EUROPEAN CENTRAL BANK
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WAGE DYNAMICS NETWORK

WORKING PAPER SERIES
NO 1268 / NOVEMBER 2010

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EVIDENCE FROM LINKED EMPLOYER-EMPLOYEE DATA

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In 2010 all ECB publications feature a motif taken from the €500 banknote.

1 This paper originated from the Wage Dynamics Network (WDN) project. We thank our WDN colleagues, especially Rebekka Christopoulou, Juan F. Jimeno and Ana Lamo. We would also like to thank Statistics Austria for granting us access to the Structure of Earnings Survey and especially Tamara Geisberger for her help with the data. We benefited considerably from comments by Rudolf Winter-Ebmer and three anonymous referees. The views expressed in this paper do not necessarily reflect those of the Oesterreichische Nationalbank or the Eurosystem.

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Wage Dynamics Network

This paper contains research conducted within the Wage Dynamics Network (WDN). The WDN is a research network consisting of economists from the European Central Bank (ECB) and the national central banks (NCBs) of the EU countries. The WDN aims at studying in depth the features and sources of wage and labour cost dynamics and their implications for monetary policy. The specific objectives of the network are: i) identifying the sources and features of wage and labour cost dynamics that are most relevant for monetary policy and ii) clarifying the relationship between wages, labour costs and prices both at the firm and macro-economic level.

The WDN is chaired by Frank Smets (ECB). Giuseppe Bertola (Università di Torino) and Julián Messina (World Bank and University of Girona) act as external consultants and Ana Lamo (ECB) as Secretary.

The refereeing process of this paper has been co-ordinated by a team composed of Gabriel Fagan (ECB, chairperson), Philip Vermeulen (ECB), Giuseppe Bertola, Julián Messina, Jan Babecký (CNB), Hervé Le Bihan (Banque de France) and Thomas Mathä (Banque centrale du Luxembourg).

The paper is released in order to make the results of WDN research generally available, in preliminary form, to encourage comments and suggestions prior to final publication. The views expressed in the paper are the author's own and do not necessarily reflect those of the ESCB.

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ISSN 1725-2806 (online)

CONTENTS

Abstract

Analyzing data from the Structure of Earnings Surveys we find that wage dispersion in Austria increased marginally between 1996 and 2002. There was an increase in the returns to education which accrued only to male workers. The positive effects of tenure and especially of experience on wages decreased over time. We adopt the Machado-Mata (2005) counterfactual decomposition technique which allows to attribute changes in each wage decile to changes in worker and workplace characteristics and into changes in returns to these characteristics. Behind the small net increase in inequality we document a number of interesting gross effects that influence the wage distribution. We find that both composition effects due to gender, education and age and market-driven effects such as changes in returns and changing workplace characteristics contributed to a higher dispersion of wages.

Keywords: Wage structure, quantile regression, Machado-Mata decomposition
JEL classification: J22, J31

Non-technical summary:

Analyzing the Structure of Earnings Survey data for Austria of 1996 and 2002 we are able do discuss changes in the Austrian wage distribution using a rich high-quality data set. We observe that the Austrian wage distribution has been remarkably stable between both survey years compared to other European countries in the same period. Wage dispersion increased, but only to a small extent and only below the median whereas it was practically stable above it.

OLS Mincer wage regressions indicate that there was - on average - an increase of the returns to education over time. This increase, however, benefited only male workers whereas women experienced lower returns to education in 2002 compared to 1996. The effects of tenure and especially of experience on wages decreased over time. We also find that, over the period analyzed here, females had an unchanged conditional (i. e. after controlling for a variety of individual and job specific characteristics) pay gap of 17%.

We estimate quantile regressions to study the impact of observable factors throughout the wage distribution. Returns to education increased mainly in the upper half of the distribution. Looking separately at male and female workers, we find that this gain accrued mainly to male workers with wages above the median. Females, on the other hand, had quite strong decreases in educational returns over time (though their returns were still higher than those of men).

Building on the coefficients from the quantile regressions, we adopt the Machado-Mata counterfactual decomposition technique which allows us to decompose wage changes in each wage decile into changes in workers' and workplace characteristics and changes in the returns of these characteristics which we divide further in "predetermined composition" changes and "market-driven" effects.

We find that the small increase in the overall wage dispersion in Austria between 1996 and 2002 was due to both composition and market-driven effects. Behind the small overall change there are a number of interesting gross effects. Most notably, the higher female labor market participation increased wage dispersion in the bottom half of the wage distribution (relative to median wages) whereas the increase in educational attainment increased wages in the top half. As regards "market-driven" effects, changes in returns to experience had an equalizing effect (through decreasing returns more at higher deciles than at lower ones). Returns to education, on the other hand, contributed to higher wage dispersion, ceteris paribus. Finally, whereas changing returns to occupational characteristics made the wage distribution more equal returns to private ownership counteracted this effect.

