more suitable for testing the theories about changes in labor price structures discussed above. Focussing on hourly wages also makes results more comparable to those for the US for which most studies have used hourly wages (e.g., DiNardo et al., 1996, Lemieux, 2006, Autor et al., 2008, Firpo et al., 2014). The second contribution we aim at is to provide a joint quantitative assessment of as many of the potential determinants of changes in the wage distribution as possible. As in other contexts, considering many potential factors at once is important to rule out spurious findings and to single out the quantitative importance of individual factors. We therefore consider a set of covariates that is larger than in most previous studies and that includes rich information at the individual level, firm information, information on union coverage, information on the task composition of occupations as well as measures of internationalization. For this purpose we complement our data base on hourly wages by information from a number of other surveys, in particular information on the task composition of occupations, information on the exporting behavior of firms, and information on international trade at the industry level. As a final (smaller) contribution, we provide a comparison of findings from different econometric decomposition techniques including the RIF regression approach (Firpo et al., 2009, 2014) and inverse probability reweighting (DiNardo et al., 1996). We also address some issues in the empirical implementation of RIF regressions, which may be of interest to researchers who want to apply this powerful tool.

To preview our results, we find that the recent changes in the German wage distribution look different from the polarizing patterns found in studies such as Autor et al. (2008) and Firpo et al. (2014) for the US. The changes we find are very monotonic in the sense that higher quantiles gained, while lower quantiles lost. We do observe polarizing ceteris paribus effects of changes in task compositions, but these were clearly dominated by other factors. Strengthening previous findings in Dustmann et al. (2009) and Baumgarten et al. (2016), we find that the single most important factor for recent rises in wage inequality in Germany were compositional effects related to de-unionization. We also document that the dramatic decline in unionization over the period

[2] The *LIAB* was used by Dustmann et al., 2009, Card et al., 2013, and Baumgarten et al., 2016, among others. The only other comparable study that uses the *GSES* we are aware of is Antonzcyk et al., 2010.

considered by us was nevertheless accompanied by rising wage premia of union coverage. In contrast to Dustmann et al. (2009) (who analyzed daily earnings), our results suggest that the effects of de-unionization were not confined to the lower part of the distribution but were equally strong in the upper half of the distribution. As the second most important factor, we identify compositional effects related to personal characteristics such as workers' age and education. Such effects are consistent with the hypothesis that the increasing demand for higher skills due to SBTC were matched by rising supply for such skills due to educational upgrading and population aging (in the absence of rising demand due to SBTC, rising supply of high skills would have depressed the wage premia payed for such skills). We do find some indications for excess demand for higher skills, but these do not translate into strong wage structure effects in our decomposition analyses. We also show that there is little evidence for strong effects of increasing firm heterogeneity beyond the factors explicitly included in our analysis (especially union coverage). We observe that the secular rise in inequality was to some extent mitigated by regional wage convergence (especially East vs. West Germany). Finally, we find some compositional and wage structure effects related to firm sizes and measures of internationalization (especially exporting behavior), but these were much smaller than the strong compositional effects of de-unionization and personal characteristics.

The rest of the paper is structured as follows. Section 2 provides a review of some related literature. In sections 3 and 4, we describe our data and econometric methods. Section 5 presents our empirical results. In section 6, we discuss these results and provide some conclusions.

2 Literature review

In this section, we provide a selective review of contributions dealing with changes in the German wage structure and with effects of the factors considered by us on the wage structure in other countries. Based on administrative data derived from social security records, Dustmann et al. (2009) have analyzed changes in the distribution of daily earnings in Germany up to 2004. They showed that inequality increases first started in the 1980s at the top, and then in the 1990s at the bottom of the distribution, about a decade later than in the US. Their analysis suggests that compositional effects of personal characteristics account for a substantial part of inequality changes in the upper half of the distribution and nonnegligible shares at the bottom, while compositional changes of de-unionization explain considerable changes at the bottom and some of the changes in the upper part of the distribution. They also present evidence on moderate trends of polarization due to changes in task structures but do not explicitly quantify their effects on the wage structure. Some of the questions related to the supply and demand for skills discussed in Dustmann et al. (2009) have recently been taken up by Glitz and Wissmann (2016).

Based on a different data base, Antonzcyk et al. (2009) explicitly examined polarization effects of task changes on the distribution of monthly wages. They find that changes in task assignment reduced rather than increased wage inequality. Antonzcyk et al. (2010) used two waves (and a more anonymized version) of the data base we also use for this article in order to study changes in the wage distribution and the gender wage gap between 2001 and 2006. Their results suggest that changes in firm-level characteristics other than those related to union bargaining were the most important determinants of rising inequality, while changes in unionization did not have much explanatory power when other firm-level characteristics were controlled for.

Also using IAB data, Card et al. (2013) studied the effects of fixed person and firm effects on the distribution of daily wages. They conclude that both increasing dispersion in person and in firm effects as well as increasing assortative matching of high person to high firm fixed effects contributed to increasing wage inequality. In a setup similar to the one used in the present article but based on IAB data, Baumgarten et al. (2016) aim to disentangle between-plant and within-plant sources of wage inequality. Their results also indicate a leading role of changes in unionization for rising inequality of workers between firms, while technological differences turn out to be important determinant of within-firm heterogeneity. Similarly, Ohlert (2016) studied determinants of establishment heterogeneity in Germany concluding that increasing differences in firm size and workforce composition contributed to rising inequality, while changes in union coverage played no important role. Also based on IAB data (but without information on union coverage), Rinawi and Backes-Gellner (2015) examine task-composition effects on the wage structure. At odds with Antonczyk et al. (2009), they find that task effects explain up to one third of the rise in wage inequality.

In a recent study for the US, Firpo et al. (2014) have analyzed the influence of detailed task measures and measures of offshorability on changes of the US wage distribution. Their article also gives a nice summary of changes in the US distribution of hourly wages over the last decades. Consistent with Autor et al. (2008), they show that, while distributional change in the 1980s was very much monotonic (very high quantiles gained, lower quantiles lost), this pattern became

U-shaped in the 1990s and 2000s. They further show (in contrast to what we find for Germany) that recent inequality increases were associated with wage structure rather than composition effects and that offshorability became a more influential factor in the 1990s and 2000s.

There is a small number of articles that empirically address aspects of internationalization for wages in Germany. Schank et al. (2007) and Klein et al. (2013) investigated the exporter wage premium, while Geishecker and Görg (2008) and Baumgarten et al. (2013) studied wage penalties associated with offshoring. These articles contain useful information on the effects of internationalization on wages but do not provide a full distributional analysis that quantifies the magnitude of these effects on the overall wage distribution. A full distributional analysis of the exporter wage premium is given in Baumgarten (2013), who finds that these effects are rather small when individual and firm characteristics are controlled for. Baumgarten et al. (2016) also find moderate effects of exporting on the wage structure in Germany. Using administrative data and more detailed measures of outsourcing than we can use in our study, Goldschmidt and Schmieder (2015) investigate the impact of outsourcing activities on the German wage structure. They conclude that the outsourcing activities studied by them contributed to some 9 percent of the increase in German wage inequality since the 1980s.

3 Data and descriptive statistics

The empirical analysis in this paper uses information from four waves (1995, 2001, 2006, 2010) of the *German Structure of Earnings Surveys (GSES)* provided by the German Federal Statistical Office. The GSES are linked employer-employee data, which allow us to to consider a rich set of covariates both at the person and the firm level. We use the minimally anonymized version of the GSES which is only accessible onsite at the German Statistical Offices. Our data differ from the widely used *Linked Employer Employee Data (LIAB)* provided by the Institute for Employment Research (IAB) in several ways. First, the *GSES* contain information on working hours which makes it possible to analyze hourly wages. Hourly wages more directly reflect the prices paid in the labor market than monthly or daily earnings and are thus better suited to test the theories about changes in wage structures discussed in the introduction. Second, the wage information in the *GSES* is largely uncensored, whereas the *LIAB* excludes a substantial part of the upper tail of the distribution due to censoring at the social security contribution ceiling. These advantages allow us to analyze the overall distribution of hourly wages in Germany, including the commonly left-out upper tail. Further advantages of the *GSES* are that the survey information is highly reliable due to the fact that firms' participation is compulsory under German law and that it comprises large enough numbers of observations ranging from some 360,000 to 590,000 observations per wave. In general, the *GSES* include a larger set of covariates at the individual level than available in administrative data.

On the other hand, there are a number of disadvantages. First, the *GSES* is not a panel study limiting the possibilities of studying fixed individual and establishment effects. Second, compared to the *LIAB*, the data lack a number of relevant variables at the firm level, in particular firms' export status. In our analysis, we try to make up for this disadvantage by imputing information on firms' export behavior to our data set which we obtain from the *LIAB* (see below). From a technical point of view, the *GSES* are the result of a two-stage random sample. The first stage constitutes in a draw from all German establishments with at least ten employees subject to social insurance contributions. The second stage is a random draw from all employees working in the selected establishment. Information on individual and firm characteristics are provided by the personnel departments of the firms surveyed. We use the appropriate sample weights in all our analyses to ensure that our results are representative for the population of firms and workers studied by us.

Given that the sectors covered by the *GSES* steadily increased over time, we are not able to use all sectors included in the most recent wave of the year 2010. Instead, we restrict the analysis to the following parts of the economy which have been covered in all years since 1995: *Mining and other quarrying*, *Manufacturing*, *Electricity, Water, Recycling*, *Construction*, *Trade of vehicles*, *Wholesale trade*, *Retail trade* and *Finance and insurance*. Contrary to some previous studies, we are not limiting our analysis to the manufacturing sector in order to provide results on a widely defined overall wage distribution for German men. In our empirical analysis, we use a classification of 24 sectors derived from the 2-digit *German Classification of Economic Activities (WZ)*.[3] Our final sample is restricted to prime age (20-60 years) men working full-time (i.e. at least 30 hours per week) in one of the sectors listed above. In line with the existing literature,

[3]The *German Classification of Economic Activities (WZ)* changed between the waves of 1995, 2001 (WZ93) and 2006 (WZ03) as well as 2010 (WZ08). While the change from WZ93 and WZ03 should not affect our results at the 2-digit level, we acknowledge that the latter change might give rise to minor inconsistencies for the period 2006-2010.

we exclude women from our analysis, given their much lower participation rate in full-time work and given the potential difficulties of sample selection bias.

3.1 Wages

As pointed out above, the dependent variable of our analysis is hourly wages. Our hourly wage measure is defined as October earnings including additional payments from overtime and bonuses from shift work, divided by October working hours including overtime. We inflate price levels in 1995, 2001, 2006 to the 2010 level using the German consumer price index (CPI). For reasons of plausibility, we exclude a small number of wage observations with less than 4 euros per hour as well as those associated with a monthly working time of more than 349 hours. Although the wage information in the *GSES* is largely uncensored, a censoring threshold at 25,000 DM (approxmiately 12,782 Euro) applied in 1995. In order to ensure comparability over time, we extend this censoring threshold to all other years adjusting for changes in the price level (for example, the implied censoring point for 2010 amounts to 15.879 Euro). We argue that we are still able to provide a comprehensive picture of the overall distribution of male hourly wages, as this censoring affected only about 200 (approximately 0.03%) of the observations for 1995 and a similar, though slightly increasing number of observations in the other waves (2001: 0.05%, 2006: 0.16%, 2010: 0.18%). Ultimately, our sample selection criteria lead to a total number of 1,923,542 observations used in our analysis (1995: 592,198 employees in 23668 firms, 2001: 359,495 employees in 15438 firms, 2006: 533,497 employees in 15477 firms, 2010: 438,352 employees in 13285 firms).

— Table 1 here —

In our analysis, we use the following covariates which we combine into seven different subgroups representing the different factors whose influence on the wage distribution we study in our decomposition analyses. We label the different subgroups as *Personal*, *Internationalization*, *Sector*, *Firm*, *Region*, *Tasks* and *Unionization* as illustrated in table 1. Descriptive statistics on these variables and their change over time are given in table A1 in the appendix.

3.2 Personal characteristics

In this subgroup, we include the individual's age (8 categories), tenure (6 categories), educational qualification (6 categories) and occupational position (3 categories). As evident from table A1, these variables followed some notable trends over the period under consideration.[4] In particular, there was some aging of the German labor force as evident from the declining population shares of age groups below 40 years and the rising shares of those above 40 years. We observe a slightly rising share of higher tenure groups at the expense of the lowest tenure bracket (0-5 years), which may be related to selective unemployment during the recessionary period 2001 to 2005. We also observe educational upgrading being reflected in the considerably declining share of individuals with lower/middle secondary schooling with or without vocational training and the rising share of individuals with an upper secondary degree (with or without vocational training) or with tertiary education. We also note that there was some increase of observations in the missings category of educational qualifications. Finally, there was a compositional shift from skilled blue collar work to white collar work, while non-skilled blue collar work stayed constant or even increased slightly.

3.3 Internationalization

This group of covariates is intended to represent three different aspects of internationalization: the exporting behavior of firms on the one hand, and the pressure on 2-digit occupations exerted by offshoring and the import of consumer goods on the other. As the *GSES* data lack a firm-level variable on export behavior, we impute this information from the *LIAB* using an ordered logit model for the categories *No Exports*, *Export share 1-25%*, *Export share 26-50%* and *Export share 51-100%*, where export share represents exports in total sales. For this imputation, we exploit a large number of individual and firm characteristics that are available in both data sets in order to predict the export share category for each observation in the *GSES*.[5] Our predicted export share variable displays very similar trends as in the original *LIAB* data. As shown in the summary statistics in table 4 and in table A1, we observe a steeply increasing trend for the share of the predicted *Export share 51-100%* category at the expense of the lower categories, which was partly

[4]The changes of these variables over time are also displayed in the columns labeled Δx in table 4.

[5]Our model includes education (7 categories), a polynomial in age and tenure, occupational status (4 categories), sector (20 categories), and firm size (7 categories).

reversed after the financial crisis in 2008. By contrast, the share of observations in the *No Exports* category stayed relatively constant with minor fluctuations.

Furthermore, we use information from the German National accounts (Federal Statistical Office of Germany, 1999-2014) at the 2-digit industry level in order to derive measures of wage pressure on occupations due to offshoring and imports of consumer goods. We differentiate between 77 occupations and 24 industries.[6] Following Baumgarten et al. (2013) and Ebenstein et al. (2014), we first consider the share of intermediate input imports coming from the same industry abroad as an indicator for offshoring at the industry level. In order to arrive at a measure reflecting the wage pressure on occupation k due to trends in offshoring activities across industries, we compute the average of these offshoring intensities across all industries, weighted with the employment share of occupation k in industry j. Consequently, our measure of wage pressure on the 2-digit occupation k in year t due to offshoring is given by

$$Offs_{kt} = \sum_{j=1}^{J} \frac{L_{kjt}}{L_{kt}} Offs_{jt} \tag{1}$$

where $Offs_{jt}$ denotes the industry-level offshoring intensities and $\frac{L_{kjt}}{L_{kt}}$ is the employment share of occupation k in industry j in year t.

For imports of consumer goods, we proceed analogously. Let $Imports_{jt}$ be the share of imports of consumer goods in industry j in year t. Our measure of wage pressure on occupation k in year t due to imports of consumption goods in the sectors this occupation is employed in is then defined as

$$Imports_{kt} = \sum_{j=1}^{J} \frac{L_{kjt}}{L_{kt}} Imports_{jt}. \tag{2}$$

3.4 Sectors

In order to address changes in the composition of the economy over time and changes in inter-industry wage differentials, we include categorial dummies for different sectors of the economy based on the *German Classification of Economic Activities (WZ)*, which we harmonized over

[6]The data include the *Classification of Occupations (KldB)* at the 2-digit level, i.e. *KldB75* in 1995 and 2001, *KldB88* in 2006 and 2010. For reasons of time consistency minor aggregations were required leading to a total number of 77 occupations. At the industry level, we consider the 24 sectors of the economy listed in table A1, see next section for more details.

time.[7] Altogether, we use a classification of 24 industries based on the 2-digit version of the *WZ*. As tables 4 and A1 show, there were generally no big shifts in the sectoral composition between 1995 and 2010. Notable exceptions were a sizable decline of the construction sector and a moderate growth of wholesale trade.

3.5 Region

We have information on the federal state a firm is located in (16 categories). Including this information is potentially important as there are sizable differences in mean wages paid in different federal states, especially if one compares East and West German states. As shown in tables 4 and A1, the distribution of firms across federal states was relatively stable.

3.6 Firms

At the firm level, we include information on firmsize (7 categories) as well as information on whether corporate management is influenced by the state. As shown in tables 4 and A1, the distribution of these characteristics was also relatively stable over the period 1995 to 2010.

3.7 Tasks

We exploit the information in the commonly used *German Qualification and Career Survey of Employees (BIBB-IAB)*, jointly provided by the Federal Institute for Vocational Training (BIBB) and the Institute for Employment Research (IAB) in order to construct measures for the analytical, interactive and manual task content of individuals' jobs. More precisely, we use three independent cross sections, each covering 20,000-30,000 individuals from the years 1998/99, 2006 and 2012, which come closest to our sample period. Given some inconsistencies in how the task questions were asked in these surveys over time, we follow the common practice in the literature and consider time-constant task measures per occupation (Baumgarten et al., 2013, Firpo et al., 2014, Böhm et al., 2016). In order to make the task information independent of time, we pool

[7] See footnote 3.

the information from all the three surveys. Note that this will lead to an underestimation of the influence of task changes over time on the distribution of wages.

Table A2 reports the mapping of the different activities into the three task-groups, i.e. *analytical*, *manual* and *interactive*. In doing so, we closely follow Gathmann and Schönberg (2010). The share of a certain task-group g is defined as the number of activities in group g performed by an individual i divided by the total number of tasks performed by the same individual, i.e.

$$Task_{ig} = \frac{number\ of\ activities\ in\ group\ g\ performed\ by\ i}{total\ number\ of\ activities\ in\ all\ groups\ performed\ by\ i}. \quad (3)$$

Following Spitz-Oener (2006), these shares are first calculated at the person-level and then averaged at the level of 2-digit occupations. As figure 1 shows, the share of analytical and interactive tasks increased over the period 1995-2001, while that of manual tasks decreased.

— Figure 1 here —

3.8 Unionization

Our data includes information on union coverage in the three categories *No union coverage*, *Sectoral bargaining* and *Firm bargaining*. *Sectoral bargaining* refers to the case in which unions and employers reach an agreement at the sector level which then generally applies to all employees in that sector (irrespective of union membership). *Firm bargaining* refers to the case in which unions and employers reach an agreement at the firm level which applies to all employees in the given firm (irrespective of union membership). It is the owners or the management of the firm who decide which bargaining regime to take part in. During the period considered by us, the most frequent categories were *Sectoral bargaining* and *No union coverage*, while *Firm bargaining* remained rare. As documented in table A1, the share of the category *Sectoral bargaining* dramatically declined over the period considered by us. By contrast, the share of *No union coverage* increased by almost the same amount, making this category the most frequent one by 2010. The share the category *Firm bargaining* increased only slightly between 1995 and 2010.[8]

[8] For a more detailed analysis of changes in union coverage in Germany, see Fitzenberger et al. (2011,2013).