1 Introduction

Changes in the structure of wages have attracted a lot of attention in the last two decades. Almost all countries have experienced increases in wage dispersion (most commonly measured by the 90-10 percentile ratio) since the late 1970s, though to differing degrees and with different time patterns. This process seems to have proceeded until recently. For the underlying causes a couple of explanations have been put forward. The most prominent approach is the hypothesis of skill-biased technical change (SBTC). The SBTC hypothesis contends that technological change has caused changes in the relative demand for skills, towards the more skilled increasing the returns to education of more skilled workers. Lately, SBTC has been amended by the concept of "routinization" where increased inequality is not so much the result of changes in the returns to education and experience but of job tasks that can be routinized and thus more easily performed by machines or outsourced. Competing and complementing explanations include the influence of increased international trade, the role of institutions, immigration and changing pay norms.[1]

Changes in wage dispersion may also occur because the workforce grows older, because more women enter the labor force and because the overall educational attainment level increases over time. These effects are not related to immediate changes in market conditions, but are largely predetermined because they are the effects of long-run demographic forces, of a secular trend of women participating in market work or of a trend towards higher education. (See Lemieux, 2006 and Autor, Katz and Kearney, 2005 for a discussion of these effects in the U. S.) It is this "pre-determinedness" that makes composition effects distinct from "market-driven" changes like changes in returns to personal characteristics or effects of changing workplaces. Distinguishing between composition and market-driven effects may thus shed light on the development of wage dispersion.[2]

The literature on wage inequality is mainly focused on the U.S. experience. Comparable European studies are rare, one exception being Martins and Pereira (2004). In Austria, there are studies on the evolution of returns to education for the period from 1981 until 1997 (Fersterer, 2000 and Fersterer and Winter-Ebmer, 2003); an update of these results for 1999 – 2005 can be found in Steiner, Schuster and Vogtenhuber (2007). Much of the rest of the discussion about the Austrian wage structure and wage inequality has focused solely on descriptive statistics or on inter-industry wage differentials (see, for example, Pollan, 2008). Another important question

[1]This literature is too voluminous to be adequately quoted here. See the surveys of Machin and Van Reenen (2008), Lemieux (2008), Goldin and Katz (2007), and Atkinson (2008).

[2]Of course, institutions may impact on both composition and market effects.

is the appropriateness and reliability of data. Earnings and wage data[3] do suffer from insufficient comparability over time and between countries. As concerns hourly wages, working time information is regarded as particularly unreliable.

Thanks to the initiative of the Wage Dynamics Network (WDN) project, a research collaboration of European central banks, a new set of studies on wage changes between the mid-1990s and 2002 has recently become available (see the cross-country study of Christopoulou, Jimeno and Lamo, 2010). These projects use data from the European Structure of Earnings Survey (ESES), a harmonized firm survey on individual earnings which has many advantages over household surveys or administrative records that have mostly been adopted in previous research. These data do not only allow controlling for individual characteristics of workers but also for workplace characteristics such as industry or occupation.

The present study was conducted in the WDN and analyzes Austrian ESES data. Using quantile regressions and a decomposition technique developed by Machado and Mata (2005) we are able to relate changes in the wage distribution to changes in the characteristics of workers and to changes in the returns to these characteristics. In turn, we classify higher educational attainment, higher participation of women and the increased average age of the workforce as "pre-determined compositon" effects whereas we interpret the rest of the effects (mostly of workplace characterics and returns to personal and workplace characteristics) as "market-driven".

Compared to other European countries the Austrian wage structure remained quite stable. The small increase in wage dispersion between 1996 and 2002 is both due to composition and market-driven effects. Behind the small overall change in the wage distribution there are a number of interesting gross effects. Most notably, the higher labor market participation of women increased wage dispersion in the bottom half (relative to median wages) whereas the increase in educational attainment increased wages in higher deciles compared to the lowest deciles. As regards market-driven effects, changes in returns to experience had an equalizing effect (through decreasing returns more at higher deciles than at lower ones). Returns to education, on the other hand, contributed to higher wage dispersion, ceteris paribus.

The paper is structured as follows: Section 2 describes the data and shows descriptive statistics. Section 3 discusses the results of OLS and of quantile regression wage equations. Section 4 explains the Machado-Mata decomposition technique – which is based on the quantile regressions – and presents the results. Section 5 summarizes and concludes.

[3]The literatur uses a mixture of data on individual earnings (sometimes standardized, e. g. "full-year full-time earnings") and on hourly wages. See Atkinson (2008) for a discussion of data problems.

2 Data and Descriptive Analysis

2.1 The Structure of Earnings Survey

We use Austrian data from the European Structure of Earnings Survey. ESES is a firm survey on individual earnings which is collected periodically under EU regulation. The aim of ESES is to provide accurate and harmonized data on earnings in EU member states. The regulation also stresses the need of the single European monetary policy for information on the level and composition of labor costs and on the structure and distribution of earnings in order to assess the economic development in the member states. A substantial advantage of ESES vis à vis household surveys is the fact that the questions on earnings and hours are answered by employers and / or personnel managers and that earnings related information is partly matched with administrative data. Therefore, the wage data are more reliable than information from houshold surveys, where – for various reasons – the wage variable suffers from substantial measurement error. Moreover, our data allow us to include firm and workplaces characteristics as explanatory factors for wages which usually cannot be done with household survey data. Compared to administrative data like social security records, ESES earnings data do not suffer from top coding.

Our aim is to analyze wage changes between the first two ESES waves which were conducted in 1996 and 2002 by Statistics Austria. The data contain information on workers in firms with 10 or more employees in the private sector except agriculture (ÖNACE sections C–K). Workers are selected in a two-stage sampling procedure. In the following, we describe the gathering of the 2002 survey data. (In 1996, procedures were different in several respects. See section 2.2.)