4 Econometric methods

We apply RIF decompositions as well as semi-parametric reweighting techniques in order to study the quantitative importance of the different sets of covariates on the changes of the German wage distribution over the period 1995 to 2010.

4.1 RIF Decomposition

The RIF decomposition builds on unconditional quantile regressions introduced in the seminal contribution by Firpo et al. (2009). It is based on the recentered influence function defined as $RIF\left(y,\nu\right)=\nu+IF\left(y;\nu\right)$ which integrates to the statistic of interest $\int RIF\left(y;\nu\right)dF(y)=\nu\left(F_y\right)$, where F_y is the distribution function of the dependent variable (log hourly wage in our case). In the simplest form, the RIF is modeled as a linear function of the explanatory variables, i.e. $E\left[RIF\left(Y;\nu\right)|X\right]=X\gamma$, where γ can be estimated by means of simple OLS. Ultimately, the idea is to run a regression of the recentered influence function $RIF\left(y;\nu\right)$ of the distributional statistic ν on explanatory variables. The statistic of interest is then obtained as $E\left(E\left[RIF\left(Y;\nu\right)|X\right]\right)=E(X)\gamma$, using the sample counterparts estimated by OLS. We will use this method to carry out detailed decomposition analyses for different inequality measures $\nu\left(F_y\right)$ based on quantiles, such as the 90-10, 90-50 and 50-10 log wage gap, as well as the Gini coefficient and the variance of log wages.

Given that the RIF regression is a linearized version of the statistic under consideration, a (detailed) Oaxaca-Blinder decomposition using the resulting coefficients can be computed in which the overall change Δ_O^ν in the distributional statistic ν

$$\Delta_O^\nu=\nu\left(F_{Y_1|T=1}\right)-\nu\left(F_{Y_0|T=0}\right) \tag{4}$$

is decomposed into a composition effect (Δ_X^ν) and a wage structure effect (Δ_S^ν)

$$\Delta_O^\nu=\underbrace{\nu\left(F_{Y_0|T=1}\right)-\nu\left(F_{Y_0|T=0}\right)}_{\Delta_X^\nu}+\underbrace{\nu\left(F_{Y_1|T=1}\right)-\nu\left(F_{Y_0|T=1}\right)}_{\Delta_S^\nu}, \tag{5}$$

where $F_{Y_t|T=s}$ denotes the distribution of wages among workers in period s being payed under the wage structure of period t.

We use a refinement of this method suggested by Firpo et al. (2007, 2014), i.e. the RIF decomposition is combined with the semi-parametric reweighting approach introduced by DiNardo et al. (1996). This is done to avoid bias in case the linear specification for the RIFs described above is not sufficiently precise, as the linear specification is only valid locally. As a result, the estimated γ may change, although the true wage structure may in fact have been unchanged. The basic idea underlying this approach is to create an artificial time period 01, in which the distribution of X in period 0 is reweighted to that of period 1. Using these three periods, two separate Oaxaca-Blinder decompositions are run on the recentered influence function, leading to

$$\Delta_O^\nu = \underbrace{\left(\bar{X}_{01} - \bar{X}_0\right)\hat{\gamma}_0^\nu}_{\Delta_{X,p}^\nu} + \underbrace{\bar{X}_{01}\left(\hat{\gamma}_{01}^\nu - \hat{\gamma}_0^\nu\right)}_{\Delta_{X,c}^\nu} + \underbrace{\bar{X}_1\left(\hat{\gamma}_1^\nu - \hat{\gamma}_{01}^\nu\right)}_{\Delta_{S,p}^\nu} + \underbrace{\left(\bar{X}_1 - \bar{X}_{01}\right)\hat{\gamma}_{01}^\nu}_{\Delta_{S,c}^\nu}, \tag{6}$$

i.e. the estimate for the composition effect (Δ_X^ν) is split up into a pure composition effect ($\Delta_{X,p}^\nu$) and a specification error ($\Delta_{X,c}^\nu$). Similarly, the estimate for the wage structure effect (Δ_S^ν) is divided into a pure wage structure effect ($\Delta_{S,p}^\nu$) and a reweighting error ($\Delta_{S,c}^\nu$). The decomposition is constructed such that the four components exactly add up to the overall change in the statistic of interest Δ_O^ν.

The detailed composition effects $\Delta_{X,p}^\nu$ reflect the contribution of changes in the distribution of particular covariates (or groups of covariates) to the overall change of the distributional statistic. For example,[9] suppose that there are wage differentials *between* sectors covered and those not covered by unions. In addition, it may be the case that inequality *within* the sectors covered by unions differs from inequality in sectors not covered (e.g., unions compress wages in the sectors covered by them). Now assume that union coverage in the economy declines. The overall compositional effect of this decline on wage inequality may be positive or negative depending on whether the decrease in inequality between sectors dominates the increase in inequality due to the declining share of sectors with low levels of within-inequality. The specification error $\Delta_{X,c}^\nu$ in (6) reflects the differences in estimated RIF coefficients in the sample of period 0 and the coefficients estimated in the sample of period 0 whose distribution was reweighted to that of period 1. The wage structure effect $\Delta_{S,p}^\nu$ represents the contributions of changes in the effects γ individual covariates (or groups of covariates) have on the distribution of wages. This includes effects on inequality *between* and *within* subgroups. In the above example, this would include changes in the magnitude of wage differentials *between* sectors covered and those not covered by unions, as well as changes in the amount of wage compression *within* sectors resulting from

[9] Compare Firpo et al. (2009).

changes in union policies (e.g., unions might increase or loose their ability to compress wages). Finally, the reweighting error $\Delta^{\nu}_{S,c}$ reflects differences in the means of covariates in sample period 1 and those in sample period 0 whose distribution was reweighted to that of sample period 1. The reweighting error will be close to zero if reweighting is successful in changing the distribution of covariates in sample period 0 to that of sample period 1.

To our best knowledge, the RIF decomposition is the only method known that is capable of providing a detailed, path-independent decomposition of arbitrary distributional statistics into composition and wage structure effects. Other decomposition methods are either confined to particular distributional statistics (e.g. based on variance decompositions), provide no detailed decomposition results (Machado and Mata, 2005, Melly, 2005, Chernozhukov et al., 2013), or provide detailed decomposition results that depend on some ordering of factors (DiNardo et al., 1996, Antonczyk et al., 2010). For more details, see the general discussion in Fortin et al., 2011.

As described in the literature, detailed decompositions of wage structure effects for a set of categorical variables depend on the choice of the omitted reference group (see Fortin et al., 2011). This also applies to the RIF decomposition described above. In preliminary estimations, we found that the detailed wage structure effects estimated by us sometimes considerably depended on which reference groups for the various sets of our categorial variables we chose. This is not surprising as the intercept of a regression always represents the average outcome for a very specific reference individual (i.e. an individual with the base level of education, age, tenure, sector, firmsize, region etc.). The intercept of the regression (and hence the exact value of all other regression coefficients) will therefore depend to a large extent on how the position of the reference individual changes over time. In order to make our regression results independent of the choice of the reference individual, we normalize the RIF regression coefficients within sets of categorial variables such that they sum up to zero, i.e. $\sum_{j\in J}\gamma_j = 0$, where J is a set of categorial dummy variables summing up to one (e.g. age categories). Gardezabal and Ugidos (2004) discuss this normalization for the case of the Oaxaca-Blinder decomposition. An advantage of this kind of normalization is that it only shifts the intercept of the regression, leaving the relative differences between coefficients intact.

Applying this normalization will not only make results independent of the choice of a reference group but will also facilitate the general interpretation of RIF decomposition results. Given that the RIF regression coefficients for groups of categorial variables are normalized to sum up to zero, information about the general level of the statistic modeled by the RIF regression (e.g. a quantile) will be shifted to the intercept of the regression, while differences in regression coefficients will only reflect deviations of individual categories from this general level.[10] The intercept of the RIF regression will therefore capture general changes in unconditional quantiles (or other inequality measures) that are not related to pure relative changes within groups of categorial variables and which therefore cannot be attributed in a detailed way to individual regressors. They may still reflect changes in the relative importance of groups of categorial variables (e.g. the importance of age vs. education effects), but such changes cannot be attributed to individual variables or groups of variables. They should therefore be summarized in the intercept as a general contribution to wage structure effects. Finally, changes in the intercept will also incorporate general changes in unconditional quantiles (or other inequality measures) that are due to factors not included as observables in the analysis.

4.2 Reweighting

As an alternative decomposition technique, we use the semi-parametric reweighting method introduced by DiNardo et al. (1996). The idea of this method is to reweight individual observations depending on whether they are over- or underrepresented in some counterfactual scenario. In the simplest case, this idea can be written as

$$\int_x f(y|x,t=0)dF(x|t=1) = \int f(y|x,t=0)\underbrace{\frac{dF(x|t=1)}{dF(x|t=0)}}_{\psi_x}dF(x|t=0), \tag{7}$$

representing the counterfactual wage distribution that results if the period 0 wage structure $f(y|x,t=0)$ conditional on characteristics x is applied to the period 1 distribution of characteristics $dF(x|t=1)$. As the equation shows, this amounts to reweighting the period 0 wage distribution using a reweighting factor $\psi_x = dF(x|t=1)/dF(x|t=0)$. Comparing this distribution to the original period 0 distribution $\int f(y|x,t=0)dF(x|t=0)$ yields an estimate of the effect of changes in the distribution of covariates x on the shape of the distribution.

In our analysis, we use a sequential version of this reweighting technique, which we illustrate for the case of three subgroups of covariates x_3, x_2, x_1 whose detailed effects on the wage distribution shall be studied. The decomposition is based on incrementally including into the reweighting

[10] We illustrate this kind of normalization for the case of a mean regression below.

procedure one subgroup of covariates after another. In a first step, the effect of changing the distribution of covariates x_1 is obtained by comparing the original period 0 distribution to the counterfactual distribution which results if just the distribution of x_1 is changed, i.e.

$$\int\int\int f(y|x_1,x_2,x_3,t=0)dF(x_3|x_2,x_1,t=0)dF(x_2|x_1,t=0)\psi_{x_1}dF(x_1|t=0) \quad (8)$$

with $\psi_{x_1} = dF(x_1|t=1)/dF(x_1|t=0)$. In a second step, the resulting distribution (8) is compared to a counterfactual distribution in which *in addition* the conditional distribution of $x_2|x_1$ is adjusted to that in target period 1, i.e.

$$\int\int\int f(y|x_1,x_2,x_3,t=0)dF(x_3|x_2,x_1,t=0)\psi_{x_2|x_1}dF(x_2|x_1,t=0)\psi_{x_1}dF(x_1|t=0) \quad (9)$$

with $\psi_{x_2|x_1} = dF(x_2|x_1,t=1)/dF(x_2|x_1,t=0)$. This yields the additional contribution of the change in $x_2|x_1$ to the overall change of the distribution. In the third step, the resulting distribution (9) is compared to a counterfactual distribution in which *in addition* the conditional distribution of $x_3|x_2,x_1$ is adjusted to that in target period 1, i.e.

$$\int\int\int f(y|x_1,x_2,x_3,t=0)\psi_{x_3|x_2,x_1}dF(x_3|x_2,x_1,t=0)\psi_{x_2|x_1}dF(x_2|x_1,t=0)\psi_{x_1}dF(x_1|t=0) \quad (10)$$

with $\psi_{x_3|x_1} = dF(x_3|x_2,x_1,t=1)/dF(x_3|x_2,x_1,t=0)$. This yields the additional contribution of the change in $x_3|x_2,x_1$ to the overall change of the distribution.

The distribution resulting from this last step (10) is at the same time the counterfactual distribution in which the joint distribution of *all* covariates $x=(x_3,x_2,x_1)$ is changed to its period 1 level. This is because

$$\psi_{x_3|x_2,x_1}\psi_{x_2|x_1}\psi_{x_1} = dF(x_3,x_2,x_1|t=1)/dF(x_3,x_2,x_1|t=0) = \psi_x, \quad (11)$$

corresponding to (7). Comparing this to the distribution of the base period 0 yields an estimate of the total composition effect of changing the distribution of all the x on the distribution of y, i.e.

$$\int_x f(y|x,t=0)dF(x|t=1) - \int_x f(y|x,t=0)dF(x|t=0). \quad (12)$$

The remaining difference between (10) and the period 1 target distribution will be due changes in the conditional wage structure, i.e.

$$\int_x f(y|x,t=1)dF(x|t=1) - \int_x f(y|x,t=0)dF(x|t=1). \quad (13)$$

In contrast to the RIF regression, the sequential reweighting method does not yield a break-down of the wage structure effects (13) into the contributions of the different groups of covariates x_3, x_2, x_1. As described above, it does yield a detailed decomposition of the composition effect into the contributions of changes in $x_3|x_2, x_1$, $x_2|x_1$ and x_1. However, this detailed decomposition strongly depends on the ordering of the factors x_3, x_2, x_1. For example, if x_1 represents personal characteristics, x_2 firm characteristics and x_3 union coverage, then some of the effects of changes in union coverage will be assumed to have been induced by changes in personal and firm characteristics, and will be ascribed to these factors rather than to changes in union coverage. As a result, factors appearing later in the conditioning scheme can be expected to have smaller contributions to the overall effect as some of their effects were already included in factors preceding them in the sequential conditioning scheme. It is important to emphasize that the *overall composition effect* resulting after having added all factors (i.e. (12)) is independent of how the sequential conditioning scheme is set up. It represents the effect of changing the joint distribution of *all* factors $x = (x_3, x_2, x_1)$ at the same time (Firpo et al., 2011).

In order to avoid the difficulties implied by the pre-conditioning on other variables, one may also think of determining the composition effect of a particular group of covariates (e.g. unionization) by reweighting only with respect to the marginal distribution of this group of covariates. This corresponds to the case in which the change of the distribution of these covariates is considered to have happened 'autonomously', i.e. it was not (even partly) induced by changes in other covariates. In the unionization example, this would assume that changes in unionization were the result of changes in social norms, exogenous changes economic policies etc. but not induced by changes in the composition of the workforce with respect to education, sector, firm structure or other observed covariates included in the analysis. In an alternative interpretation, this kind of effect represents the *maximal* composition effect of a group of covariates based on the assumption that the marginal distribution of this group of covariates is changed autonomously (while retaining its relationship to other covariates). It corresponds to the case in which this group of covariates is placed as the first factor in the sequential decomposition scheme (see (8)). In our empirical results, we also compute these 'maximal' effects for each group of covariates. These effects will be labeled 'unconditional reweighting effects' below.

In practice, the reweighting factors $\psi_{x_3|x_2,x_1}, \psi_{x_2|x_1}, \psi_{x_1}$ are estimated using their representation as

$$\psi_{x_1} = \frac{dF(t=1|x_1)}{dF(t=0|x_1)} \frac{dF(t=0)}{dF(t=1)}$$

$$\psi_{x_2|x_1} = \frac{dF(t=1|x_2,x_1)}{dF(t=0|x_2,x_1)} \frac{dF(t=0|x_1)}{dF(t=1|x_1)}$$

$$\psi_{x_3|x_2,x_1} = \frac{dF(t=1|x_3,x_2,x_1)}{dF(t=0|x_3,x_2,x_1)} \frac{dF(t=0|x_2,x_1)}{dF(t=1)|x_2,x_1)} \tag{14}$$

which follows from Bayes law. In our empirical implementation, we estimate the ingredients in (14) by logit models that include the appropriate groups of covariates as well as a rich set of interaction terms. Our empirical analysis includes six rather than three groups of covariates. The procedure described above is therefore extended to sequentially adding six groups of covariates, see table 2 which also shows the implied reweighting factors. Note their regular structure in which sets of covariates are added in an incremental way.

— Table 2 here —

It is important to emphasize that both the RIF decomposition and the reweighting decomposition ignore general equilibrium effects. They both correspond to the hypothetical thought experiment of changing the distribution of observed covariates without changing the wage structure (i.e. the remuneration structures given covariates), see also our discussion of general equilibrium effects in section 6.

5 Empirical results

5.1 Development of inequality

The general development of the distribution of real hourly wages between 1995 and 2010 is displayed in figure 2. For the period as a whole, quantiles near or above the median gained whereas quantiles below the median lost. In figure 3, we observe a continuous trend of increasing spread with stronger increments at the beginning of the observation period than towards the end.

The right hand panel of figure 3 shows that the period 1995 to 2001 was characterized by a loss of mass in the middle of the distribution and an increase in the upper half of the distribution (consistent with uniform wage gains across the distribution over this period). By contrast, the period 2001 to 2006 was characterized considerable increases in spread reflected in an increase of mass in the lower and upper part at the expense of the middle part. Changes between 2006 and 2010 were quantitatively less important amounting to a moderate shift of mass from the upper middle to the lower part of the distribution.

— Figures 2 and 3 here —

Figure 4 displays the changes of a number of inequality measures over the period 1995 to 2010. The gap between the 90th and 10th percentile of the distribution of log wages continuously increased between 1995 and 2010, with smaller increments towards the end of the observation period. In terms of (unlogged) real hourly wages, the ratio of the 90th to the 10th quantile increased from 2.385 to 2.983. This general trend is confirmed by the results for the Gini coefficient and the variance of log wages. The results for the 50th to 10th percentile and the 90th to 10th percentile in figure 4 suggest that the inequality increases were steeper in the lower than in the upper part of the distribution, except at the very end of the observation period.

— Figure 4 here —

As to the top of the distribution, there were only moderate inequality increases between the 95th and the 90th percentile but more pronounced increases between the 99th and the 95th percentile. In terms of unlogged real hourly wages, the ratio of the 99th to the 95th percentile increased from 1.403 to 1.495, while that of the 95th to the 90th percentile changed only slightly from 1.186 to 1.198. Although our data excludes developments within the top one percent of the distribution of hourly wages, our findings are consistent with the view that changes in the upper part of the German wage distribution were relatively modest when compared to other, especially Anglo-Saxon countries (see Atkinson et al., 2011, Piketty and Saez, 2014, Bartels and Jenderny, 2015).

5.2 Trends in between-group inequality

In order to get a general impression about trends in the relationship between observed characteristics and hourly wages, table 3 presents OLS regressions of log hourly wages on our complete set of covariates. In addition, the changes of the regression coefficients over time are explicitly given in table 4. In order to facilitate interpretation, we apply the normalization described above, i.e. we center estimated coefficients around zero within groups of categorial regressors. For example, the estimated coefficients for the age categories indicate that in 1995, being in the age group 20 to 25 years was associated with a wage penalty of 13.6 percentage points compared to the mean level of returns to age normalized to zero. By contrast, being in an age group of 51 to 55 years was related to a premium of 5.4 percentage points above this mean level. The results over the years 1995 to 2010 suggest that the returns to age widened to some extent, with age groups below 36 years loosing and those above 36 years gaining over time. The widening of the wage differentials with respect to age is summarized in the variance of the estimated age coefficients shown in the intermediate row at the end of the age coefficients.