Firms are drawn from a random sample stratified by NUTS[4] 1 region, firm size and industry whereby Statistics Austria's enterprise register served as the sampling frame. From all firms with at least 10 workers, approximately 34% were drawn to gather firm and detailed worker information. In these firms, individual workers are selected by simple random sampling whereby the share of all workers in a firm is inversely related to firm size: In the smallest size class (10–19 workers) each worker is selected whereas in the biggest size category (1000 workers or more) every 80th worker is chosen.

Basic firm information is available from the enterprise register. In the questionnaire sent to firms, these have to complement firm data with respect to ownership information (public or private sector) and the type of collective agreement that applies (if any). For the selected workers (indicated by their social security identifier) firms have to provide the following information:

[4]NUTS (Nomenclature des Unités Territoriales Statistiques) is the EU regional classification. At the NUTS 1 level, Austria comprises the following regions: Eastern, Southern and Western Austria.

Entry date, career interruptions (e. g. parental leave), normal full-time and normal actual working time, holiday entitlement, days of absence in the reference year, contract type (temporary vs. permanent contracts), occupation. More detailed earnings information has to be given on a reference month (which normally is October): Total hours of work, hours related to overtime work, earnings for normal hours and overtime work and or weekend / shift work. Other data (such as basic information like gender and age as well as annual earnings and formal education) are taken from registers maintained by Statistics Austria.[5]

From the data collected in the reference month we compute two alternative hourly wage variables: (1) A broader wage measure which equals gross total earnings, including the sum of overtime earnings and pemium payments for shift work, divided by total paid hours (including overtime and absence hours paid at full rate) and (2) a narrow wage measure which is defined by total gross earnings and premium payments for shift work divided by total paid hours net of overtime hours. The difference between both measures is thus whether overtime earnings and hours are considered or not. 2002 wages are converted into real 1996 wages. From the information on education we compute mandatory years of education for each worker following Fersterer (2000).

These data are not easily available for economic research. However, Statistics Austria granted us access. Due to data protection concerns, however, we were not able to access the data directly. Instead, we had a Statistics Austria contact person run Stata programs and check the associated output for possible violations of data protection legislation.

2.2 Differences between ESES 1996 and 2002

Both surveys differ in several respects. In the following, we describe these differences and discuss how to overcome the associated problems.[6] The 1996 survey focuses exclusively on "core" employees who kept their employment relationship for the whole year, except for sectors that are characterized by high seasonal employment fluctuations (above all tourism and construction). In contrast, in 2002 all workers who were employed in the reference month are sampled in the survey. For this reason, the share of employees in the data not working for the firm over the course of the total reporting year

[5] More detailed information can be found in Statistik Austria (2006) and in a number of articles in Statistik Austria's monthly periodical "Statistische Nachrichten" in the following issues: 12/1998, 4/1999, 5/1999, 8/1999 (all on the 1996 survey) and 6/2005 (on the 2002 survey).

[6] For more details on differences between the two surveys see Statistik Austria: "Standard-Dokumentation, Metainformationen zur Verdienststrukturerhebung 2002", 31 March, 2006 available from `http://www.statistik.at`. Comparibility problems are not confined to the Austrian Survey alone. A Eurostat report titled "Structure of Earnings Survey 2002 - Quality Report" from May 2006 contains an overview.

was only 6% in 1996 but 24% in 2002 where the concept of employment was defined more comprehensively. Another, related difference is that the earlier survey captures only standard employment contracts which means that "minor jobs" *("geringfügig Beschäftigte")* are not covered in 1996.[7] In contrast, in the 2002 data, about 4% of all workers are in such mini jobs.

We try to make the two datasets as comparable as possible by focusing only on those employees who are "core" employees with certainty, i. e. we restrict our dataset to (i) *full-year* workers who were in (ii) *standard contracts* (which implies excluding minor jobs). This has the consequence that we disregard a substantial number of observations from both surveys, considerably more so from the second one. Another difficulty is that the definition of the part-time variable and the sampling weights have changed between the surveys. We account for this by not regarding the part-time dummy as an explanatory variable and by using unweighted data.

There are further differences: As regards the 1996 survey, all data stem from the firm questionnaires. In 2002, as described, some variables are taken from administrative data. It is likely that the administrative data are less error-prone. Also, the sampling of workers was different in the first survey: Whereas for 2002 firms had to provide information for pre-selected workers they could choose themselves for which workers to indicate that information (only the requested number of employees was given) for 1996. Finally, the sampling frame in 2002 was based on enterprises but it was establishments in 1996. It is difficult to say whether these differences affect the data and how – if yes – one could account for them. Certainly, this constitutes a problem of comparability. However, the remarkable similarity of the wage distributions in both surveys documented below – despite the differences how the data were gathered – makes us confident that the comparison across ESES waves is meaningful.

2.3 Sample Selection and Descriptive Statistics

As described, we restrict our samples to workers that conform to the concept of "core employees" in both years. Because of possible outliers we also drop observations below the first and above the 99th wage percentile. Furthermore, we disregard apprentices and persons below (above) the age of 16 (65) years. Finally, we have to disregard some sectors[8] consisting of a small number of firms because of Statistics Austria's view that the coefficients of the dummies for these sectors in wage regressions might reveal sensitive information on individual firms and thus violating data protection legislation.[9]

[7] Minor jobs in Austria are jobs where the salary is below an earnings threshold (which was some EUR 270/month in 1996.