— Table 3 here —

We also observe a moderate widening of the returns to tenure, education and occupational position. Low tenure groups and education groups below high school equivalent tended to loose, while higher tenure groups and individuals with tertiary education tended to gain. Returns to the different occupational positions did not change much between 1995 and 2010. As to the effects of offshoring intensities on occupations, our results suggest that occupations that were more affected by offshoring in the different sectors of the economy did not suffer but gain from these activities in terms of wages paid. On the other hand, we obtain a slightly negative effect of imports in consumption goods on the wages of occupations employed in the respective sectors. However, there were no changes of these wage differentials over time. By contrast, the exporter wage premium moderately increased over time. The relative difference of wages paid in firms who did not export and those whose export share was 51 - 100% changed from around 5.5 percentage points in 1995 to around 7.8 percentage points in 2010.

The results on sectoral wage differentials shown in the table suggest no systematic patterns. Judged by the variance of sector coefficients, wage differentials across sectors did not significantly widen over our observation period. As regards to the returns to firm size, we observe a slight tendency towards narrowing differentials. The wage penalties associated with smaller firm sizes tended to shrink, whereas wage premia related to large firms slightly decreased. There was also a significant narrowing of wage differentials between federal states (see lower part of tables 3 and 4). Both wage premia related to working in West German federal states and wage penalties related to working in East German states significantly diminished over time. The considerable convergence of wages across regions was also reflected in the variance of the corresponding coefficients which declined from 2.696 to 1.625. As to the returns to the different task inputs, we observe a stable relative return of around plus .12 percentage points (per one percentage point change in the share of this task) for analytical tasks, while the return to interactive tasks rose from about .11 to .16 percent points. This was at the expense of the relative return to manual tasks which fell from around -.22 percentage points to around -.27 percentage points.

We observe important trends in wage differentials between workers covered and those not covered by union bargaining (last rows of table 3). In 1995, the ceteris paribus effect of being covered by a union agreement when compared to the uncovered case was even negative. This relationship reversed over the period 1995 to 2010. In 2010, covered workers earned ceteris paribus 9 to 10 percentage points higher average wages than uncovered ones, suggesting that either unions were able to protect covered workers from wage losses or that they were increasingly able to negotiate positive wage premia for the sectors covered by them. Given the important role unions play in the German labor market, we also report the above wage regressions separately for individuals covered and those not covered by union agreements (tables A3 and A4 in the appendix). The results confirm the expectation that unions considerably compressed wage differentials across practically all observable covariates (reflected in the much lower variances of regression coefficients for the different sets of covariates). Moreover, unions also compressed wage differentials *within* groups of workers with identical observable characteristics as reflected in a lower estimate for the residual variance of the regression. These strong differences in within-group inequality and the considerable wage differences *between* covered and uncovered workers suggest potentially important composition effects as a result of the secular decline in union coverage identified in the previous section.

The last row of table 3 suggests a rising degree of inequality *within* the subgroups defined by our long list of observed covariates. This was reflected in an increasing trend for the variance of our regression residuals which rose from .219 to .274.

5.3 Changes in quantities vs. changes in relative prices

It is instructive to relate the changes in relative prices described in the previous section to changes in the underlying quantities. In the spirit of Katz and Murphy (1992), this allows one to gauge whether quantities and prices evolved in the same or in opposite directions. Let $\Delta\beta$ be the changes in 'relative prices' (the regression coefficients in the OLS regression shown in table 3), and Δx the corresponding changes in 'quantities' (the relative frequencies of the different characteristics shown in table A1). If $\sum \Delta\beta\Delta x \leq 0$ for a group of covariates (e.g. education), then categories whose relative prices increased tended to decline, consistent with an equilibrium adjustment process (rising prices go along with falling quantities, and vice versa). If on the other hand $\sum \Delta\beta\Delta x > 0$, then this is indicative of excess demand as categories whose quantities rose were still able to command price increases.

— Table 4 here —

The results in table 4 indicate that there may have been excess demand for more experienced age groups as these groups became more frequent while at the same time commanding higher relative prices.[11] The results for tenure and occupational position are more mixed, with relative prices and quantities moving in opposite directions. For education, we also find some evidence for excess demand as the prices and quantities of low educational levels fell at the same time, while those of the highest educational level rose at the same time. For a more detailed analysis of skill premia along human capital characteristics, see Glitz and Wissmann (2016).

As noted above, we observe rising exporter wage premia which go along with increasing shares of firms that export. This indicates rising product demand from outside Germany. The results for sectors, firm size and region do not show systematic patterns. In most cases, it is not clear whether relative prices and quantities move in the same or in different directions. For task prices, we find that both the relative price and the quantities of manual tasks fell, while those of interactive tasks both increased. This is consistent with rising demand for interactive as compared to manual tasks. Finally, it is remarkable that unions managed to negotiate higher and higher wage premia although union coverage drastically fell over the period considered by us. Viewed

[11]We also computed the sums $\sum \Delta\beta\Delta x$ in which we weighted each term with the frequency of the respective category. This lead to very similar results.

from the opposite perspective, the fact that larger and larger parts of the economy preferred to not engage in union bargaining may have been influenced by the rising wage premia paid in collective agreements.

Summarizing, we find indications of excess demand for some characteristics, but it is unclear how strong these were and how strongly they may have contributed to the rise in wage inequality observed over the period 1995-2010. In order to address this question, we now turn to our decomposition analyses.

5.4 RIF decomposition

5.4.1 Overall period 1995-2010

Given the local nature of the RIF methodology (Firpo et al., 2009), our strategy is to apply RIF decompositions to our three subperiods 1995-2001, 2001-2006, 2006-2010, and to aggregate these results over the period 1995-2010.[12] We start with a graphical analysis of the effects changes of our covariates have on unconditional quantiles. Figure 5 shows that the change of the distribution of log hourly wages between 1995 and 2010 was such that unconditional quantiles below the 35th percentile fell, while those above the 35th increased. This pattern is distinctively different from the changes in the US wage distribution over similar periods which featured a U-shaped pattern, i.e. especially middle quantiles lost in comparative terms, while lower and upper quantiles gained (Autor et al., 2008, Firpo et al., 2014). Distributional change in the German distribution of hourly wages was strictly monotonic across quantiles in the sense that the higher the quantile the larger the gain over the period 1995 to 2010.

— Figures 5 to 7 here —

Decomposing the overall change into composition and wage structure effects, we find that the pattern of composition effects shows the same monotonic behavior as the overall change, but that additional wage structure effects played some role in the upper middle range of the distribution.

[12]For our estimates, we report bootstrapped standard errors based on 100 resamples. The resamples are a simultaneous draw from all four years and take account of the clustering at the firm level.

When we look at composition effects more closely (figure 6), we observe strong composition effects related to de-unionization in line with Dustmann et al. (2009) and Baumgarten et al. (2016). De-unionization over the period 1995 to 2010 was associated with a decrease of unconditional quantiles in the lower half of the distribution. But in contrast to Dustmann et al. (2009) and Baumgarten (2016) (based on daily earnings), we also measure steep compositional effects of de-unionization in the upper half of the distribution. Second to effects of de-unionization, compositional effects of changes in personal characteristics also significantly contributed to distributional change. This was particularly true for quantiles in the upper half of the distribution of hourly wages, which significantly gained. This result is consistent with the population aging and educational upgrading described in the previous section. The composition effects of all other groups of covariates were relatively modest, although we observe some increases in unconditional quantiles in the upper quarter of the distribution associated with internationalization, and very modest changes in the upper half of the distribution related to task compositions.

Figure 7 provides the break-down of wage structure effects that are related to the different groups of covariates considered by us. These effects look slightly more erratic than the composition effects, but some groups of covariates show bigger effects than others. In particular, wage structure effects related to firm characteristics and internationalization tended to favor higher quantiles, while those related to region, unionization and personal characteristics were detrimental for higher quantiles. For tasks, we observe small effects whose patterns are consistent with the polarization hypothesis, i.e. the middle of the distribution lost compared to the bottom and the top of the distribution. Importantly, all of these effects were dominated by general wage structure effects represented by the constant of the RIF regression. As discussed above, these changes represent changes in the wage structure that cannot be attributed to particular groups of covariates or that may be related to factors not included as covariates in the analysis. According to figure 7, these general wage structure effects were such that the upper middle of the distribution gained more than the middle and the top part, whereas the very bottom of the distribution suffered losses.

— Table 5 here —

In table 5, we provide numerical results on the importance of the different trends for general measures of inequality. Consistent with the graphical analysis, the numbers show that composition effects go a long way in accounting for the overall change in wage inequality. For example, the overall change in the log wage differential between the 90th and the 10th percentile, 22.37 log percentage points, can be broken down into a total composition effect of 19.77 points, a wage structure effect of 5.01 points, and an error contribution of -2.40 points. Consistent with the graphical analysis, the largest statistically significant composition effects came from de-unionization (9.66 points), and personal characteristics (6.14 points). This means that over 70 percent of the total changes in inequality can be accounted for by compositional changes of de-unionization and personal characteristics alone. In addition, there were moderate composition effects of internationalization (2.52 points) and tasks (1.26 points). As significant wage structure effects, we obtain contributions from internationalization (2.58 points), firm characteristics (4.73 points) and a negative effect from region (-2.37 points) reflecting the convergence of wages across federal states over the period under consideration. The results for the Gini coefficient and the variance of logs generally reproduce the results for the 90th to 10th log wage gap (columns 5 and 6 of table 5).

Distinguishing between effects on the upper half (90th vs. 50th percentile) and on the lower half of the distribution (50th vs. 10th percentile), we find that the same groups of covariates generally turn out significant, but that some covariates mattered more for one part of the distribution. In particular, we see that the inequality increasing composition effects of de-unionization, internationalization and personal characteristics were particularly strong in the upper half of the distribution. The positive wage structure effects of internationalization, region and unionization were also concentrated in the upper half of the distribution, but they were compensated by inequality reducing wage structure effects of regional convergence and unions. For the lower half, we find negative wage structure effects related to personal characteristics which, however, were more than compensated by strong inequality increasing wage structure effects contributed by the regression constant. As described above, these represent general wage structure effects that cannot be attributed to any particular group of covariates.

The last three columns of table 5 display the results for top 10 percent of the distribution. As shown earlier, most of the inequality increase occurred at the very top, i.e. within the top 5 percent. Compared to the rest of the distribution, we find weaker composition effects and much stronger unexplained wage structure effects. De-unionization still played some role but not for the very top (i.e. the 99th vs. the 95th percentile). Overall, the patterns found for the top 10 percent of the distribution look more erratic and less precisely estimated. There are also sizable specification errors warning of an over-interpretation of these results. However, the conclusion remains that the factors responsible for changes in the main part of the distribution did not explain many of the changes at the top.

5.4.2 Subperiod analysis

Figures A1 to A9 and tables A5 to A7 in the appendix provide supplementary information on the timing of effects and changes over the three subperiods 1995-2001, 2001-2006, and 2006-2010. As the tables show, the first two subperiods each accounted for some 40 percent of the overall inequality increase, while the last subperiod accounted for around 20 percent. The inequality increasing composition effects contributed by changes in personal characteristics were evenly distributed across the three subperiods, whereas the compositional effects of de-unionization were concentrated in the first and, to a lesser extend, in the second subperiod. This corresponds with the timing of changes in unionization displayed in table 4.

Tables A5 to A7 suggest that the inequality increasing wage structure effects found for the overall period 1995-2010 were mostly contributed by the second subperiod 2001-2006. As indicated in the previous section, the detailed results on wage structure effects show less clear patterns than those for composition effects. A remarkable finding in this respect is the reversal of the wage structure effects associated with union coverage which turned out inequality reducing in the subperiods 1995-2001 and 2001-2006, and inequality increasing during subperiod 2006-2010. A possible explanation would be that unions increasingly compressed wage differentials within the sectors covered by them in the first two subperiods, but gave up these policies in the subperiod 2006-2010. However, we do not find evidence for this in our separate wage regressions by union coverage (see table A3). We conclude that the pattern must be related to the sizable changes in wage differentials *between* workers with different degrees of union coverage (last rows of table 4).

5.5 Reweighting

Given the finding that composition effects played a leading role in accounting for changes of the distribution over the period 1995-2010, we provide a supplementary analysis of these effects using an alternative econometric technique. As described above, reweighting as introduced by DiNardo et al. (1996) is a transparent and intuitive method for describing changes in distributions that result from changes in the distribution of underlying characteristics.

— Figure 8 here —

We start with reweighting with respect to one set of covariates at a time ('unconditional reweighting', see section 4.2). For example, the brown line in figure 8 shows the density change produced by reweighting the 1995 wage distribution to the 2010 distribution of personal characteristics. It can be seen that the density change generated in this way has some similarity with the actual density change 1995-2010 (shown by the dark blue line), but that compositional changes in personal characteristics alone are far from explaining the overall change. The figure further shows that unconditional reweighting with respect to compositional changes in unionization alone comes closest to the actual density change (light blue line). Isolated reweighting with respect to either the task composition (red line) or the sectoral composition (orange line) also produces changes that go in the direction of the overall change, but these changes are rather small. The same is true of changes induced by unconditional reweighting with respect to our internationalization or firm characteristics. These compositional changes even counteract the actual density change. Table 6 reports the resulting contributions to explaining changes in inequality measures between 1995 and 2010. The results suggest that changing the composition of the workforce with respect to unionization alone can account for 14.67 out of 21.80 log percentage points of the change in the 90th to 10th percentile differential. Changing only the distribution of personal characteristics accounts for 8.10 out of 21.80 log percentage points.[13] These effects are sizable and confirm the strong association of distributional changes with compositional movements in union coverage and personal characteristics found in the RIF regression.

— Table 6 here —

As described in section 4.2, unconditional reweighting corresponds to the the case in which one set of covariates is changed autonomously, ignoring possible causal pathways between covariates. For

[13] The exact numerical value for the overall inequality changes differ slightly from those in the RIF analysis, because they are based on the smoothed densities rather than on the raw data.

example, it may be the case that changes in unionization are the mechanical result of educational upgrading, sectoral change or other changes in the composition of the economy or the workforce. In figure 9 and the lower panel of table 6, we therefore present a reweighting decomposition based on a sequential ordering of our six factors.[14] We chose the sequential ordering as: 1) Personal characteristics, 2) Internationalization, 3) Sectoral change, 4) Firm characteristics, 5) Tasks, 6) Unionization. A possible justification for this ordering is that we ascribe changes in personal characteristics to exogenous population aging and secular educational upgrading. We then view trends in internationalization as (almost) equally exogenous. Changes in sectoral composition may have partly been induced by changes in these preceding factors. Conditional on personal characteristics, internationalization and sectoral change, we then allow for changes in firm characteristics. Changes in task profiles are modeled as conditional on all these preceding factors. Finally, we model changes in unionization conditional on all characteristics considered, i.e. we allow for the possibility that changes in unionization were at least partly induced by changes in all preceding factors.[15] We admit that the sequential ordering chosen by us is to a certain extent arbitrary. We also carried out the decomposition for alternative sequential orderings. In many cases, the results were qualitatively similar, but in many other cases they differed considerably from our chosen sequence, especially if the ordering of factors was very different. A crucial advantage of the ordering chosen by us is that the unionization factor appears as the last stage of the decomposition so that expect to minimize the risk of 'overestimating' the importance unionization effects.

— Figure 9 here —

The sequential decomposition results for inequality measures shown in the lower panel of table 6 suggest that the most important compositional effects were contributed by changes in personal characteristics (8.10 points), firm characteristics (5.12 points) and unionization (7.34 points). Changes in personal characteristics and unionization still come out as the most important drivers of distributional change, but the importance of the unionization factor is reduced. The significant result for the firm effects further show that the contribution of a factor does not have to be the

[14] For this exercise, we merged our federal state indicators into the firm factor in order to keep the number of sequential stages low. This will not change any of the results as there were basically no changes in the composition across regions over the period considered by us (see table 4).

[15] The exact form of the reweighting factors are given in table 2.

smaller the later it appears in the sequential ordering (the firm effects were close to zero when firms were taken as the first factor in the sequential decomposition, see upper panel of table 6). Rather, the results of the sequential decomposition may depend on the interaction of factors in the sequential ordering.

Figure 9 shows the sequence of density changes obtained by incrementally adding the six factors to the reweighting procedure. The brown line represents the density change induced by first changing personal characteristics.[16] The green line in figure 9 shows the density change induced by reweighting with respect to both personal characteristics and internationalization. The difference between the green and the brown line is the effect ascribed to internationalization alone (because it results from adding internationalization to what is already there). Further adding sector results in the orange line which is not much different from the previous green line. Adding firm effects leads to a more distinct change, consistent with the contribution of the firm factor in the lower panel of table 6. Adding tasks does not lead to much additional change, implying that changes in tasks do not contribute much to distributional change once changes in other characteristics have been accounted for. Finally, adding changes in unionization adds considerable distributional change, although only changes in unionization conditional on changes in all the preceding factors are being considered.

The final light blue line in figure 9 represents distributional change induced by reweighting with respect to the joint distribution of *all* factors considered, independent of how these factors are ordered. Figure 9 therefore reinforces our conclusion from the RIF regressions that compositional changes go a long way in accounting for changes in the German wage distribution over the period 1995-2010. Our results from reweighting also confirm the qualitative finding that compositional changes in personal characteristics and unionization were the most important factors in this context, although there are some quantitative differences across the different decomposition variants.

[16]This line is identical to the brown line in figure 8 because personal characteristics appear as the first factor in the sequential decomposition.

5.6 Unobserved firm heterogeneity

Following recent contributions addressing firm and establishment effects (Card et al., 2013, Ohlert, 2015, Barth et al. 2016, Baumgarten et al. 2016), this section provides a supplementary analysis of the role of between-firm differences that go beyond the differences in observable firm characteristics already included in our analysis. In order to address the question to what extent such unobserved differences between firms contributed to rising wage inequality, we carry out the following procedure. We first obtain cross-sectional firm effects by regressing log hourly wages on our list of observable covariates and a full set of firm dummies. Because of partitioning properties of OLS, this is equivalent to taking the residuals from wage regressions as in table 3 and computing average residuals at the firm level. We then consider the distribution of these firm-specific wage effects. In order to assess to what extent rising heterogeneity in firm-specific wage effects contributed to rising wage inequality, we assign to each individual in the wage distribution of a base year the corresponding firm effect in the distribution of the target year, assuming that the individual keeps working at a firm in the same percentile of the distribution of firm effects. We are aware that we are unable to capture changes in sorting of workers to firms as in Card et al. (2013) in this way. However, lacking longitudinal information, we are not able to properly estimate changes in matching of workers to firms. Still, our procedure will be informative about the quantitative importance of changes in unobserved firm heterogeneity.

— Table 7 here —

Table 7 shows that assigning workers in 1995 their (more heterogenous) firm effects of 2010 increases the 90th to 10th gap by a moderate 2.0 log percentage points. This accounts for some 10 percent of the overall inequality change of 21.49 log percentage points. The results also show that increasing unobserved firm heterogeneity mattered in all three subperiods. It was strongest in the subperiod 2001-2006, and it affected both the lower and the upper half of the distribution. Overall, we conclude that rising unobserved firm heterogeneity mattered for rising wage inequality but that its contribution was small compared to the effects of the other factors analyzed in the previous sections.

6 Summary and discussion

This paper analyzes the relative importance of different factors for the evolution of the German wage distribution over the period 1995 to 2010. Our results suggest that recent changes in the German distribution of hourly wages look very different from the polarizing changes recently observed for the US distribution. Being monotonic over the distribution in the sense that higher quantiles gained but lower quantiles lost, they look more like the changes in the US distribution observed in the 1980s. In line with the task-based approach, we do observe polarizing ceteris paribus effects of changes in task composition, but these were clearly dominated by other factors. We acknowledge that our estimations based on time-invariant task content measures necessarily underestimate the effects of this factor. But note that studies for other countries also using time-invariant task content measures found bigger effects for task changes (Firpo et al., 2014).

As the single most important factor for recent rises in wage inequality in Germany, we identify compositional effects of de-unionization. Contrary to previous findings in Dustmann et al. (2009) for daily earnings, we show that compositional effects of de-unionization also mattered for the upper half of the distribution of hourly wages. We also document that the dramatic decline in unionization over the period considered by us was nevertheless accompanied by rising wage premia of union coverage. As the second most important factor for changes in the distribution, we measure compositional effects related to personal characteristics such as worker's age and education. Such effects are consistent with the hypothesis that the increasing demand for higher skills due to SBTC were matched by rising supply for such skills in the form of educational upgrading and population aging. This is because in the absence of rising demand due to SBTC, rising supply of high skills would have depressed the wage premia payed for such skills. We do find some evidence for excess demand for higher skills, but this does not translate into strong wage structure effects in our decomposition analyses. Altogether, our analysis suggests that some 70 percent of the change in inequality can be accounted for by compositional effects of de-unionization and personal characteristics, and that 80 to 90 percent can be accounted for by compositional changes in all the observed covariates considered by us.

We also find some compositional and wage structure effects related to measures of internationalization, but these were much smaller than the strong compositional effects of de-unionization and personal characteristics. The relative modest size of these effects is in line with previous contributions for Germany such as Baumgarten (2013) and Goldschmidt and Schmieder (2015). They are also in line with the general statement in Helpman (2016) that the available international evidence does not support the hypothesis that the secular rise in wage inequality is a result of globalization. Finally, we obtain some evidence in favor of the view that increasing observed and unobserved heterogeneity between firms has contributed to rising wage inequality. Our results are not at odds with studies such as Card et al. (2013) as these studies summarize in their firm fixed effects factors we include as observed covariates in our analysis. Rather, our results suggest that the important contributions of firm heterogeneity to rising wage inequality found in Card et al. (2013) might be related to changes in union coverage between firms or time-invariant personal characteristics such as education.

We point out that our estimates are certainly not to be interpreted as causal effects. This is for several reasons, one being that the factors in our analysis might be dynamically related to each other. For example, de-unionization might have been a consequence of internationalization (e.g., Dreher, 2007), or educational upgrading may have been the response to skill-biased technological change. In the case of de-unionization, we considered this possibility by placing it at the end of our sequential conditioning scheme, with the result that it robustly remained an important explanatory factor. Even if a factor like de-unionization was itself a consequence of another factor, it would still be very relevant to see that changes in the distribution were largely mediated by this factor. It is unclear whether causal effects (representing the effect of isolated changes in one factor) are relevant at all in the present context, as distributional change is always the result of the interaction and sequence of a large number of different factors. In a broader perspective and in line with Dustmann et al. (2014), de-unionization might have been a way for the German economy to arrive at a wage structure consistent with the needs of the economy. Our finding that the decline in union coverage was the major determinant of the recent rise in wage inequality is also consistent with the fact that de-unionization substantially slowed down towards the end of our observation period, and that newer (not yet publicly available) data for Germany indicate no further increases in wage inequality after 2011 (Möller, 2016).

A related limitation of our analysis is it cannot address equilibrium effects of compositional changes. In the case of de-unionization, one might expect that the declining importance of unions also spills over to uncovered sectors of the economy because threat effects of union power are reduced. However, this would only strengthen the conclusion that de-unionization played an important role for rising inequality. In any case, the sheer size of the compositional effects found by us suggests that a substantial part of distributional change was channeled through changes in the composition of the economy, irrespective of whether these compositional changes had additional effects on the wage structure. In a cross-country perspective, our results suggest that, even if we observe a fairly uniform trend of rising wage inequality in many developed countries, the exact forms this trend takes may depend very much on institutional and country-specific features.

7 References

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8 Figures

Figure 1 – Task composition 1995-2010

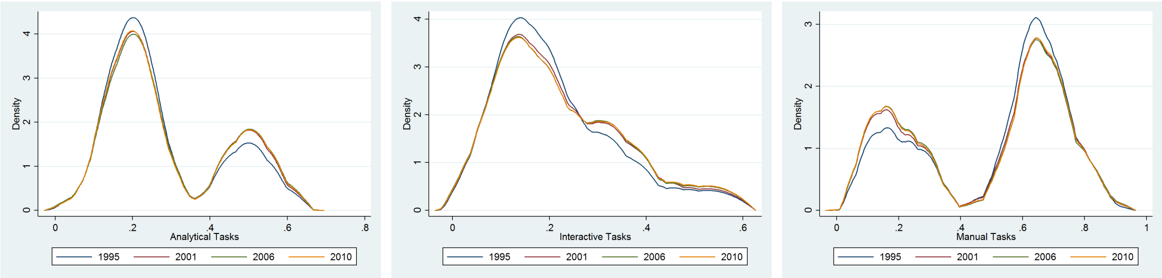


Figure 2 – Quantiles of real hourly wage, 1995-2010

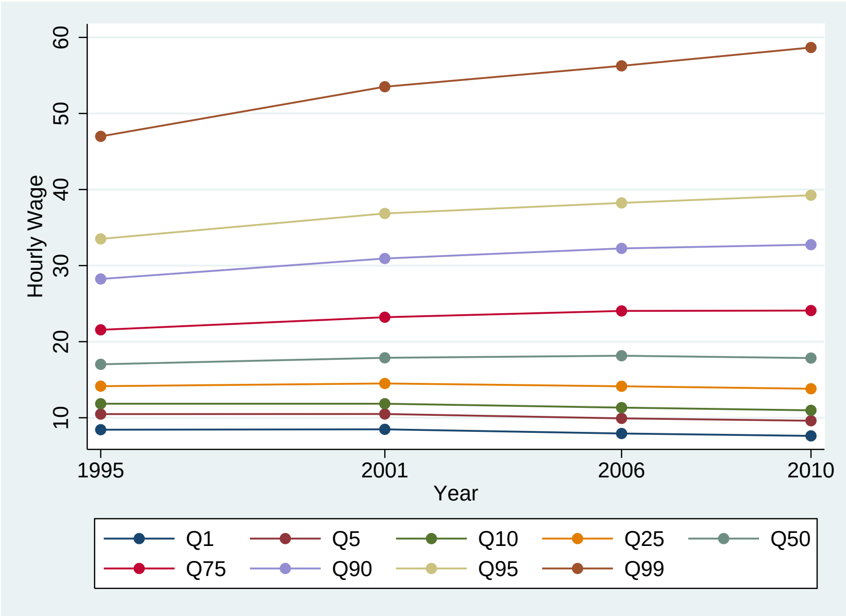


Figure 3 – Changes in the density of log hourly wages 1995-2010

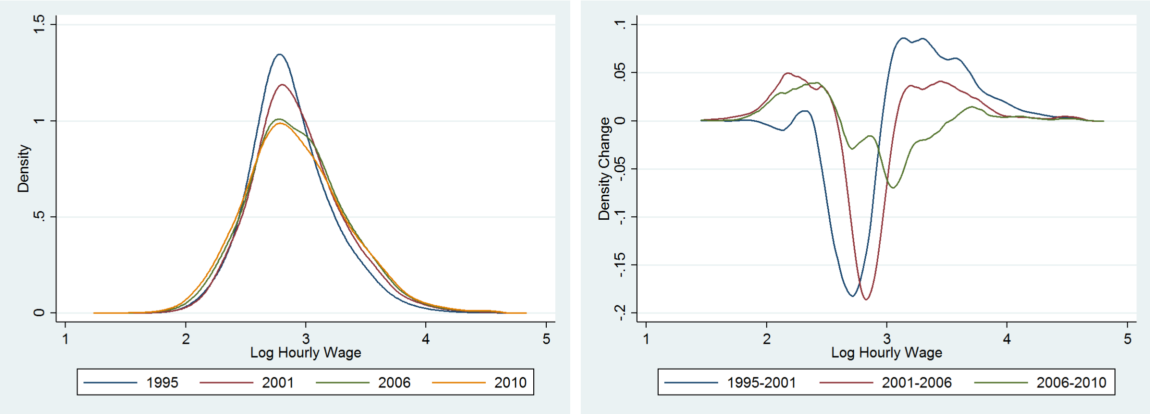


Figure 4 – Development of inequality, 1995-2010

Figure 5 – Aggregate decomposition 1995-2010

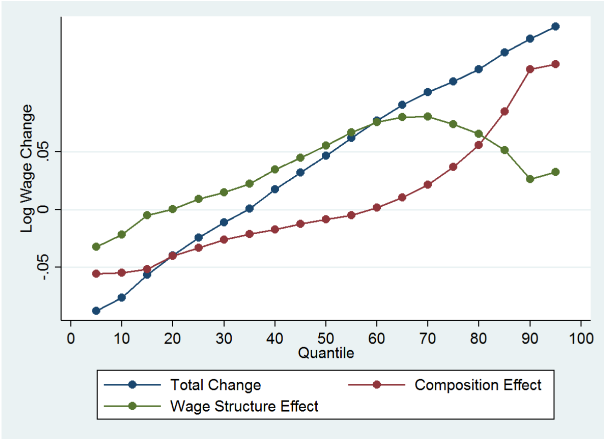


Figure 6 – Composition effects 1995-2010

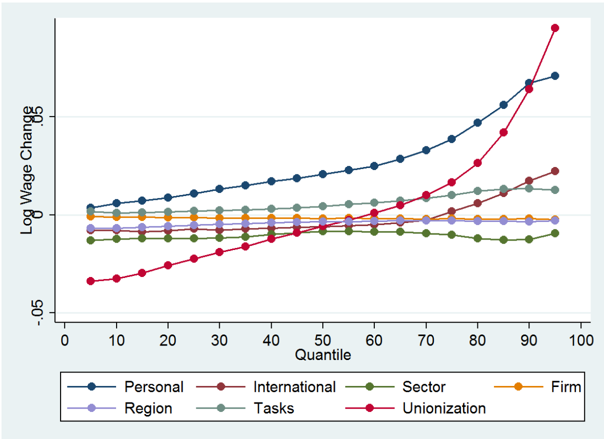


Figure 7 – Wage structure effects 1995-2010

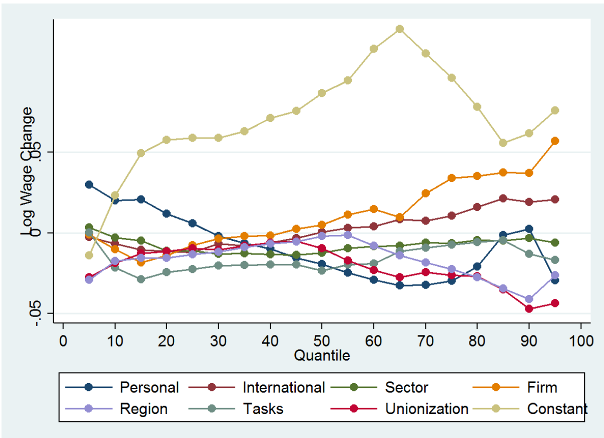


Figure 8 – Unconditional reweighting 1995-2010

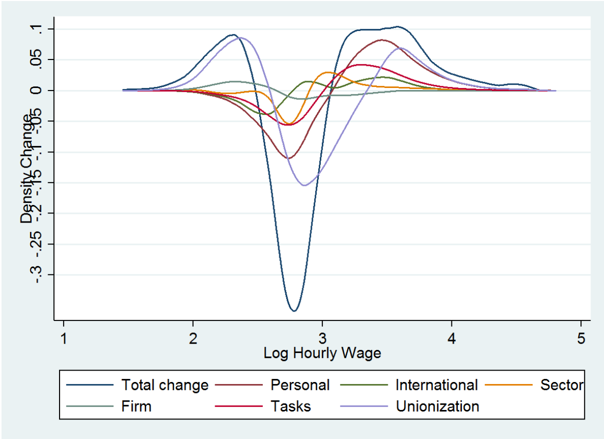
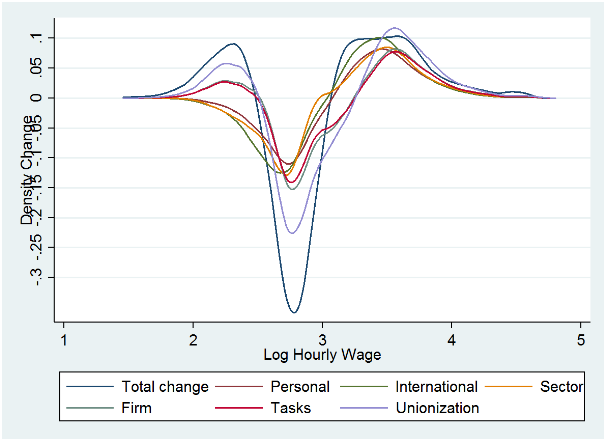


Figure 9 – Sequential reweighting 1995-2010



9 Tables

Table 1 – Groups of covariates

Group	Covariates
1. Personal	Age (8 categories) Tenure (6 categories) Education (6 categories) Job Position (3 categories)
2. Internationalization	Predicted share of exports (4 categories) Share of intermediate imports Share of imports in consumption goods
3. Sector	Sector (24 categories)
4. Region	Federal state (16 categories)
5. Firm	Firmsize (7 categories) State-owned (binary)
6. Tasks	Share of analytical tasks Share of manual tasks Share of interactive tasks
7. Unionization	Union coverage (3 categories)

Table 2 – Reweighting factors

Package	Reweighting factor
1. Personal	$\frac{dF(t=1\|Personal)}{dF(t=0\|Personal)}\frac{dF(t=0)}{dF(t=1)}$
2. International	$\frac{dF(t=1\|International,Personal)}{dF(t=0\|International,Personal)}\frac{dF(t=0\|Personal)}{dF(t=1)\|Personal)}$
3. Sector	$\frac{dF(t=1\|Sector,International,Personal)}{dF(t=0\|Sector,International,Personal)}\frac{dF(t=0\|International,Personal)}{dF(t=1)\|International,Personal)}$
4. Firm[a]	$\frac{dF(t=1\|Firm,Sector,International,Personal)}{dF(t=0\|Firm,Sector,International,Personal)}\frac{dF(t=0\|Sector,International,Personal)}{dF(t=1)\|Sector,International,Personal)}$
5. Tasks	$\frac{dF(t=1\|Tasks,Firm,Sector,International,Personal)}{dF(t=0\|Tasks,Firm,Sector,International,Personal)}\frac{dF(t=0\|Firm,Sector,International,Personal)}{dF(t=1)\|Firm,Sector,International,Personal)}$
6. Unionization	$\frac{dF(t=1\|Unionization,Tasks,Firm,Sector,International,Personal)}{dF(t=0\|Unionization,Tasks,Firm,Sector,International,Personal)}\frac{dF(t=0\|Tasks,Firm,Sector,International,Personal)}{dF(t=1)\|Tasks,Firm,Sector,International,Personal)}$

[a] Includes information on region (federal state)

Table 3 – OLS regressions of log hourly wage on covariates (total sample)

	1995		2001		2006		2010	
	Coeff.	Std.	Coeff.	Std	Coeff.	Std	Coeff.	Std
Age 20-25	-0.136	0.002	-0.162	0.003	-0.186	0.004	-0.175	0.004
Age 26-30	-0.058	0.001	-0.072	0.002	-0.100	0.003	-0.094	0.003
Age 31-35	-0.007	0.001	-0.005	0.002	-0.016	0.002	-0.022	0.002
Age 36-40	0.021	0.001	0.031	0.001	0.040	0.002	0.033	0.002
Age 41-45	0.035	0.001	0.041	0.002	0.066	0.002	0.071	0.002
Age 46-50	0.045	0.001	0.047	0.002	0.065	0.002	0.074	0.002
Age 51-55	0.054	0.002	0.056	0.002	0.066	0.002	0.062	0.002
Age 56-60	0.046	0.002	0.062	0.003	0.065	0.003	0.052	0.003
Variance age coefficients (x100)	0.384		0.539		0.793		0.726	
Tenure 0-5	-0.069	0.002	-0.078	0.002	-0.079	0.003	-0.086	0.003
Tenure 6-10	-0.006	0.001	-0.020	0.003	-0.019	0.002	-0.018	0.002
Tenure 11-15	0.010	0.001	0.005	0.002	0.010	0.002	0.008	0.003
Tenure 16-20	0.010	0.001	0.028	0.002	0.022	0.002	0.020	0.002
Tenure 21-25	0.021	0.001	0.029	0.002	0.035	0.002	0.032	0.002
Tenure >25	0.034	0.002	0.035	0.003	0.031	0.003	0.044	0.003
Variance tenure coefficients (x100)	0.111		0.157		0.156		0.187	
Lower/middle secondary without vocational training	-0.108	0.003	-0.129	0.003	-0.131	0.004	-0.139	0.005
Lower/middle secondary with vocational training	-0.061	0.002	-0.073	0.003	-0.081	0.003	-0.091	0.003
Upper secondary (German high school equivalent)	-0.017	0.004	-0.013	0.005	-0.017	0.005	-0.010	0.006
University of Applied Science (Fachhochschule)	0.092	0.003	0.101	0.004	0.095	0.005	0.100	0.004
University	0.170	0.004	0.202	0.005	0.209	0.006	0.219	0.005
Missing information	-0.074	0.005	-0.088	0.007	-0.075	0.008	-0.080	0.006
Variance education coefficients (x100)	0.967		1.346		1.374		1.535	
Non-skilled blue collar	-0.106	0.002	-0.099	0.003	-0.107	0.003	-0.118	0.003
Skilled blue collar and foremen	-0.008	0.001	-0.018	0.002	-0.014	0.003	-0.002	0.003
White collar	0.114	0.002	0.117	0.003	0.121	0.004	0.120	0.004
Variance occupational position coefficients	0.806		0.788		0.878		0.937	
Offshoring (0-100%)	0.005	0.001	0.006	0.001	0.008	0.001	0.011	0.001
Imports of consumption goods (0-100%)	-0.002	0.000	-0.002	0.000	-0.002	0.000	-0.002	0.000
No Exports	-0.028	0.004	-0.028	0.005	-0.034	0.006	-0.041	0.007
Export share 1-25%	-0.008	0.002	0.001	0.003	0.001	0.005	-0.017	0.004
Export share 26-50%	0.009	0.003	0.017	0.004	0.011	0.006	0.022	0.005
Export share 51-100%	0.027	0.003	0.010	0.005	0.022	0.005	0.037	0.007
Variance export coefficients (x100)	0.041		0.030		0.043		0.095	
Mining and other quarring	-0.058	0.013	-0.118	0.051	-0.015	0.018	0.042	0.030
Food products, beverages, tobacco	-0.047	0.005	-0.071	0.008	-0.073	0.008	-0.045	0.011
Textiles	-0.086	0.008	-0.073	0.016	-0.076	0.012	-0.122	0.016
Wood	-0.026	0.008	-0.041	0.012	-0.062	0.010	-0.071	0.010
Paper	-0.006	0.008	0.012	0.008	0.028	0.011	0.018	0.008
Printing	0.144	0.007	0.130	0.009	0.122	0.009	0.084	0.012
Coke and petroleum products	0.099	0.025	0.146	0.021	0.155	0.021	0.207	0.056
Chemicals	0.038	0.006	0.033	0.007	0.037	0.008	0.030	0.010
Rubber, plastic	-0.025	0.006	-0.036	0.007	-0.036	0.011	-0.023	0.010
Non-metallic products	0.001	0.005	-0.017	0.006	-0.035	0.010	-0.023	0.012
Basic metals	0.040	0.007	0.054	0.013	0.040	0.013	0.031	0.011
Fabricated metal products	0.018	0.005	-0.011	0.007	-0.004	0.009	-0.019	0.010