[8] The omitted sectors comprise the NACE codes 10 (coal mining), 11 (oil production), 13 (iron ore mining), 16 (tobacco products) and 61 (shipping).

[9] Because of these data protection concerns the corresponding coefficients were deleted in the output. This would have made our decomposition analysis (described in section 4) impossible. Hence the decision to leave out these sectors altogether.

This leaves us with 93,702 employees in 1996 and 85,404 employees in 2002. Table 1 shows the number of firms and employees in the survey dataset in the raw data and in the estimating sample finally used.

(Table 1 about here)

Table 2 displays summary statistics of our data. Between 1996 and 2002, the average base hourly wage increased from 9.92 Euro to 11.53 Euro, and the average broader hourly wage measure increased from 10.39 Euro to 11.84 Euro. This corresponds to nominal (real) increases of 16.1% (6.3%) and 13.9% (4.3%), respectively. Like in most other countries we see an inceasing trend in female labor force participation: The proportion of female employees increased by 5.3 percentage points from 1996 to 2002. The average age of employees increased by 1.3 years while the average length of tenure with the current employer decreased by 0.4 years. Educational attainment measured by average years of schooling increased by 0.3 years. The proportion of employees who had completed tertiary education increased from 7.6% in 1996 to 8.9% in 2002 (not shown).

(Table 2 about here)

Turning to workplace characteristics, table 2 reveals that a growing share of workers was employed in smaller firms (e.g. 45% of workers worked in 2002 for firms with fewer than 25 employees (39% in 1996)) and that the fraction of private-sector employees in the data increased from some 93% to 97%. With respect to the regional distribution, the share of workers in Eastern Austria increased slightly, whereas the share of Southern Austrian employees declined; Western Austria's share was stable.

Before we proceed to describing changes in the wage structure, some words on the Austrian labor market and the macroeconomic situation in both survey years. The cyclical position was quite similar: According to Eurostat, the unemployment rate was 4.3 and 4.2% in 1996 and 2002, respectively. Unemployment was also increasing in both years compared to the previous year. According to OeNB estimations the output gap was slightly negative (1% in 1996 and 0.4% in 2002). Hence, we do not expect that our comparison is distorted by differing macroeconomic circumstances. In the period considered here, the share of non-farm private employees in total dependent employment was stable at 70%. The employment rate of males of 76.4% in 2002 was above the average of the EU member countries at that time, but stagnant. Female employment was with 61.3% above average, too, and on the rise.

Austria has been a distinctively corporatist country with strong roles for employer and worker associations in both wage bargaining and labor market policy. However, the long-term decline in union membership that can be observed in all industrialized countries has happened also to the country: Union density was 40.1% in 1996 and 35.4% in 2002 which is higher than in Anglo-Saxon countries but lower than in Scandinavia. Union coverage remained unaffected: It used to be (and still is) more than 95% (Visser, 2006).

2.4 Changes in the Wage Structure

Because of the data restrictions described above and because of the limited sectoral coverage one should be cautious about interpreting our results as describing changes in *the* wage distribution in Austria. For example, the focus on "core" employees will in all likelihood underestimate wage inequality in a given cross section and will probably miss some of the the growth in wage inequality that is typically associated with an increasing share of the workfoce in non-standard ("atypical") work contracts. This has to be borne in mind when interpreting the following results.

`(Figure 1 about here)`

To capture changes in the wage distribution apart from shifts in mean wages figure 1 displays demeaned kernel density plots of the log wage distributions in 1996 and 2002, respectively. Panel (a) of the figure shows the distribution according to the broader wage measure. It is surprising how stable the wage distribution has been between both survey years: The graphs representing the 1996 distribution (black line) and the 2002 distribution (gray line) almost entirely overlap. Panel (b) of the graph shows the distribution according to the narrow wage measure. The result is very similar. For this reason, from now on, we restrict our presentation of results to the broader wage measure.[10]

The distribution of the 2002 survey has slightly less mass at the center and slightly more mass at the tails indicating a small increase in wage inequality. This is confirmed by table 3 which shows basic indicators characterizing the wage distributions. As indicated by the coefficient of variation

[10]Our choice of this measure against the other can be justified by the fact that this is the wage measure that could be computed for all countries for which similar analyses were conducted within the WDN (see Christopoulou et al., 2010). As table 2 shows means and standard deviations for both wage definitions don't differ much. Moreover, the regression and decomposition results are very similar for both wage measures. A full set of results for the alternative wage variable is available from the authors upon request.

and the Gini coefficient, there has been a slight increase in wage inequality between 1996 and 2002.

(Table 3 about here)

In the literature wage inequality is usually discussed with respect to the ratios of the 10th, the 50th, and the 90th percentile (p10, p50, and p90), respectively. These are given in table 3, together with the first and the third quartile as well with the first and the last percentile (p1 and p99). Increases of nominal wages between the two surveys were higher in the upper half of the distribution, though somewhat lower at the 90th percentile than at the median. The p90/p10 ratio rose from 2.57 to 2.61.

The table further indicates that the increase in overall inequality occured rather at the lower half of the distribution: The p90/p50 measure even decreased slightly whereas the ratio of median wages to those at the bottom increased. Rising wage dispersion due to a deterioration of low wages relative to median wages can be observed in other continental European countries, too (cf. Christopoulou et al., 2010) but not in the U. S. where wage inquality rose primarily above median wages since the beginning of the 1990s (cf. Goldin and Katz, 2008).[11]

Our results are in line with the tabulations for Austria in Part III.B in the book by Atkinson (2008) which contains detailed country results on the evolution of the earnings distribution in OECD countries. Both social security data (table B.6 in Atkinson) and earnings tax data (table B.9) indicate a slight increase in the overall earnings dispersion as well as higher earnings growth above the median.