Computer, electronic, optical products	-0.001	0.006	-0.004	0.008	0.019	0.007	0.014	0.009
Electrical equipment	0.002	0.006	-0.000	0.008	-0.006	0.010	-0.002	0.009
Machinery and equipment	0.011	0.005	0.012	0.006	0.003	0.008	-0.001	0.011
Motor vehicles, trailers	0.115	0.008	0.098	0.009	0.095	0.011	0.087	0.011
Other transport equipment	0.005	0.008	0.071	0.026	0.013	0.013	0.081	0.012
Furniture etc	-0.024	0.008	-0.048	0.011	-0.072	0.010	-0.026	0.008
Electricity, water, recycling	0.083	0.008	0.110	0.011	0.090	0.014	0.062	0.012
Construction	0.057	0.004	0.018	0.005	0.004	0.006	0.002	0.008
Trade of vehicles	-0.040	0.015	-0.037	0.007	-0.033	0.008	-0.063	0.015
Wholesale trade	-0.079	0.007	-0.062	0.009	-0.011	0.009	-0.028	0.011
Retail trade	-0.160	0.008	-0.141	0.012	-0.173	0.022	-0.237	0.015
Finance and insurance	-0.060	0.007	-0.023	0.012	-0.011	0.010	0.003	0.013
Variance sector coefficients (x100)	0.456		0.522		0.478		0.656	
Firmsize 10-19	-0.076	0.004	-0.077	0.005	-0.073	0.005	-0.052	0.007
Firmsize 20-49	-0.052	0.004	-0.062	0.004	-0.052	0.006	-0.042	0.006
Firmsize 50-99	-0.035	0.004	-0.035	0.004	-0.035	0.005	-0.022	0.006
Firmsize 100-199	-0.005	0.003	-0.001	0.005	-0.013	0.004	-0.009	0.006
Firmsize 200-499	0.031	0.003	0.025	0.004	0.018	0.005	0.011	0.006
Firmsize 500-999	0.057	0.003	0.065	0.006	0.066	0.009	0.032	0.007
Firmsize >1000	0.078	0.004	0.086	0.006	0.089	0.006	0.081	0.008
Variance firmsize coefficients (x100)	0.286		0.333		0.315		0.182	
State-owned	-0.021	0.004	-0.044	0.008	-0.030	0.007	-0.028	0.007
Schleswig-Holstein	0.100	0.006	0.079	0.008	0.053	0.008	0.063	0.011
Hamburg	0.175	0.007	0.191	0.021	0.146	0.011	0.150	0.013
Lower Saxony	0.082	0.005	0.084	0.005	0.039	0.007	0.033	0.007
Bremen	0.134	0.010	0.054	0.012	0.065	0.010	0.092	0.024
North Rhine-Westphalia	0.128	0.004	0.116	0.005	0.089	0.005	0.094	0.006
Hesse	0.106	0.004	0.127	0.007	0.123	0.007	0.098	0.008
Rhineland-Palatinate	0.096	0.006	0.089	0.006	0.071	0.009	0.072	0.007
Baden-Wuerttemberg	0.139	0.003	0.142	0.005	0.149	0.005	0.134	0.007
Bavaria	0.103	0.004	0.098	0.005	0.097	0.007	0.097	0.007
Saarland	0.073	0.008	0.084	0.012	0.073	0.010	0.055	0.011
Berlin	0.058	0.008	0.032	0.009	0.011	0.013	0.024	0.014
Brandenburg	-0.190	0.010	-0.178	0.009	-0.148	0.010	-0.149	0.013
Mecklenburg-West Pomerania	-0.221	0.009	-0.214	0.010	-0.183	0.010	-0.184	0.013
Saxony	-0.267	0.007	-0.249	0.009	-0.213	0.010	-0.217	0.010
Saxony-Anhalt	-0.239	0.008	-0.227	0.009	-0.184	0.009	-0.153	0.011
Thuringia	-0.278	0.009	-0.229	0.008	-0.187	0.010	-0.207	0.010
Variance federal states (16 categories) Coefficients (x100)	2.696		2.322		1.653		1.625	
Share of analytical tasks	0.116	0.012	0.106	0.014	0.120	0.023	0.110	0.018
Share of interactive tasks	0.108	0.012	0.112	0.017	0.110	0.025	0.155	0.021
Share of manual tasks	-0.224	0.005	-0.218	0.007	-0.230	0.007	-0.265	0.009
Variance task coefficients (x100)	2.510		2.375		2.646		3.548	
No union coverage	0.033	0.003	0.021	0.005	-0.063	0.008	-0.063	0.006
Sectoral bargaining	-0.016	0.003	-0.012	0.004	0.005	0.007	0.027	0.005
Firm bargaining	-0.017	0.005	-0.010	0.008	0.058	0.013	0.036	0.008
Variance unionization coefficients (x100)	0.054		0.023		0.246		0.203	
Constant	2.900	0.005	2.920	0.009	2.946	0.010	2.967	0.010
Root MSE	0.219		0.244		0.265		0.274	

Source: Structure of Earnings Surveys 1995, 2001, 2006, 2010 and own calculations. Standard errors clustered at establishment level. Coefficients within groups of categorial regressors are centered around zero.

Table 4 – Changes in OLS coefficients vs. changes in quantities

	1995-2001		2001-2006		2006-2010		1995-2010	
	Δx	$\Delta\beta$	Δx	$\Delta\beta$	Δx	$\Delta\beta$	Δx	$\Delta\beta$
Age 20-25	-0.010	-0.026	-0.002	-0.024	0.000	0.011	-0.012	-0.039
Age 26-30	-0.046	-0.014	-0.011	-0.028	0.005	0.006	-0.052	-0.036
Age 31-35	-0.007	0.002	-0.047	-0.011	-0.014	-0.006	-0.068	-0.015
Age 36-40	0.040	0.010	-0.012	0.009	-0.046	-0.007	-0.018	0.012
Age 41-45	0.029	0.006	0.030	0.025	-0.007	0.005	0.052	0.036
Age 46-50	0.025	0.002	0.024	0.018	0.025	0.009	0.074	0.029
Age 51-55	-0.015	0.002	0.015	0.010	0.020	-0.004	0.020	0.008
Age 56-60	-0.015	0.016	0.003	0.003	0.017	-0.013	0.005	0.006
Age: $\sum \Delta x \Delta\beta * 100$	0.124		0.211		0.033		0.735	
Tenure 0-5	0.003	-0.009	-0.046	-0.001	-0.011	-0.007	-0.054	-0.017
Tenure 6-10	0.003	-0.014	0.017	0.001	-0.016	0.001	0.004	-0.012
Tenure 11-15	0.029	-0.005	-0.005	0.005	0.005	-0.002	0.029	-0.002
Tenure 16-20	-0.016	0.018	0.031	-0.006	0.002	-0.002	0.017	0.010
Tenure 21-25	-0.009	0.008	-0.005	0.006	0.015	-0.003	0.001	0.011
Tenure $>$25	-0.010	0.001	0.007	-0.004	0.006	0.013	0.003	0.010
Tenure: $\sum \Delta x \Delta\beta * 100$	-0.058		-0.021		0.010		0.102	
Lower/middle secondary without vocational training	-0.013	-0.021	-0.023	-0.002	-0.007	-0.008	-0.043	-0.031
Lower/middle secondary with vocational training	-0.031	-0.012	-0.017	-0.008	-0.019	-0.01	-0.067	-0.03
Upper secondary (German high school equivalent)	0.013	0.004	0.012	-0.004	0.002	0.007	0.027	0.007
University of Applied Science (Fachhochschule)	0.007	0.009	0.002	-0.006	0.000	0.005	0.009	0.008
University	0.013	0.032	0.006	0.007	0.004	0.010	0.023	0.049
Missing information	0.011	-0.014	0.021	0.013	0.020	-0.005	0.052	-0.006
Education: $\sum \Delta x \Delta\beta * 100$	0.102		0.044		0.020		0.442	
Non-skilled blue collar	0.018	0.007	-0.015	-0.008	0.015	-0.011	0.018	-0.012
Skilled blue collar and foremen	-0.066	-0.010	-0.007	0.004	-0.008	0.012	-0.081	0.006
White collar	0.048	0.003	0.021	0.004	-0.007	-0.001	0.062	0.006
Occupational Position: $\sum \Delta x \Delta\beta * 100$	0.093		0.018		-0.025		-0.033	
Offshoring(0-100%)	0.157	0.001	0.228	0.002	-0.343	0.003	0.042	0.006
Imports of consumption goods (0-100%)	0.007	0.000	-0.281	0.000	0.227	0.000	-0.047	0.000
No Exports	0.001	0.000	-0.005	-0.006	-0.024	-0.007	-0.028	-0.013
Export share 1-25%	-0.071	-0.007	-0.07	0.000	0.039	0.016	-0.102	0.009
Export share 26-50%	-0.006	0.008	-0.033	-0.006	0.092	0.011	0.053	0.013
Export share 51-100%	0.076	-0.017	0.108	0.012	-0.107	0.015	0.077	0.010
Export: $\sum \Delta x \Delta\beta * 100$	-0.084		0.152		0.020		0.091	
Mining and other quarring	-0.008	-0.060	-0.002	0.103	-0.003	0.057	-0.013	0.100
Food products, beverages, tobacco	0.001	-0.024	-0.001	-0.002	0.005	0.028	0.005	0.002
Textiles	-0.005	0.013	-0.001	-0.003	-0.001	-0.046	-0.007	-0.036
Wood	0.001	-0.015	-0.002	-0.021	-0.001	-0.009	-0.002	-0.045
Paper	0.000	0.018	-0.001	0.016	0.001	-0.010	0.000	0.024

Printing	0.003	-0.014	-0.003	-0.008	-0.009	-0.038	-0.009	-0.060
Coke and petroleum products	0.000	0.047	-0.001	0.009	0.000	0.052	-0.001	0.108
Chemicals	-0.003	-0.005	-0.004	0.004	0.001	-0.007	-0.006	-0.008
Rubber, plastic	0.002	-0.011	0.000	0.000	0.001	0.013	0.003	0.002
Non-metallic products	-0.002	-0.018	-0.005	-0.018	0.000	0.012	-0.007	-0.024
Basic metals	-0.001	0.014	-0.002	-0.014	0.001	-0.009	-0.002	-0.009
Fabricated metal products	0.008	-0.029	-0.001	0.007	0.000	-0.015	0.007	-0.037
Computer, electronic, optical products	0.007	-0.003	-0.002	0.023	-0.014	-0.005	-0.009	0.015
Electrical equipment	0.006	-0.002	0.002	-0.006	-0.003	0.004	0.005	-0.004
Machinery and equipment	-0.011	0.001	0.017	-0.009	-0.019	-0.004	-0.013	-0.012
Motor vehicles, trailers	0.013	-0.017	0.021	-0.003	-0.019	-0.008	0.015	-0.028
Other transport equipment	-0.008	0.066	0.001	-0.058	-0.004	0.068	-0.011	0.076
Furniture etc	0.000	-0.024	-0.004	-0.024	0.031	0.046	0.027	-0.002
Electricity, water, recycling	-0.002	0.027	0.004	-0.020	0.015	-0.028	0.017	-0.021
Construction	-0.044	-0.039	-0.029	-0.014	0.010	-0.002	-0.063	-0.055
Trade of vehicles	0.006	0.003	0.006	0.004	0.002	-0.030	0.014	-0.023
Wholesale trade	0.010	0.017	0.012	0.051	0.015	-0.017	0.037	0.051
Retail trade	0.005	0.019	0.001	-0.032	-0.007	-0.064	-0.001	-0.077
Finance and insurance	0.023	0.037	-0.008	0.012	0.000	0.014	0.015	0.063
Sector: $\sum \Delta x \Delta \beta * 100$	0.212		0.053		0.149		0.385	
Firmsize 10-19	0.005	-0.001	-0.008	0.004	0.002	0.021	-0.001	0.024
Firmsize 20-49	0.015	-0.010	-0.016	0.010	0.011	0.010	0.010	0.010
Firmsize 50-99	-0.009	0.000	0.005	0.000	-0.005	0.013	-0.009	0.013
Firmsize 100-199	0.008	0.004	0.001	-0.012	-0.003	0.004	0.006	-0.004
Firmsize 200-499	-0.011	-0.006	0.002	-0.007	-0.002	-0.007	-0.011	-0.020
Firmsize 500-999	0.006	0.008	0.003	0.001	-0.012	-0.034	-0.003	-0.025
Firmsize >1000	-0.014	0.008	0.011	0.003	0.011	-0.008	0.008	0.003
Firmsize: $\sum \Delta x \Delta \beta * 100$	-0.012		-0.018		0.041		0.025	
State-owned	-0.023	-0.023	-0.003	0.014	0.017	0.002	-0.009	-0.007
Schleswig-Holstein	-0.003	-0.021	0.001	-0.026	0.002	0.010	0.000	-0.037
Hamburg	0.000	0.016	-0.002	-0.045	0.001	0.004	-0.001	-0.025
Lower Saxony	0.004	0.002	0.003	-0.045	0.004	-0.006	0.011	-0.049
Bremen	-0.001	-0.080	-0.001	0.011	0.001	0.027	-0.001	-0.042
North Rhine-Westphalia	0.008	-0.012	-0.027	-0.027	-0.012	0.005	-0.031	-0.034
Hesse	-0.005	0.021	0.003	-0.004	-0.004	-0.025	-0.006	-0.008
Rhineland-Palatinate	0.008	-0.007	-0.006	-0.018	0.003	0.001	0.005	-0.024
Baden-Wuerttemberg	0.008	0.003	0.006	0.007	-0.010	-0.015	0.004	-0.005
Bavaria	0.000	-0.005	0.016	-0.001	0.001	0.000	0.017	-0.006
Saarland	-0.003	0.011	0.003	-0.011	-0.002	-0.018	-0.002	-0.018
Berlin	-0.008	-0.026	-0.002	-0.021	0.004	0.013	-0.006	-0.034
Brandenburg	-0.004	0.012	0.001	0.030	0.005	-0.001	0.002	0.041
Mecklenburg-West Pomerania	-0.001	0.007	0.000	0.031	0.000	-0.001	-0.001	0.037
Saxony	0.001	0.018	0.004	0.036	0.001	-0.004	0.006	0.050
Saxony-Anhalt	-0.003	0.012	0.000	0.043	0.002	0.031	-0.001	0.086
Thuringia	0.002	0.049	0.001	0.042	0.003	-0.020	0.006	0.071
Federal States: $\sum \Delta x \Delta \beta * 100$	0.012		0.099		0.030		0.131	
Share of analytical tasks	0.014	-0.010	0.003	0.014	-0.003	-0.010	0.014	-0.006
Share of interactive tasks	0.009	0.004	0.002	-0.002	0.001	0.045	0.012	0.047
Share of manual tasks	-0.024	0.006	-0.004	-0.012	0.001	-0.035	-0.027	-0.041

Tasks: $\sum \Delta x \Delta \beta * 100$	-0.025		0.009		0.004		0.159	
No union coverage	0.123	-0.012	0.060	-0.084	0.039	0.000	0.222	-0.096
Sectoral bargaining	-0.128	0.004	-0.065	0.017	-0.033	0.022	-0.226	0.043
Firm bargaining	0.005	0.007	0.005	0.068	-0.006	-0.022	0.004	0.053
Unionization: $\sum \Delta x \Delta \beta * 100$	-0.195		-0.581		-0.059		-3.082	

Source: Structure of Earnings Surveys 1995, 2001, 2006, 2010 and own calculations.

Table 5 – Aggregated RIF-Decompositions 1995-2010

Inequality measure	90-10	90-50	50-10	Gini	Log Variance	99-90	99-95	95-90
Total change	22.37***	10.10***	12.27***	4.63***	6.23***	7.40***	6.35***	1.05***
	(1.11)	(0.83)	(0.65)	(0.19)	(0.25)	(1.00)	(0.95)	(0.36)
Total Composition	19.77***	14.46***	5.31***	4.76***	5.48***	4.50***	0.33	4.17***
	(0.77)	(0.68)	(0.59)	(0.18)	(0.21)	(0.96)	(0.74)	(0.36)
Personal	6.14***	4.66***	1.46***	1.44***	1.69***	0.79***	0.45*	0.34**
	(0.37)	(0.29)	(0.16)	(0.08)	(0.10)	(0.29)	(0.24)	(0.15)
International	2.52***	2.33***	0.19	0.55***	0.61***	-0.43	-0.93**	0.50**
	(0.43)	(0.40)	(0.33)	(0.09)	(0.11)	(0.55)	(0.45)	(0.21)
Sector	-0.05	-0.44	0.38	0.07	0.12	1.19***	0.88***	0.32**
	(0.31)	(0.30)	(0.33)	(0.06)	(0.08)	(0.40)	(0.30)	(0.15)
Firm	-0.07	-0.02	-0.06	-0.01	-0.02	0.14	0.19	-0.04
	(0.19)	(0.19)	(0.19)	(0.04)	(0.05)	(0.24)	(0.20)	(0.09)
Region	0.35	0.02	0.33	0.03	0.08	-0.15	-0.18	0.03
	(0.29)	(0.11)	(0.25)	(0.05)	(0.07)	(0.15)	(0.14)	(0.05)
Tasks	1.26***	0.91***	0.35***	0.30***	0.30***	-0.06	0.02	-0.07
	(0.26)	(0.18)	(0.11)	(0.06)	(0.07)	(0.14)	(0.11)	(0.07)
Unionization	9.66***	6.99***	2.67***	2.38***	2.71***	2.97***	-0.12	3.10***
	(0.49)	(0.40)	(0.16)	(0.11)	(0.13)	(0.44)	(0.36)	(0.19)
Total Wage Structure	5.01***	-0.92	5.92***	1.35***	2.18***	6.82***	5.27***	1.55**
	(1.28)	(1.04)	(0.58)	(0.24)	(0.31)	(1.62)	(1.39)	(0.67)
Personal	-1.75	2.19	-3.94***	-0.72**	-1.53***	-6.94***	-3.75	-3.19***
	(1.47)	(1.37)	(0.76)	(0.30)	(0.39)	(2.24)	(2.35)	(1.23)
International	2.58**	1.84*	0.72	0.59***	0.75***	0.29	0.13	0.17
	(1.06)	(0.94)	(0.76)	(0.21)	(0.27)	(1.42)	(1.13)	(0.70)
Sector	-0.03	0.90	-0.93	-0.01	-0.14	-2.32	-2.05	-0.27
	(1.07)	(1.01)	(0.60)	(0.27)	(0.34)	(1.92)	(1.30)	(0.90)
Firm	4.73*	3.21*	1.52	1.28***	1.75**	3.51	1.54	1.97
	(2.79)	(1.73)	(2.02)	(0.24)	(0.70)	(2.96)	(2.47)	(1.46)
Region	-2.37**	-3.89***	1.53*	-0.24	-0.35	3.24***	1.76*	1.48***
	(1.04)	(0.76)	(0.89)	(0.44)	(0.25)	(1.03)	(0.92)	(0.45)
Tasks	0.86	1.05	-0.18	0.21	-0.06	-0.96	-0.62	-0.38
	(1.10)	(1.04)	(0.73)	(0.24)	(0.30)	(1.68)	(1.60)	(0.72)
Unionization	-2.85	-3.75**	0.89	-0.57	-0.51	3.11	2.75*	0.36
	(1.84)	(1.76)	(1.22)	(0.42)	(0.53)	(2.14)	(1.67)	(0.87)
Constant	3.84	-2.48	6.31**	0.82	2.26*	6.92	5.50	1.42
	(4.61)	(3.75)	(2.92)	(0.87)	(1.22)	(5.38)	(4.75)	(2.08)

Specification Error	-2.19***	-1.48***	-0.72	-1.22***	-1.26***	-2.09*	1.64*	-3.73***
	(0.85)	(0.71)	(0.48)	(0.13)	(0.18)	(1.10)	(1.00)	(0.55)
Reweighting Error	-0.21	-1.97***	1.75***	-0.27***	-0.16	-1.82***	-0.88***	-0.94***
	(0.50)	(0.38)	(0.31)	(0.10)	(0.13)	(0.27)	(0.26)	(0.16)

Source: Structure of Earnings Surveys 1995, 2001, 2006, 2010 and own calculations.

Log wage differentials×100. Bootstrapped standard errors clustered at establishment level in parentheses (100 replications).

***/ **/ * statistically significant at 1%/5%/10%-level

Table 6 – Decomposition based on reweighting 1995-2010

Inequality measure	90-10	90-50	50-10	Gini	Log Variance
Total Change	21.80***	10.11***	11.69***	4.57***	6.08***
	(0.92)	(0.67)	(0.57)	(0.18)	(0.26)
Unconditional reweighting (one factor at a time)					
Personal	8.10***	6.26***	1.84***	1.76***	2.26***
	(0.41)	(0.29)	(0.20)	(0.09)	(0.11)
International	1.07***	1.14***	-0.07	0.12*	0.32***
	(0.34)	(0.31)	(0.11)	(0.07)	(0.08)
Sector	0.84***	0.10	0.74***	0.17**	0.41***
	(0.29)	(0.26)	(0.17)	(0.07)	(0.08)
Firm[a]	0.87***	0.27**	0.60***	0.11***	0.34***
	(0.24)	(0.11)	(0.20)	(0.04)	(0.05)
Tasks	3.05***	2.14***	0.90***	0.59***	0.88***
	(0.34)	(0.23)	(0.12)	(0.07)	(0.08)
Unionization	14.67***	10.32***	4.35***	2.96***	3.76***
	(0.79)	(0.56)	(0.28)	(0.14)	(0.19)
Sequential reweighting decomposition					
Total Composition	19.89	13.39	6.50	4.08	5.35
Personal	8.10***	6.26***	1.84***	1.76***	2.26***
	(0.41)	(0.29)	(0.20)	(0.09)	(0.11)
International	-0.44**	-0.37*	-0.07	-0.16***	-0.15***
	(0.20)	(0.19)	(0.11)	(0.04)	(0.05)
Sector	0.34	0.37	-0.03	0.13*	0.11
	(0.29)	(0.28)	(0.17)	(0.07)	(0.09)
Firm[a]	5.12***	3.18***	1.94***	1.02***	1.29***
	(0.50)	(0.37)	(0.28)	(0.10)	(0.13)
Tasks	-0.57***	-0.44***	-0.13	-0.13***	-0.16***
	(0.17)	(0.13)	(0.09)	(0.04)	(0.04)
Unionization	7.34***	4.39***	2.95***	1.46***	2.00***
	(0.90)	(0.74)	(0.26)	(0.17)	(0.22)
Residual (wage structure effect)	1.91*	-3.28***	5.19***	0.49**	0.73**
	(1.10)	(0.92)	(0.61)	(0.22)	(0.30)

Source: Structure of Earnings Surveys 1995, 2010 and own calculations.

Bootstrapped standard errors clustered at establishment level in parentheses (100 replications).

Log wage differentials×100. [a] Includes regional information (federal states)

***/ **/ * statistically significant at 1%/5%/10%-level

Table 7 – Effect of unobserved firm heterogeneity 1995-2010

Inequality measure	90-10	90-50	50-10	Gini	Log Variance
1995-2010					
Total change	21.49	10.10	10.11	4.46	6.36
Unobserved firm heterogeneity	2.00***	0.90***	1.10***	0.43***	0.58***
	(0.20)	(0.11)	(0.13)	(0.05)	(0.06)
1995-2001					
Total change	8.35	4.07	4.28	1.80	2.14
Unobserved firm heterogeneity	0.41***	0.10	0.31***	0.08***	0.12**
	(0.15)	(0.07)	(0.10)	(0.03)	(0.05)
2001-2006					
Total change	8.43	3.07	5.36	1.65	2.77
Unobserved firm heterogeneity	0.85***	0.28**	0.57***	0.14**	0.23***
	(0.23)	(0.13)	(0.14)	(0.06)	(0.08)
2006-2010					
Total change	4.73	3.04	1.70	1.03	1.38
Unobserved firm heterogeneity	0.58**	0.25*	0.33**	0.11*	0.17*
	(0.25)	(0.15)	(0.13)	(0.06)	(0.09)

Source: Structure of Earnings Surveys 1995, 2001, 2006, 2010 and own calculations.

Bootstrapped standard errors clustered at establishment level (100 replications).

Log wage differentials×100. [a] Includes regional information (federal states)

***/**/* statistically significant at 1%/5%/10%-level

10 Appendix

Table A1 – Descriptive statistics

Variable	1995		2001		2006		2010	
	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Personal								
Age 20-25	0.081	0.273	0.071	0.256	0.069	0.253	0.069	0.254
Age 26-30	0.152	0.359	0.106	0.308	0.095	0.294	0.100	0.300
Age 31-35	0.176	0.381	0.169	0.375	0.122	0.327	0.108	0.311
Age 36-40	0.150	0.357	0.190	0.393	0.178	0.382	0.132	0.338
Age 41-45	0.132	0.339	0.161	0.368	0.191	0.393	0.184	0.387
Age 46-50	0.109	0.312	0.134	0.340	0.158	0.365	0.183	0.387
Age 51-55	0.121	0.326	0.106	0.308	0.121	0.326	0.141	0.348
Age 56-60	0.078	0.268	0.063	0.242	0.066	0.249	0.083	0.276
Tenure 0-5	0.403	0.491	0.406	0.491	0.360	0.480	0.349	0.477
Tenure 6-10	0.185	0.388	0.188	0.391	0.205	0.404	0.189	0.392
Tenure 11-15	0.114	0.317	0.143	0.351	0.138	0.345	0.143	0.350
Tenure 16-20	0.100	0.300	0.084	0.278	0.115	0.319	0.117	0.322
Tenure 21-25	0.085	0.279	0.076	0.265	0.071	0.257	0.086	0.280
Tenure >25	0.113	0.316	0.103	0.303	0.110	0.313	0.116	0.321
Lower/middle secondary without vocational training	0.140	0.347	0.127	0.333	0.104	0.305	0.097	0.296
Lower/middle secondary with vocational training	0.711	0.453	0.680	0.467	0.663	0.473	0.644	0.479
Upper secondary (German high school equivalent)	0.026	0.158	0.039	0.195	0.051	0.219	0.053	0.224
University of Applied Science (Fachhochschule)	0.043	0.203	0.050	0.218	0.052	0.221	0.052	0.222
University	0.032	0.177	0.045	0.207	0.051	0.220	0.055	0.227
Missing information	0.048	0.213	0.059	0.235	0.080	0.272	0.100	0.300
Non-skilled blue collar	0.218	0.413	0.236	0.424	0.221	0.415	0.236	0.424
Skilled blue collar and foremen	0.462	0.499	0.396	0.489	0.389	0.487	0.381	0.486
White collar	0.321	0.467	0.369	0.482	0.390	0.488	0.383	0.486
Internationalization								
No Exports	0.474	0.499	0.475	0.499	0.470	0.499	0.446	0.497
Export share 1-25%	0.292	0.455	0.221	0.415	0.151	0.358	0.190	0.392
Export share 26-50%	0.077	0.267	0.071	0.257	0.038	0.191	0.130	0.336
Export share 51-100%	0.157	0.363	0.233	0.423	0.341	0.474	0.234	0.423
Offshoring (0-100%)	4.020	2.311	4.177	2.380	4.405	2.771	4.062	2.841
Imports of consumption goods (0-100%)	3.267	5.138	3.274	4.764	2.993	4.816	3.220	5.116
Sector								
Mining and other quarring	0.021	0.143	0.013	0.111	0.011	0.103	0.008	0.087
Food products, beverages, tobacco	0.038	0.192	0.039	0.193	0.038	0.191	0.043	0.202
Textiles	0.015	0.122	0.010	0.101	0.009	0.094	0.008	0.090
Wood	0.012	0.109	0.013	0.111	0.011	0.105	0.010	0.100
Paper	0.014	0.119	0.014	0.119	0.013	0.113	0.014	0.118
Printing	0.020	0.141	0.023	0.150	0.020	0.139	0.011	0.103
Coke and petroleum products	0.003	0.051	0.003	0.050	0.002	0.048	0.002	0.042
Chemicals	0.045	0.207	0.042	0.200	0.038	0.190	0.039	0.194
Rubber, plastic	0.034	0.180	0.036	0.187	0.036	0.186	0.037	0.190
Non-metallic products	0.028	0.164	0.026	0.158	0.021	0.144	0.021	0.144
Basic metals	0.033	0.177	0.032	0.175	0.030	0.171	0.031	0.172
Fabricated metal products	0.062	0.241	0.070	0.255	0.069	0.254	0.069	0.253

Computer, electronic, optical products	0.035	0.185	0.042	0.201	0.040	0.197	0.026	0.159
Electrical equipment	0.030	0.172	0.036	0.186	0.038	0.192	0.035	0.185
Machinery and equipment	0.119	0.323	0.108	0.310	0.125	0.331	0.106	0.307
Motor vehicles, trailers	0.055	0.229	0.068	0.252	0.089	0.285	0.070	0.255
Other transport equipment	0.024	0.154	0.016	0.126	0.017	0.128	0.013	0.113
Furniture etc	0.021	0.142	0.021	0.143	0.017	0.129	0.048	0.213
Electricity, water, recycling	0.028	0.165	0.026	0.159	0.030	0.171	0.045	0.207
Construction	0.176	0.381	0.132	0.338	0.103	0.304	0.113	0.316
Trade of vehicles	0.032	0.176	0.038	0.192	0.044	0.206	0.046	0.210
Wholesale trade	0.076	0.266	0.086	0.281	0.098	0.297	0.113	0.317
Retail trade	0.040	0.196	0.045	0.208	0.046	0.209	0.039	0.194
Finance and insurance	0.039	0.193	0.062	0.241	0.054	0.227	0.054	0.226
Firm								
Firmsize 10-19	0.074	0.261	0.079	0.269	0.071	0.257	0.073	0.260
Firmsize 20-49	0.151	0.358	0.166	0.372	0.150	0.357	0.161	0.368
Firmsize 50-99	0.134	0.341	0.125	0.331	0.130	0.336	0.125	0.330
Firmsize 100-199	0.125	0.330	0.133	0.339	0.134	0.341	0.131	0.337
Firmsize 200-499	0.170	0.375	0.159	0.366	0.161	0.367	0.159	0.365
Firmsize 500-999	0.097	0.296	0.103	0.304	0.106	0.308	0.094	0.292
Firmsize >1000	0.250	0.433	0.236	0.424	0.247	0.432	0.258	0.437
State-owned	0.046	0.210	0.023	0.150	0.020	0.141	0.037	0.188
Region								
Schleswig-Holstein	0.026	0.158	0.023	0.149	0.024	0.152	0.026	0.160
Hamburg	0.023	0.148	0.023	0.149	0.021	0.144	0.022	0.145
Lower Saxony	0.076	0.265	0.080	0.271	0.083	0.276	0.087	0.282
Bremen	0.011	0.103	0.010	0.100	0.009	0.095	0.010	0.098
North Rhine-Westphalia	0.254	0.436	0.262	0.440	0.235	0.424	0.223	0.416
Hesse	0.081	0.273	0.076	0.265	0.079	0.269	0.075	0.264
Rhineland-Palatinate	0.043	0.203	0.051	0.219	0.045	0.208	0.048	0.213
Baden-Wuerttemberg	0.163	0.370	0.171	0.376	0.177	0.381	0.167	0.373
Bavaria	0.166	0.372	0.166	0.372	0.182	0.386	0.183	0.387
Saarland	0.016	0.125	0.013	0.114	0.016	0.124	0.014	0.118
Berlin	0.027	0.163	0.019	0.137	0.017	0.129	0.021	0.144
Brandenburg	0.021	0.142	0.017	0.128	0.018	0.133	0.023	0.148
Mecklenburg-West Pomerania	0.013	0.115	0.012	0.107	0.012	0.107	0.012	0.109
Saxony	0.037	0.189	0.038	0.191	0.042	0.200	0.043	0.202
Saxony-Anhalt	0.023	0.151	0.020	0.139	0.020	0.141	0.022	0.147
Thuringia	0.019	0.137	0.021	0.144	0.022	0.145	0.025	0.155
Tasks								
Share of analytical tasks	0.276	0.142	0.290	0.150	0.293	0.151	0.290	0.151
Share of interactive tasks	0.212	0.118	0.221	0.123	0.223	0.126	0.224	0.126
Share of manual tasks	0.513	0.232	0.489	0.245	0.485	0.247	0.486	0.247
Unionization								
No union coverage	0.265	0.441	0.388	0.487	0.448	0.497	0.487	0.500
Sectoral bargaining	0.697	0.460	0.569	0.495	0.504	0.500	0.471	0.499
Firm bargaining	0.038	0.191	0.043	0.203	0.048	0.213	0.042	0.201
Observations	592.198		359.495		533.497		438.352	

Source: Structure of Earnings Surveys 1995, 2001, 2006, 2010 and own calculations. Weighted data.

Table A2 – Mapping of activities into task indicators

Task	Activity
Analytical	Researching, evaluating, measuring
	Designing, planning, sketching
	Correcting texts or data
	Programming
	Executing laws or interpreting rules
Manual	Equipping or operating machinery
	Repairing, renovating, reconstructing
	Manufacturing, installing or constructing
	Nursing, serving, accomodating
	Transporting
Interactive	Selling, buying, advertising
	Teaching or training
	Negotiating
	Employing, managing personnel, organizing

Table A3 – OLS regressions of log hourly wage on covariates (with union coverage)

	1995		2001		2006		2010	
	Coeff.	Std.	Coeff.	Std	Coeff.	Std	Coeff.	Std
Age 20-25	-0.122	0.002	-0.138	0.004	-0.184	0.006	-0.165	0.006
Age 26-30	-0.043	0.001	-0.053	0.002	-0.109	0.004	-0.095	0.004
Age 31-35	0.005	0.001	0.004	0.002	-0.022	0.002	-0.026	0.003
Age 36-40	0.025	0.001	0.031	0.001	0.032	0.002	0.028	0.002
Age 41-45	0.031	0.001	0.035	0.002	0.059	0.002	0.064	0.002
Age 46-50	0.035	0.001	0.041	0.002	0.069	0.003	0.070	0.003
Age 51-55	0.038	0.002	0.045	0.002	0.077	0.003	0.064	0.003
Age 56-60	0.030	0.002	0.035	0.004	0.079	0.004	0.061	0.004
Variance age coefficients (x100)	0.275		0.363		0.846		0.681	
Tenure 0-5	-0.058	0.002	-0.065	0.003	-0.059	0.004	-0.072	0.004
Tenure 6-10	-0.011	0.001	-0.013	0.004	-0.009	0.003	-0.010	0.003
Tenure 11-15	0.005	0.001	0.002	0.002	0.005	0.002	0.008	0.003
Tenure 16-20	0.008	0.001	0.019	0.002	0.015	0.002	0.014	0.003
Tenure 21-25	0.020	0.001	0.024	0.002	0.027	0.003	0.024	0.003
Tenure >25	0.037	0.002	0.032	0.003	0.020	0.003	0.037	0.004
Variance tenure coefficients (x100)	0.088		0.106		0.082		0.125	
Lower/middle secondary without vocational training	-0.087	0.002	-0.102	0.004	-0.139	0.005	-0.148	0.005
Lower/middle secondary with vocational training	-0.041	0.002	-0.047	0.003	-0.080	0.004	-0.091	0.003
Upper secondary (German high school equivalent)	-0.031	0.004	-0.022	0.004	-0.028	0.006	-0.021	0.006
University of Applied Science (Fachhochschule)	0.085	0.003	0.096	0.004	0.097	0.007	0.111	0.005
University	0.124	0.005	0.145	0.006	0.210	0.007	0.229	0.006
Missing information	-0.050	0.005	-0.071	0.006	-0.061	0.018	-0.080	0.008
Variance education coefficients (x100)	0.591		0.810		1.393		1.695	
Non-skilled blue collar	-0.100	0.002	-0.088	0.003	-0.103	0.005	-0.109	0.004
Skilled blue collar and foremen	-0.008	0.001	-0.013	0.002	-0.018	0.004	-0.009	0.003