3 Wage Regressions

3.1 OLS Regressions

To assess labor market returns of workers' characterictics we perform Mincer-type regressions for 1996 and 2002, where log real wages are regressed on individual-specific and workplace-specific variables. We use two different specifications. Model 1, stated in (1), is a standard Mincer wage equation which includes personal characteristics like age (i. e. potential experience as a proxy for actual work experience which is not available), age squared, tenure (i. e. years of service with the current employer), tenure squared, the

[11]These usual measures miss what is going on at the very top and the very bottom end of the distribution. One noteworthy result of table 3 is that the wages at the top (the 99th percentile) increased considerably faster than the rest of the distribution (+18% compared to 14% on average). That top incomes rise much faster than, say, incomes at the 90th percentile was also found for Anglo-Saxon countries (cf. Piketty and Saez, 2006).

minimum years of education implied by highest completed level of education, and a dummy for holding a vocational degree. This regression model is fitted for males and females separately but also for the whole data set including an additional gender dummy.

$$\ln w_{it} = \alpha_t + \sum_{j=1}^{j_1} \beta_{jt} X_{jit} + \varepsilon_{it} \tag{1}$$

w_{it} represents the log real hourly wage of individual i in year t, X is a vector of $x_1, ..., x_{j_1}$ observable personal characteristics, α is a constant, β is a vector of parameters to be estimated and ε is the stochastic error. Model 2 (equation (2)) includes in addition several workplace-specific dummies $x_{j_1+1}, ..., x_J$ for the employee's occupation (ISCO 1) within the firm, the sector (NACE-2 digits) of the employer, for firm size and location (NUTS-1 digits), and a control for private ownership of the firm.

$$\ln w_{it} = \alpha_t + \sum_{j=1}^{j_1} \beta_{jt} X_{jit} + \sum_{j=j_1+1}^{J} \beta_{jt} X_{jit} + \varepsilon_{it} \tag{2}$$

When estimating (2) instead of (1) one has to be cautious because the regression results are purely descriptive. Especially the industry and occupation dummies are potential outcome measures. Therefore the returns to schooling (and the other human capital variables) should not be interpreted as causal effects on wages. Following other papers using similar data our wage regressions are carried out with unweighted data. It is not easy to decide whether in survey data analysis regressions should be weighted or not, cf. Deaton (1997). So, given the different calculation of weights in the 1996 and 2002 ESES data (see section 2.2) we chose to follow the practice of the literature.

Moreover, one has to bear in mind that, as the data cover only those workers that are actually employed, our coefficients may be biased due to sample selection. Fersterer (2000) has investigated the extent of the sample selection bias for 1981 – 1997 in Austrian labor force survey data and found that the bias is not large although he had a twofold selection problem – non-reporting of income and the decision whether to participate or not – whereas the ESES data are only affected by the latter problem. Finally, we are not able to control for unobserved heterogeneity of workers (e. e. differences in the ability to learn or in social skills) which may lead to biased coefficients in wage regressions.

`(Table 4 about here)`

Table 4 shows the OLS regression results for models 1 and 2, for all workers, males and females separately for 1996 and 2002, respectively. Using the full sample including both males and females, the OLS estimates of model 1 exhibit – for both years – a highly significant and virtually unchanged gender pay difference (measured by the female dummy) of about 17%. That difference is rather robust and does not change much when the additional explanatory variables are included (model 2). The returns to years of schooling have increased slightly over time: Whereas in 1996 each additional statutory year of education yielded on average a wage increase of 6.0%, it was 7.1% in 2002.[12] When controlling for workplace characteristics by running regression model 2, the effects of education on wages are much smaller, but the returns are still increasing over time.

These results indicate that the decline in returns to schooling in Austria observed by Fersterer and Winter-Ebmer (2003) in the 1980s and early 1990s has not continued.[13] In contrast to Fersterer and Winter-Ebmer and Steiner et al. (2007) our results mean that an additional year of education pays considerably more for women than for men in both survey years. This holds regardless of the survey year and the regression model chosen. However, the overall increase in returns to schooling over time appears to have accrued only to men: Returns to education for males have risen by about 1.5 percentage points between 1996 and 2002 while female workers' returns declined by half a percentage point.

Returns to tenure decreased only a little over time. The impact of age[14] on wages was reduced, confirming the earlier trend documented by Fersterer and Winter-Ebmer (2003). Age proxies actual experience whereby it will overstate expercience more for women than for men, thus biasing down the age coefficients for females. The typical result in the literature therefore is that the returns to (potential) experience are lower for women than for men. This is confirmed by the results for model 1 in table 4. According to model 2, however, the age coefficients are practically the same for men and women. This indicates that after accounting for the choice of different sectors and occupations there are no gender difference in returns to potential experience. Furthermore, it is noteworthy, that the age effect decreased more for males than for females between both survey years.

[12] Strictly speaking, in our specification with age as explanatory variable, the returns to education are not simply equal to the coefficient of the years of schooling, but equal to $\beta_1 + \beta_2 + 2\beta_3\bar{a}$ where β_1 is the coefficient of formal education, β_2 is the coefficient of age, β_3 is the coefficient of age squared and $\bar{a}$ is the mean of age. If one computes the returns to education like this the increase over time for all workers is 0.9 instead of 1.1 percentage points.