White collar	0.108	0.002	0.101	0.004	0.121	0.005	0.118	0.005
Variance occupational position coefficients	0.727		0.603		0.851		0.868	
Offshoring (0-100%)	0.005	0.001	0.008	0.001	0.007	0.001	0.009	0.001
Imports of consumption goods (0-100%)	-0.002	0.000	-0.002	0.000	-0.002	0.000	-0.002	0.000
No Exports	-0.012	0.004	-0.014	0.006	-0.037	0.009	-0.034	0.011
Export share 1-25%	-0.005	0.002	-0.002	0.004	0.012	0.009	-0.015	0.006
Export share 26-50%	0.007	0.003	0.012	0.004	0.009	0.008	0.024	0.006
Export share 51-100%	0.010	0.003	0.004	0.005	0.016	0.007	0.025	0.008
Variance export coefficients (x100)	0.008		0.009		0.047		0.064	
Mining and other quarring	-0.080	0.012	-0.136	0.045	-0.013	0.023	-0.009	0.032
Food products, beverages, tobacco	-0.043	0.005	-0.056	0.009	-0.048	0.012	-0.028	0.014
Textiles	-0.103	0.007	-0.085	0.020	-0.092	0.016	-0.110	0.020
Wood	-0.011	0.008	-0.017	0.021	-0.056	0.015	-0.136	0.017
Paper	0.002	0.008	0.009	0.008	0.013	0.015	0.014	0.010
Printing	0.153	0.008	0.164	0.010	0.138	0.012	0.124	0.027
Coke and petroleum products	0.090	0.031	0.138	0.027	0.168	0.024	0.221	0.054
Chemicals	0.038	0.007	0.027	0.008	0.045	0.010	0.050	0.011
Rubber, plastic	-0.013	0.006	-0.027	0.008	-0.043	0.020	-0.019	0.015
Non-metallic products	-0.013	0.006	-0.044	0.006	-0.078	0.014	-0.045	0.017
Basic metals	0.041	0.007	0.057	0.014	0.049	0.017	0.042	0.012
Fabricated metal products	0.024	0.005	-0.004	0.009	0.001	0.016	-0.002	0.016
Computer, electronic, optical products	0.025	0.006	0.026	0.008	0.025	0.011	0.040	0.012
Electrical equipment	0.020	0.006	0.024	0.009	0.007	0.015	0.029	0.010
Machinery and equipment	0.036	0.005	0.031	0.007	0.013	0.012	0.014	0.015
Motor vehicles, trailers	0.124	0.008	0.112	0.010	0.091	0.013	0.061	0.011
Other transport equipment	-0.008	0.008	0.079	0.030	0.029	0.014	0.088	0.012
Furniture etc	-0.019	0.008	-0.027	0.013	-0.053	0.015	0.005	0.013
Electricity, water, recycling	0.078	0.008	0.104	0.011	0.107	0.017	0.085	0.016
Construction	0.040	0.004	-0.009	0.007	-0.038	0.009	-0.030	0.011
Trade of vehicles	-0.051	0.010	-0.057	0.009	-0.044	0.012	-0.040	0.018
Wholesale trade	-0.110	0.007	-0.091	0.015	-0.038	0.015	-0.083	0.018
Retail trade	-0.156	0.009	-0.162	0.013	-0.161	0.048	-0.271	0.022
Finance and insurance	-0.066	0.007	-0.057	0.010	-0.020	0.011	-0.002	0.015
Variance sector coefficients (x100)	0.516		0.647		0.539		0.863	
Firmsize 10-19	-0.051	0.004	-0.049	0.006	-0.062	0.008	-0.074	0.012
Firmsize 20-49	-0.033	0.004	-0.039	0.005	-0.042	0.009	-0.042	0.009
Firmsize 50-99	-0.028	0.004	-0.020	0.005	-0.030	0.007	-0.028	0.008
Firmsize 100-199	-0.008	0.003	-0.005	0.006	-0.012	0.007	0.010	0.009
Firmsize 200-499	0.016	0.002	0.011	0.004	0.009	0.007	0.015	0.007
Firmsize 500-999	0.038	0.003	0.036	0.005	0.063	0.012	0.038	0.008
Firmsize >1000	0.066	0.003	0.065	0.006	0.075	0.007	0.081	0.008
Variance firmsize coefficients (x100)	0.153		0.143		0.234		0.233	
State-owned	-0.020	0.003	-0.043	0.008	-0.040	0.008	-0.047	0.008
Schleswig-Holstein	0.075	0.006	0.076	0.012	0.038	0.011	0.033	0.014
Hamburg	0.167	0.008	0.176	0.035	0.125	0.014	0.137	0.019
Lower Saxony	0.069	0.004	0.064	0.006	0.029	0.008	0.026	0.009
Bremen	0.126	0.007	0.032	0.012	0.043	0.013	0.053	0.016
North Rhine-Westphalia	0.106	0.003	0.086	0.005	0.066	0.007	0.055	0.008
Hesse	0.076	0.004	0.072	0.006	0.095	0.009	0.062	0.011
Rhineland-Palatinate	0.099	0.006	0.083	0.006	0.059	0.012	0.059	0.009

Baden-Wuerttemberg	0.120	0.004	0.131	0.006	0.136	0.008	0.105	0.011
Bavaria	0.071	0.004	0.066	0.005	0.083	0.011	0.079	0.008
Saarland	0.068	0.008	0.068	0.013	0.053	0.013	0.042	0.015
Berlin	0.056	0.009	0.040	0.011	0.023	0.016	0.045	0.018
Brandenburg	-0.149	0.011	-0.149	0.014	-0.120	0.013	-0.091	0.026
Mecklenburg-West Pomerania	-0.194	0.009	-0.181	0.018	-0.147	0.017	-0.185	0.030
Saxony	-0.231	0.008	-0.199	0.015	-0.174	0.019	-0.169	0.017
Saxony-Anhalt	-0.215	0.009	-0.190	0.011	-0.142	0.016	-0.099	0.023
Thuringia	-0.245	0.015	-0.176	0.010	-0.167	0.017	-0.152	0.019
Variance federal states (16 categories) Coefficients (x100)	2.048		1.568		1.122		0.992	
Share of analytical tasks	0.166	0.011	0.187	0.018	0.131	0.039	0.086	0.023
Share of interactive tasks	-0.016	0.013	-0.046	0.022	0.061	0.042	0.118	0.027
Share of manual tasks	-0.151	0.005	-0.140	0.009	-0.192	0.008	-0.204	0.011
Variance task coefficients (x100)	1.688		1.891		1.918		2.105	
Constant	2.853	0.005	2.882	0.008	2.958	0.010	2.985	0.010
Root MSE	0.186		0.199		0.245		0.246	

Source: Structure of Earnings Surveys 1995, 2001, 2006, 2010 and own calculations. Standard errors clustered at establishment level. Coefficients within groups of categorial regressors are centered around zero.

Table A4 – OLS regressions of log hourly wage on covariates (without union coverage)

	1995		2001		2006		2010	
	Coeff.	Std.	Coeff.	Std	Coeff.	Std	Coeff.	Std
Age 20-25	-0.162	0.005	-0.189	0.005	-0.186	0.005	-0.182	0.005
Age 26-30	-0.083	0.003	-0.086	0.003	-0.093	0.004	-0.095	0.003
Age 31-35	-0.023	0.003	-0.008	0.003	-0.010	0.003	-0.020	0.003
Age 36-40	0.016	0.003	0.033	0.002	0.049	0.002	0.037	0.003
Age 41-45	0.041	0.003	0.050	0.003	0.074	0.003	0.077	0.003
Age 46-50	0.061	0.003	0.054	0.004	0.062	0.003	0.078	0.003
Age 51-55	0.081	0.004	0.066	0.004	0.055	0.003	0.061	0.003
Age 56-60	0.070	0.005	0.081	0.005	0.049	0.004	0.045	0.004
Variance age coefficients (x100)	0.633		0.754		0.754		0.768	
Tenure 0-5	-0.087	0.004	-0.098	0.004	-0.101	0.004	-0.099	0.004
Tenure 6-10	-0.007	0.004	-0.040	0.003	-0.037	0.003	-0.031	0.003
Tenure 11-15	0.013	0.004	0.000	0.004	0.008	0.004	0.006	0.004
Tenure 16-20	0.013	0.004	0.042	0.004	0.032	0.003	0.025	0.004
Tenure 21-25	0.031	0.004	0.041	0.006	0.054	0.005	0.045	0.004
Tenure >25	0.037	0.005	0.054	0.006	0.044	0.005	0.054	0.005
Variance tenure coefficients (x100)	0.172		0.295		0.291		0.274	
Lower/middle secondary without vocational training	-0.120	0.006	-0.138	0.006	-0.129	0.007	-0.137	0.007
Lower/middle secondary with vocational training	-0.065	0.004	-0.084	0.004	-0.089	0.005	-0.095	0.005
Upper secondary (German high school equivalent)	0.025	0.009	0.012	0.010	-0.002	0.010	0.011	0.011
University of Applied Science (Fachhochschule)	0.081	0.006	0.095	0.007	0.095	0.008	0.093	0.007
University	0.154	0.007	0.192	0.007	0.203	0.010	0.205	0.009
Missing information	-0.075	0.008	-0.078	0.010	-0.079	0.008	-0.078	0.007
Variance education coefficients (x100)	0.917		1.306		1.354		1.417	

Non-skilled blue collar	-0.122	0.004	-0.124	0.005	-0.111	0.004	-0.122	0.005
Skilled blue collar and foremen	-0.011	0.003	-0.024	0.003	-0.010	0.003	0.002	0.004
White collar	0.134	0.006	0.148	0.006	0.122	0.005	0.120	0.006
Variance occupational position coefficients	1.095		1.254		0.909		0.983	
Offshoring (0-100%)	-0.005	0.002	0.002	0.001	0.006	0.001	0.013	0.001
Imports of consumption goods (0-100%)	-0.000	0.001	-0.002	0.000	-0.002	0.000	-0.001	0.000
No Exports	-0.035	0.008	-0.022	0.009	-0.016	0.008	-0.034	0.011
Export share 1-25%	-0.013	0.005	0.005	0.005	-0.009	0.005	-0.011	0.006
Export share 26-50%	0.014	0.007	0.013	0.008	0.010	0.007	0.012	0.008
Export share 51-100%	0.034	0.008	0.004	0.010	0.016	0.007	0.033	0.012
Variance export coefficients (x100)	0.069		0.017		0.017		0.062	
Mining and other quarring	0.037	0.016	0.021	0.022	-0.020	0.029	0.097	0.022
Food products, beverages, tobacco	-0.064	0.011	-0.093	0.011	-0.092	0.011	-0.072	0.014
Textiles	-0.056	0.017	-0.067	0.019	-0.062	0.015	-0.112	0.024
Wood	-0.032	0.011	-0.033	0.011	-0.060	0.014	-0.050	0.011
Paper	-0.008	0.016	0.007	0.014	0.035	0.014	0.023	0.013
Printing	0.086	0.013	0.058	0.014	0.086	0.012	0.064	0.013
Coke and petroleum products	0.132	0.029	0.137	0.022	0.159	0.055	0.087	0.036
Chemicals	0.031	0.015	0.040	0.013	0.027	0.014	0.021	0.020
Rubber, plastic	-0.025	0.012	-0.028	0.010	-0.025	0.012	-0.012	0.013
Non-metallic products	0.019	0.010	0.011	0.010	-0.001	0.013	-0.004	0.015
Basic metals	0.035	0.014	0.048	0.016	0.029	0.014	0.034	0.021
Fabricated metal products	0.021	0.009	0.004	0.008	-0.004	0.010	-0.020	0.013
Computer, electronic, optical products	-0.025	0.009	-0.028	0.011	0.017	0.010	0.000	0.012
Electrical equipment	-0.035	0.010	-0.013	0.013	-0.008	0.014	-0.034	0.014
Machinery and equipment	-0.010	0.009	0.002	0.010	0.002	0.010	0.002	0.012
Motor vehicles, trailers	0.057	0.018	0.046	0.017	0.108	0.019	0.116	0.015
Other transport equipment	0.010	0.023	0.048	0.025	-0.004	0.022	0.037	0.032
Furniture etc	-0.031	0.018	-0.070	0.012	-0.081	0.014	-0.032	0.009
Electricity, water, recycling	0.057	0.023	0.072	0.019	0.059	0.019	0.013	0.020
Construction	0.063	0.008	0.028	0.007	0.018	0.008	0.018	0.010
Trade of vehicles	-0.054	0.029	-0.034	0.011	-0.039	0.011	-0.065	0.017
Wholesale trade	-0.057	0.010	-0.059	0.009	-0.016	0.011	-0.012	0.012
Retail trade	-0.150	0.015	-0.111	0.016	-0.198	0.016	-0.228	0.019
Finance and insurance	0.000	0.019	0.111	0.026	0.072	0.028	0.130	0.028
Variance sector coefficients (x100)	0.335		0.313		0.504		0.561	
Firmsize 10-19	-0.087	0.007	-0.090	0.007	-0.081	0.007	-0.049	0.009
Firmsize 20-49	-0.063	0.007	-0.077	0.008	-0.059	0.007	-0.044	0.008
Firmsize 50-99	-0.054	0.007	-0.052	0.007	-0.039	0.006	-0.024	0.009
Firmsize 100-199	-0.021	0.007	-0.017	0.008	-0.017	0.007	-0.024	0.009
Firmsize 200-499	0.042	0.009	0.030	0.008	0.020	0.009	0.001	0.010
Firmsize 500-999	0.088	0.009	0.098	0.013	0.048	0.011	0.015	0.013
Firmsize >1000	0.096	0.010	0.107	0.014	0.128	0.014	0.125	0.017
Variance firmsize coefficients (x100)	0.480		0.557		0.445		0.303	
State-owned	0.022	0.015	0.019	0.016	0.003	0.015	-0.011	0.011
Schleswig-Holstein	0.123	0.014	0.069	0.012	0.054	0.011	0.082	0.015
Hamburg	0.176	0.015	0.185	0.020	0.154	0.015	0.151	0.020
Lower Saxony	0.093	0.010	0.086	0.009	0.050	0.011	0.026	0.009
Bremen	0.099	0.026	0.078	0.015	0.095	0.016	0.092	0.026

North Rhine-Westphalia	0.154	0.008	0.128	0.008	0.104	0.008	0.125	0.009
Hesse	0.144	0.008	0.162	0.011	0.140	0.011	0.120	0.012
Rhineland-Palatinate	0.081	0.014	0.081	0.010	0.074	0.010	0.080	0.011
Baden-Wuerttemberg	0.166	0.007	0.150	0.006	0.146	0.007	0.146	0.008
Bavaria	0.156	0.007	0.116	0.008	0.103	0.008	0.112	0.010
Saarland	0.056	0.013	0.091	0.027	0.080	0.014	0.050	0.014
Berlin	0.033	0.012	0.000	0.012	-0.017	0.017	-0.004	0.019
Brandenburg	-0.223	0.014	-0.182	0.011	-0.161	0.013	-0.168	0.014
Mecklenburg-West Pomerania	-0.226	0.015	-0.219	0.012	-0.201	0.011	-0.172	0.013
Saxony	-0.293	0.010	-0.273	0.008	-0.230	0.009	-0.255	0.010
Saxony-Anhalt	-0.262	0.014	-0.231	0.012	-0.198	0.011	-0.165	0.012
Thuringia	-0.275	0.010	-0.241	0.009	-0.192	0.011	-0.220	0.011
Variance federal states (16 categories) Coefficients (x100)	3.143		2.579		1.923		1.937	
Share of analytical tasks	0.187	0.024	0.116	0.021	0.141	0.026	0.144	0.026
Share of interactive tasks	0.166	0.025	0.192	0.023	0.126	0.028	0.170	0.028
Share of manual tasks	-0.353	0.012	-0.308	0.011	-0.267	0.010	-0.314	0.012
Variance task coefficients (x100)	6.227		4.830		3.559		4.933	
Constant	2.999	0.015	3.023	0.017	2.927	0.016	2.918	0.013
Root MSE	0.268		0.285		0.284		0.293	

Source: Structure of Earnings Surveys 1995, 2001, 2006, 2010 and own calculations. Standard errors clustered at establishment level. Coefficients within groups of categorial regressors are centered around zero.