[13] A comparison of our results is problematic because we regress gross wages whereas Fersterer and Winter-Ebmer refer to net wages. Steiner et al. (2007) run wage regressions for both gross and net wages for the period from 1999 to 2005 and find that returns to education in 2002 are higher than in the preceding years.

[14] The effects of the squared terms are negligibly small.

3.2 Quantile Regressions

Theory as well as existing empirical studies suggest that the effect of the explanatory variables changes across the distribution of wages. As our ultimate goal is to get a better understanding of the underlying causes of changes in the wage distribution we run quantile regressions for each decile of the distribution:

$$\ln w_{it}^{\vartheta} = \alpha_t^{\vartheta} + \sum_{j=1}^{J} \beta_{jt} X_{jit}^{\vartheta} + \varepsilon_{it}^{\vartheta}, \tag{3}$$

where ϑ refers to the deciles of the wage distribution. We estimate (3) only including the workplace-specific regressors, i. e. model 2. Figures 2 to 4 display the quantile coefficients for education, age and tenure graphically on the same scale.[15]

`(Figures 2 to 4 about here)`

Figure 2 indicates that the returns to education go up with the wage level. The increase over time occured mainly in the top wage deciles and happened only to men. For women, however, returns to education *de*creased more in higher than in lower deciles. Figure 3 shows that returns to potential experience were fairly stable over the wage distribution in 2002 after they decreased somewhat more for higher wages. The changes for female workers are more mixed: Returns decreased in the lower half of the wage distribution while increasing slightly in the upper half. Figure 4 finally indicates that returns to tenure go down with the level of wages. The small decrease over time took place more or less in all deciles, and it was somewhat more pronounced for female workers.

4 Decomposition of Changes in the Wage Distribution

4.1 The Machado-Mata Method

We want to relate the distributional changes to changes in the composition of the work force and changes of the compensation of different groups within the work force. In doing so, we follow the approach of Machado and Mata (2005). The analysis relies on the quantile regression results of the extended Mincer equation stated in (3) above. Given these estimates, we decompose the change between the 1996 and 2002 log wage distributions into a part

[15]The full set of regression results can be found in the appendix in tables A.1 and A.2.

that is due to changes in labor market characteristics and a part that is due to changes in the returns to these characteristics. This involves decomposing the differences between two counterfactual densities: first, the wage density corresponding to the 1996 distribution of characteristics with returns held constant at 2002 levels, and, second, the wage density corresponding to the 2002 distribution of labor market characteristics with returns constant at 1996 levels. The important contribution of Machado and Mata (2005) was to extend the Blinder-Oaxaca technique so that it can be performed for each quantile:[16]

$$\begin{aligned}\ln \bar{w}_{02}^{\vartheta} - \ln \bar{w}_{96}^{\vartheta} &= \left(\alpha_{02}^{\vartheta} - \alpha_{96}^{\vartheta}\right) + \sum_{j} \left(\beta_{j02}^{\vartheta} - \beta_{j96}^{\vartheta}\right) \bar{X}_{j96}^{\vartheta} \\ &\quad + \sum_{j} \beta_{j02}^{\vartheta} \left(\bar{X}_{j02}^{\vartheta} - \bar{X}_{j96}^{\vartheta}\right) + \left(\bar{\varepsilon}_{02}^{\vartheta} - \bar{\varepsilon}_{96}^{\vartheta}\right) \qquad (4)\end{aligned}$$

where $\bar{X}_{jt}^{\vartheta}$ is the vector of mean characteristics of decile ϑ in year t and $\bar{\varepsilon}_{t}^{\vartheta}$ is the mean of the unobserved component. In both years, we have only one observation for each decile, therefore we approximate the mean values for $\bar{X}_{jt}^{\vartheta}$ by bootstrapping as suggested by Albrecht, Björklund and Vroman (2003). This involves the following steps:

1. A random sample of 100 observations is drawn for each year.
2. The drawn observations are ordered by wages so that each observation represents one percentile of the wage distribution.
3. This procedure is repeated for 500 times and the averages for each decile are computed.

The terms on the right-hand side of the equation above can be interpreted as follows: Under the assumption that worker and workplace characteristics remained unchanged, $\left(\alpha_{02}^{\vartheta} - \alpha_{96}^{\vartheta}\right)$ is due to changes in the returns to unobserved features common among employees and/or due to changes in the returns to the reference categories (of categorial variables). $\sum_j \left(\beta_{j02}^{\vartheta} - \beta_{j96}^{\vartheta}\right) \bar{X}_{j96}^{\vartheta}$ is due to changes in the returns to observable worker and workplace characteristics.

$\sum_j \beta_{j02}^{\vartheta} \left(\bar{X}_{j02}^{\vartheta} - \bar{X}_{j96}^{\vartheta}\right)$ represents wage changes that would have occured because of changes in observable characteristics if the returns to these characteristics had remained unchanged. Characteristics effects may be the result of (largely) predetermined changes in the composition of education, age and gender of the labor force or they may reflect adjustments to economic

[16] Autor et al. (2005) show that the Machado Mata method is superior to or generalizes earlier approaches in the literature.

developments (e. g. sectoral shifts, changes in the distribution of occupations and changes in the regional distribution). Finally, $\left(\bar{\varepsilon}^{\vartheta}_{02} - \bar{\varepsilon}^{\vartheta}_{96}\right)$ is due to changes in the remaining unobserved effects (which are not common among employees). The validity of these decompositions relies on the partial equilibrium assumption that prices and quantities can be seen as independent (cf. Autor et al., 2005).