Figure A1 – Aggregate decomposition 1995-2001

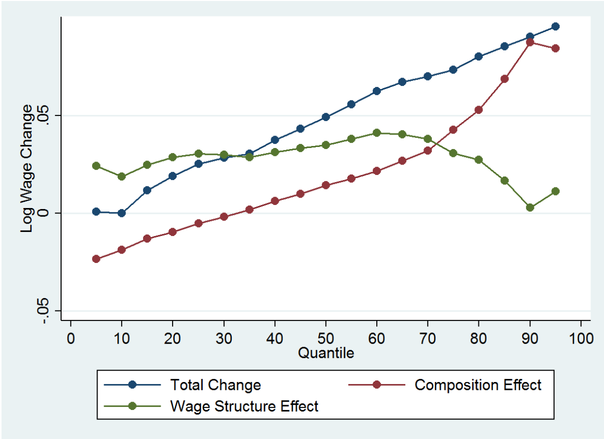


Figure A2 – Composition effects 1995-2001

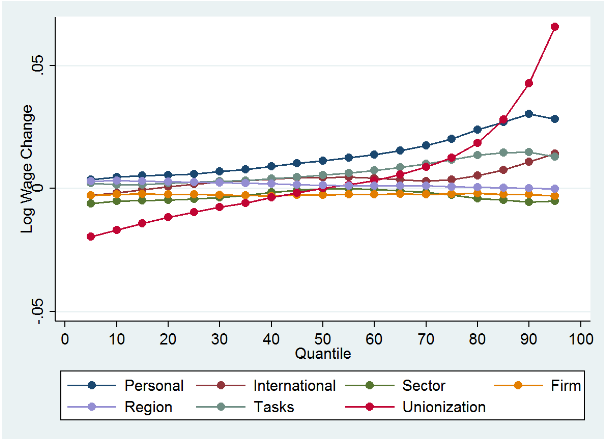


Figure A3 – Wage structure effects 1995-2001

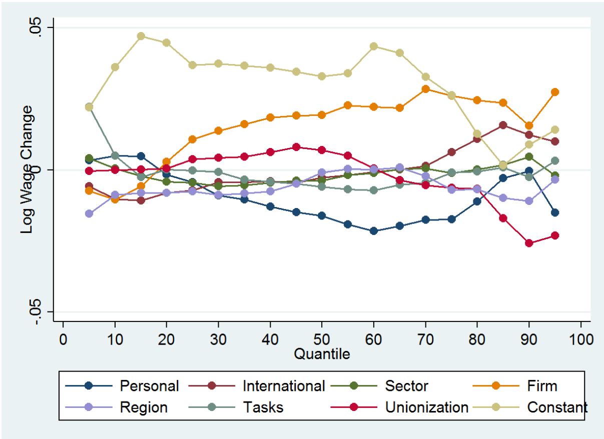


Figure A4 – Aggregate decomposition 2001-2006

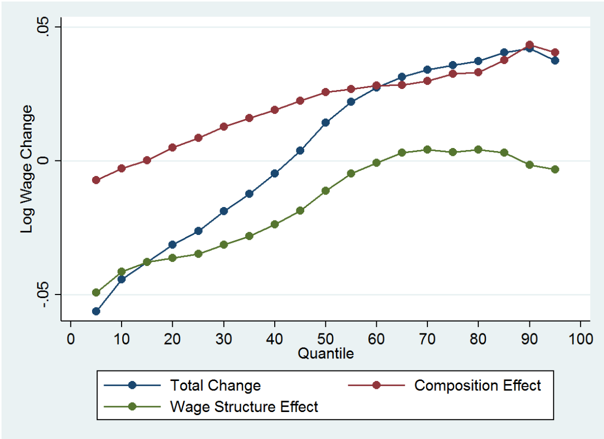


Figure A5 – Composition effects 2001-2006

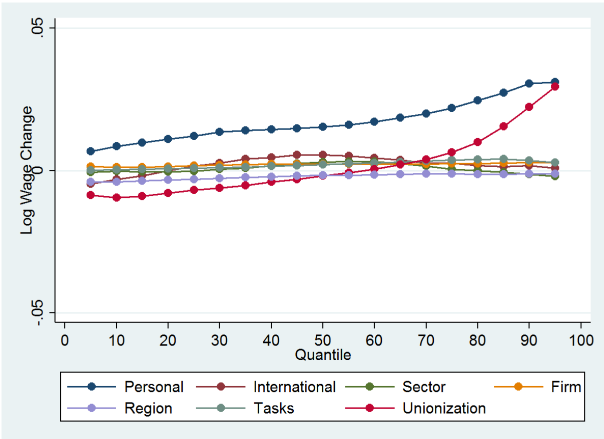


Figure A6 – Wage structure effects 2001-2006

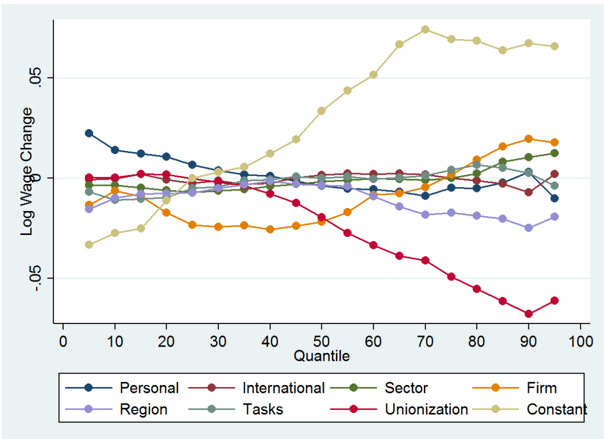


Figure A7 – Aggregate decomposition 2006-2010

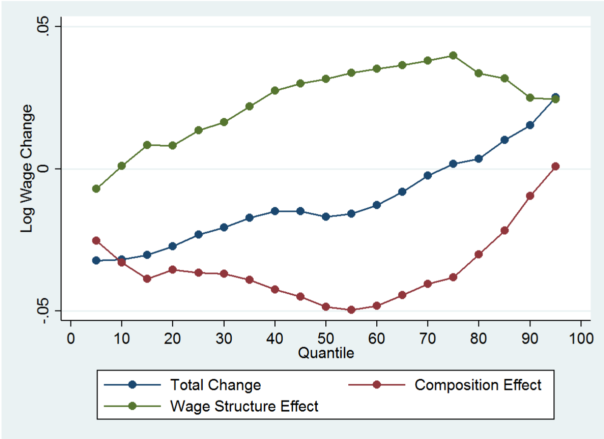


Figure A8 – Composition effects 2006-2010

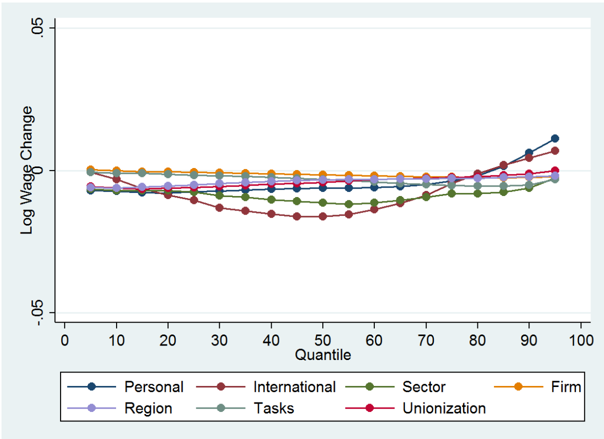


Figure A9 – Wage structure effects 2006-2010

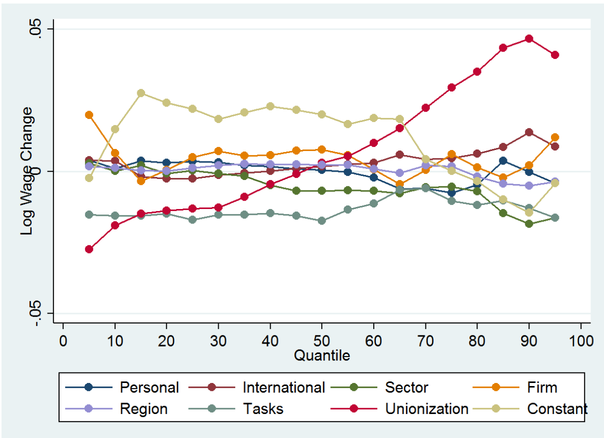


Table A5 – RIF-Decomposition sub-period 1995-2001

Inequality measure	90-10	90-50	50-10	Gini	Log Variance	99-90	99-95	95-90
Total change	9.01***	4.10***	4.91***	1.85***	2.24***	3.96***	3.44***	0.52
	(0.81)	(0.72)	(0.45)	(0.17)	(0.19)	(1.23)	(1.12)	(0.33)
Total composition	10.77***	7.10***	3.67***	2.55***	2.86***	1.29***	-0.91*	2.20***
	(0.65)	(0.47)	(0.34)	(0.16)	(0.18)	(0.55)	(0.47)	(0.21)
Personal	2.56***	1.90***	0.66***	0.54***	0.60***	-0.71***	-0.52***	-0.19*
	(0.24)	(0.19)	(0.10)	(0.06)	(0.06)	(0.22)	(0.15)	(0.10)
International	1.27***	0.64***	0.63***	0.25***	0.29***	-0.12	-0.45***	0.33***
	(0.27)	(0.19)	(0.12)	(0.06)	(0.07)	(0.14)	(0.13)	(0.09)
Sector	-0.04	-0.54***	0.49***	-0.01	0.02	0.11	0.09	0.03
	(0.18)	(0.16)	(0.19)	(0.04)	(0.04)	(0.17)	(0.14)	(0.07)
Firm	0.00	0.01	-0.02	0.01	0.01	0.22	0.28	-0.05
	(0.11)	(0.07)	(0.13)	(0.02)	(0.03)	(0.15)	(0.15)	(0.03)
Region	-0.32*	-0.13	-0.19	-0.07*	-0.08	-0.14***	-0.12**	-0.02
	(0.19)	(0.08)	(0.15)	(0.04)	(0.05)	(0.05)	(0.05)	(0.03)
Tasks	1.33***	0.94***	0.39***	0.30***	0.32***	-0.19	-0.01	-0.18***
	(0.23)	(0.17)	(0.06)	(0.05)	(0.05)	(0.12)	(0.09)	(0.06)
Unionization	5.97***	4.27***	1.70***	1.53***	1.70***	2.10***	-0.18	2.28***
	(0.41)	(0.30)	(0.14)	(0.10)	(0.11)	(0.33)	(0.29)	(0.18)
Total wage structure	-1.58**	-2.83***	1.25***	-0.15	-0.15	4.71***	3.78***	0.93**
	(0.69)	(0.66)	(0.43)	(0.16)	(0.19)	(1.29)	(1.17)	(0.43)
Personal	-0.54	1.57	-2.10***	-0.33	-0.47*	-4.60**	-3.13	-1.47*
	(1.05)	(1.01)	(0.45)	(0.24)	(0.28)	(1.96)	(1.93)	(0.83)
International	2.26***	1.50**	0.75	0.45***	0.53***	-0.41	-0.18	-0.23
	(0.74)	(0.69)	(0.50)	(0.17)	(0.20)	(0.97)	(0.89)	(0.38)
Sector	0.42	0.83	-0.42	0.08	0.05	-0.26	0.41	-0.67*
	(0.69)	(0.69)	(0.47)	(0.13)	(0.15)	(0.85)	(0.66)	(0.40)
Firm	2.58	-0.38	2.96	0.61	0.80	3.76	2.58	1.18
	(2.23)	(1.76)	(2.00)	(0.42)	(0.56)	(2.55)	(2.36)	(0.90)
Region	-0.23	-1.01	0.79	0.02	0.13	0.40	-0.35	0.75**
	(0.84)	(0.75)	(0.64)	(0.17)	(0.21)	(0.87)	(0.79)	(0.34)
Tasks	-0.76	0.34	-1.10*	-0.04	-0.23	-0.30	-0.88	0.58
	(0.90)	(0.75)	(0.60)	(0.20)	(0.25)	(1.27)	(1.19)	(0.57)
Unionization	-2.59**	-3.29***	0.69	-0.55**	-0.65**	1.22	0.95	0.27
	(1.03)	(1.01)	(0.67)	(0.26)	(0.30)	(0.98)	(0.68)	(0.76)
Constant	-2.71	-2.39	-0.32	-0.39	-0.31	4.90	4.38	0.52
	(2.66)	(2.42)	(2.33)	(0.57)	(0.77)	(4.07)	(3.64)	(1.37)
Specification error	-0.16	0.20	-0.37	-0.53***	-0.46***	-1.92***	0.58	-2.50***
	(0.41)	(0.38)	(0.23)	(0.07)	(0.08)	(0.65)	(0.72)	(0.32)
Reweighting error	-0.01	-0.36*	0.35***	-0.02	-0.01	-0.12	-0.01	-0.11
	(0.25)	(0.19)	(0.12)	(0.05)	(0.06)	(0.19)	(0.14)	(0.08)

Source: Structure of Earnings Surveys 1995, 2001, 2006, 2010 and own calculations.

Log wage differentials×100. Bootstrapped standard errors clustered at establishment level in parentheses (100 replications).

***/**/* statistically significant at 1%/5%/10%-level

Table A6 – RIF-Decomposition sub-period 2001-2006

Inequality measure	90-10	90-50	50-10	Gini	Log Variance	99-90	99-95	95-90
Total change	8.63***	2.77***	5.87***	1.74***	2.56***	0.82	1.28	-0.45
	(1.25)	(1.21)	(0.68)	(0.23)	(0.29)	(1.27)	(1.09)	(0.41)
Total composition	6.56***	3.42***	3.14***	1.35***	1.72***	-0.11	-0.63	0.52**
	(0.79)	(0.68)	(0.39)	(0.19)	(0.22)	(0.54)	(0.42)	(0.21)
Personal	2.23***	1.53***	0.68***	0.51***	0.62***	0.08	0.04	0.04
	(0.25)	(0.21)	(0.10)	(0.06)	(0.06)	(0.22)	(0.20)	(0.09)
International	0.49***	-0.37*	0.86***	0.00	0.06	-0.60*	-0.52*	-0.08
	(0.16)	(0.22)	(0.18)	(0.04)	(0.04)	(0.33)	(0.29)	(0.09)
Sector	-0.10	-0.43**	0.33*	-0.03	-0.01	-0.09	-0.02	-0.07
	(0.12)	(0.20)	(0.20)	(0.03)	(0.03)	(0.28)	(0.23)	(0.07)
Firm	0.17	0.06	0.11	0.03	0.04	-0.06	-0.06	0.00
	(0.22)	(0.06)	(0.20)	(0.03)	(0.04)	(0.24)	(0.21)	(0.04)
Region	0.28	0.05	0.23	0.04	0.07	0.04	0.03	0.01
	(0.24)	(0.08)	(0.23)	(0.04)	(0.06)	(0.12)	(0.10)	(0.04)
Tasks	0.34	0.16	0.18	0.07	0.09	-0.08	0.00	-0.08**
	(0.22)	(0.11)	(0.11)	(0.05)	(0.06)	(0.08)	(0.06)	(0.04)
Unionization	3.19***	2.43***	0.76***	0.73***	0.85***	0.59***	-0.12	0.71***
	(0.56)	(0.44)	(0.14)	(0.13)	(0.15)	(0.21)	(0.15)	(0.15)
Total wage structure	4.72***	1.86*	2.85***	1.12***	1.65***	0.90	0.86	0.04
	(1.18)	(1.08)	(0.55)	(0.22)	(0.28)	(1.01)	(0.95)	(0.33)
Personal	-1.09	0.70	-1.79***	-0.48**	-1.00***	-3.23	-1.91	-1.32
	(1.05)	(0.91)	(0.48)	(0.21)	(0.26)	(2.29)	(1.92)	(0.84)
International	-0.69	-0.87*	0.18	0.04	0.06	2.28*	1.38	0.91**
	(0.85)	(0.49)	(0.64)	(0.17)	(0.24)	(1.19)	(1.10)	(0.37)
Sector	1.40*	1.23*	0.18	0.34*	0.41*	-0.41	-0.60	0.19
	(0.81)	(0.71)	(0.55)	(0.18)	(0.23)	(0.84)	(0.73)	(0.40)
Firm	2.59	4.15**	-1.56	0.66	0.89	-0.70	-0.51	-0.19
	(2.22)	(1.90)	(1.93)	(0.50)	(0.66)	(2.20)	(1.75)	(1.12)
Region	-1.51*	-2.15***	0.64	-0.19	-0.35	2.55***	1.98**	0.57*
	(0.83)	(0.73)	(0.69)	(0.18)	(0.24)	(0.98)	(0.85)	(0.31)
Tasks	1.35	0.26	1.09*	0.21	0.18	-0.08	0.50	-0.62
	(0.87)	(0.74)	(0.59)	(0.16)	(0.21)	(1.24)	(1.19)	(0.57)
Unionization	-6.82***	-4.83***	-1.99**	-1.41***	-1.83***	2.02	1.36	0.66
	(1.89)	(1.57)	(1.00)	(0.40)	(0.50)	(1.27)	(0.85)	(0.82)
Constant	9.48***	3.37	6.10**	1.96***	3.28***	-1.49	-1.34	-0.15
	(2.84)	(2.40)	(2.73)	(0.62)	(0.82)	(4.70)	(3.99)	(1.64)
Specification error	-1.93***	-1.64***	-0.29	-0.52***	-0.58***	0.45	1.27**	-0.82***
	(0.43)	(0.45)	(0.18)	(0.07)	(0.09)	(0.70)	(0.64)	(0.28)
Reweighting error	-0.72***	-0.89***	0.17	-0.22***	-0.23***	-0.42***	-0.22**	-0.20***
	(0.22)	(0.18)	(0.11)	(0.05)	(0.06)	(0.13)	(0.10)	(0.07)

Source: Structure of Earnings Surveys 1995, 2001, 2006, 2010 and own calculations.

Log wage differentials×100. Bootstrapped standard errors clustered at establishment level in parentheses (100 replications).

***/**/* statistically significant at 1%/5%/10%-level

Table A7 – RIF-Decomposition sub-period 2006-2010

Inequality measure	90-10	90-50	50-10	Gini	Log Variance	99-90	99-95	95-90
Total change	4.72***	3.23***	1.50*	1.04***	1.44***	2.62**	1.64	0.98**
	(1.16)	(1.27)	(0.91)	(0.22)	(0.29)	(1.24)	(1.08)	(0.46)
Total composition	2.44***	3.94***	-1.50***	0.86***	0.90***	3.32***	1.87***	1.45***
	(0.67)	(0.72)	(0.59)	(0.16)	(0.20)	(0.72)	(0.53)	(0.29)
Personal	1.35***	1.23***	0.12	0.39***	0.47***	1.42***	0.93***	0.49***
	(0.33)	(0.26)	(0.15)	(0.07)	(0.09)	(0.18)	(0.13)	(0.07)
International	0.76**	2.06***	-1.30***	0.30***	0.26***	0.29	0.04	0.25
	(0.35)	(0.36)	(0.31)	(0.07)	(0.09)	(0.40)	(0.33)	(0.16)
Sector	0.09	0.53*	-0.44	0.11**	0.11	1.17***	0.81***	0.36***
	(0.24)	(0.28)	(0.35)	(0.05)	(0.07)	(0.36)	(0.26)	(0.13)
Firm	-0.24	-0.09	-0.15	-0.05**	-0.07**	-0.02	-0.03	0.01
	(0.16)	(0.16)	(0.27)	(0.02)	(0.03)	(0.31)	(0.22)	(0.10)
Region	0.39	0.10	0.29	0.06	0.09	-0.05	-0.09	0.04
	(0.30)	(0.10)	(0.27)	(0.04)	(0.07)	(0.09)	(0.09)	(0.03)
Tasks	-0.41*	-0.19	-0.22**	-0.07	-0.11	0.21**	0.03	0.19***
	(0.22)	(0.13)	(0.10)	(0.05)	(0.07)	(0.09)	(0.07)	(0.05)
Unionization	0.50**	0.29**	0.21**	0.12**	0.16***	0.28**	0.18**	0.11***
	(0.21)	(0.14)	(0.09)	(0.05)	(0.06)	(0.11)	(0.08)	(0.04)
Total wage structure	1.87**	0.05	1.82***	0.38***	0.68***	1.21	0.63	0.58
	(0.87)	(0.69)	(0.65)	(0.14)	(0.21)	(1.62)	(1.44)	(0.56)
Personal	-0.12	-0.08	-0.05	0.09	-0.06	0.89	1.29	-0.40
	(1.28)	(1.15)	(0.61)	(0.27)	(0.34)	(2.10)	(2.01)	(1.05)
International	1.01	1.21*	-0.21	0.10	0.16	-1.58	-1.07	-0.51
	(0.75)	(0.68)	(0.55)	(0.16)	(0.21)	(1.73)	(1.44)	(0.72)
Sector	-1.85*	-1.16	-0.69	-0.43	-0.60*	-1.65	-1.86	0.21
	(1.06)	(1.00)	(0.70)	(0.27)	(0.34)	(1.80)	(1.31)	(0.83)
Firm	-0.44	-0.56	0.12	0.01	0.06	0.45	-0.53	0.98
	(2.40)	(1.85)	(1.76)	(0.41)	(0.62)	(1.83)	(1.56)	(0.96)
Region	-0.63	-0.73	0.10	-0.07	-0.13	0.29	0.13	0.16
	(0.86)	(0.77)	(0.80)	(0.17)	(0.25)	(0.93)	(0.79)	(0.37)
Tasks	0.27	0.45	-0.17	0.04	-0.01	-0.58	-0.24	-0.34
	(1.06)	(0.87)	(0.70)	(0.22)	(0.30)	(1.67)	(1.60)	(0.58)
Unionization	6.56***	4.37***	2.19**	1.39***	1.97***	-0.13	0.44	-0.57
	(1.55)	(1.28)	(1.01)	(0.40)	(0.52)	(2.20)	(1.70)	(0.78)
Constant	-2.93	-3.46	0.53	-0.75	-0.71	3.51	2.46	1.05
	(4.02)	(3.00)	(2.49)	(0.84)	(1.14)	(5.71)	(4.82)	(1.97)
Specification error	-0.10	-0.04	-0.06	-0.17	-0.22	-0.62	-0.21	-0.41
	(0.64)	(0.55)	(0.38)	(0.11)	(0.15)	(0.98)	(0.91)	(0.38)
Reweighting error	0.52	-0.72**	1.23***	-0.03	0.08	-1.28***	-0.65***	-0.63***
	(0.36)	(0.29)	(0.26)	(0.07)	(0.10)	(0.21)	(0.20)	(0.12)

Source: Structure of Earnings Surveys 1995, 2001, 2006, 2010 and own calculations.

Log wage differentials×100. Bootstrapped standard errors clustered at establishment level in parentheses (100 replications).

***/**/* statistically significant at 1%/5%/10%-level