Following Christopoulou et al. (2010) we make the following distinction: (i) *predetermined composition effects* reflect changes in the gender composition, changes in the age structure and changes in education of the workforce. Predetermined composition effects thus are the sum of characteristics effects of gender, age and educational attainment.[17] (ii) *Market-driven effects*, on the other hand, are all other effects, i. e. years of tenure and the returns to worker and workplace characteristics. Although the distinction may be subject to some controversy because female employment, schooling decisions and the age structure of the population may also be regarded as the result of market decisions they probably differ from the other factors in the extent that markets play a role and that they are more long-run. One should also note that both market-driven and composition effects may considerably be incluenced by institutional factors.

4.2 Decomposition Results

The results of this decomposition excercise are shown in Table 5. Because we are primarily interested on the effects on the total wage distribution we focus only on the results for all workers shown in panel (a) of the table. To economize on space, we do not show the results for single variables for the market-driven effects but only categories like individual and workplace characteristics and the associated returns.[18] For completeness, separate results for male and female workers are displayed in panels (b) and (c). We are especially interested whether explanatory variables have an equalizing effect (by increasing the wage in the lowest deciles relative to the top and/or to the median) or whether they contribute to a higher wage dispersion (by lowering bottom wages relative to the top and/or the median). While on average the contributions of all the explanatory factors tend to cancel out each other – hence, the small change in the overall wage dispersion – there is still a number of interesting gross effects at work.

(Table 5 about here)

[17] For the decomposition we aggregated the effects of minimum years of education and vocational training as educational attainment.

[18] More detailed decomposition results are contained in the appendix in tables A.3 – A.5.

How did predetermined changes in the composition of the workforce affect the evolution of the wage distribution? The fourth line of panel (a) in table 5 indicates that, altogether, they contributed slightly to the increase of wage inequality by decreasing wages in bottom deciles relative to the median and by increasing wages in the higher deciles (with the exception of the top decile). A more detailed look at the single factors (see table A.3 in the appendix) reveals that the gender composition effect is particularly strong in the bottom four deciles and that higher education increased wages in the higher deciles relative to the bottom. These effects are mitigated, however, by changes in the age composition of the workforce. The increase in age had a slightly equalizing effect on the wage distribution by increasing wages in bottom deciles relative to the top.

Turning to total market-driven effects, we see that these increased wage dispersion especially at the top and the bottom deciles. Again, there are different patterns in the sub-components. The reduction in the average tenure of the workforce lowered top wages, thus making the distribution of wages more equal. (This is due to the fact that returns to tenure decrease with the wage level.) On the other hand, changing workplace characteristics increased wage dispersion. This is the sum of the effects of changes in the dummies for occupation, sector, size-class, region and private ownerwhip (see the appendix) whereby the individual effects are small and show no clear trends. Total individual returns don't have a large impact on the wage distribution, but a look at the single components reveals interesting details: As we have seen (figure 3) returns to experience declined over time, but more so at the top deciles. Leaving everything else constant, this reduces wage dispersion. In contrast, higher returns to education in the top deciles (figure 2) increased wage dispersion. Finally, the sum of returns to workplace characteristics has no clear-cut effect on the wage distribution. As regards the contribution of the single influence factors (again, see the appendix) one finds a decrease of returns to occupations in the top half of the distribution relative to the bottom which is counteracted by the effect of the returns to private ownership which increased top wages relatively more.

How do our results compare to those of other European countries in the same period? Christopoulou et al. (2010) conclude that pre-determined compositional effects did not play a major role in the (mostly larger) changes of the wage structure. However, they find a considerably role of market-driven changes in other countries.

What about the theoretical explanations that were mentioned at the beginning? As we find increasing returns to education although the supply of skills has also increased we cannot reject the SBTC hypothesis. However, as these gains accrued only to male workers, other factors must be at work, too. As far as other potential factors like immigration are concerned, the limitation of our data does not make a more detailed investigation possible. The cross-country comparison performed in Christopoulou et al. (2010)

suggests that wage changes are related to technology, increased internationalization and immigration whereas the role of changes in institutions remains unclear.

5 Summary and Conclusions

Analyzing the Structure of Earnings Survey data for Austria of 1996 and 2002 we are able do discuss changes in the Austrian wage distribution using a rich high-quality data set. We observe that the Austrian wage distribution has been remarkably stable between both survey years compared to other European countries in the same period. Wage dispersion increased, but only to a small extent and only below the median whereas it was practically stable above it.

OLS Mincer wage regressions indicate that there was – on average – an increase of the returns to education over time. This increase, however, benefited only male workers whereas women experienced lower returns to education in 2002 compared to 1996. The effects of tenure and especially of experience on wages decreased over time. We also find that, over the period analyzed here, females had an unchanged conditional (i. e. after controlling for a variety of individual and job specific characteristics) pay gap of 17%. We estimate quantile regressions to study the impact of observable factors throughout the wage distribution. Returns to education increased mainly in the upper half of the distribution. Looking separately at male and female workers, we find that this gain accrued mainly to male workers with wages above the median. Females, on the other hand, had quite strong decreases in educational returns over time (though their returns were still higher than those of men).

Building on the coefficients from the quantile regressions, we adopt the Machado-Mata counterfactual decomposition technique which allows us to decompose wage changes in each wage decile into changes in workers' and workplace characteristics and changes in the returns of these characteristics which we divide further in "predetermined composition" changes and "market-driven" effects. We find that the small increase in the overall wage dispersion in Austria between 1996 and 2002 was due to both composition and market- driven effects. Behind the small overall change there are a number of interesting gross effects. Most notably, the higher female labor market participation increased wage dispersion in the bottom half of the wage distribution (relative to median wages) whereas the increase in educational attainment increased wages in the top half. As regards "market-driven" effects, changes in returns to experience had an equalizing effect (through decreasing returns more at higher deciles than at lower ones). Returns to education, on the other hand, contributed to higher wage dispersion, ceteris paribus. Finally, whereas changing returns to occupational characteristics made the wage distribution more equal returns to private ownership counteracted this effect.

The future will provide researchers with more data from the Structure of Earnings Survey, both by expanding the time dimension and by increasing the sectoral coverage. In our view, these data can become a rich source for for a better understanding of the longer-term development of the wage distribution in Austria.

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Appendix. Tables

Table 1: Raw and estimation data

		no. of employers	no. of workers
1996	raw data	8,020	121,926
	estimation data	7,843	93,702
	share of raw data	97.8%	76.9%
2002	raw data	10,036	140,155
	estimation data	9,778	85,404
	share of raw data	97.4%	60.9%

Table 2 : Summary statistics

	1996 mean	1996 s. d.	2002 mean	2002 s. d.	diff. of means 2002–1996
wage (narrow measure):	(at current prices)				
male workers	10.473	4.243	12.320	5.056	1.847
female workers	8.781	3.445	10.227	4.387	1.446
all	9.920	4.078	11.525	4.919	1.605
wage (broader measure):	(at current prices)				
male workers	11.104	4.269	12.751	5.070	1.647
female workers	8.925	3.473	10.357	4.427	1.432
all	10.393	4.154	11.841	4.973	1.448
individual worker characteristics:					
age (years)	37.000	10.262	38.348	10.079	1.348
tenure (years)	9.510	8.438	9.115	8.426	–0.395
education (years)	10.380	2.001	10.675	2.051	0.295
vocational degree (dummy)	0.093		0.035		–0.058
female (dummy)	0.327		0.380		0.053
workplace characteristics (dummies):					
ISCO 1 (legislators, senior officials and managers)	0.040		0.042		0.002
ISCO 2 (professionals)	0.012		0.019		0.007
ISCO 3 (technicians and associate professionals)	0.107		0.086		–0.021
ISCO 4 (clerks)	0.234		0.275		0.041
ISCO 5 (service workers and shop and market sales workers)	0.086		0.126		0.040
ISCO 7 (craft and related trades workers)	0.268		0.224		–0.043
ISCO 8 (plant and machine operators and assemblers)	0.129		0.085		–0.044
ISCO 9 (elementary occupations)	0.126		0.143		0.018
NACE C (mining)	0.017		0.008		–0.009
NACE D (manufacturing)	0.470		0.338		–0.132
NACE E (utilities)	0.023		0.012		–0.012
NACE F (construction)	0.079		0.117		0.038
NACE G (wholesale and retail trade)	0.072		0.204		0.133
NACE H (tourism)	0.063		0.053		–0.010
NACE I (transport and communication)	0.087		0.083		–0.004
NACE J (financial services)	0.129		0.076		–0.053
NACE K (real estate, business services)	0.049		0.110		0.061
NUTS 1 (Eastern Austria)	0.358		0.399		0.042
NUTS 2 (Southern Austria)	0.248		0.207		–0.041
NUTS 3 (Western Austria)	0.394		0.394		0.000
no. of employees ≤ 25	0.387		0.451		0.064
25 < no. of employees ≤50	0.235		0.243		0.008
50 < no. of employees ≤100	0.146		0.104		–0.042
100 < no. of employees ≤ 250	0.119		0.093		–0.025
250 < no. of employees ≤ 500	0.052		0.050		–0.002
500 < no. of employees ≤ 1000	0.025		0.027		0.002
no. of employees > 1000	0.037		0.033		–0.004
private sector	0.929		0.967		0.038
observations		93,702		85,404	

Table 3: Basic indicators for the wage distribution in 1996 and 2002

	1996	2002	abs. or rel. (%) change
mean hourly wage (at current prices)	10.39	11.84	13.9%
std. dev.	4.15	4.92	0.765
coefficient of variation	0.40	0.42	0.016
p1	4.93	5.55	12.7%
p10	6.25	7.01	12.1%
p25	7.52	8.47	12.7%
p50	9.34	10.66	14.1%
p75	12.14	13.78	13.5%
p90	16.05	18.27	13.8%
p99	24.44	28.83	18.0%
p90/p10	2.567	2.606	0.039
p90/p50	1.718	1.714	–0.004
p50/p10	1.495	1.520	0.025
Gini coefficient	0.209	0.214	0.005

Note: Statistics are given for the broad wage measure as defined in the text.

Table 4: OLS regression results

	1996						2002					
	model 1			model 2			model 1			model 2		
	all workers	males	females	all workers	males	females	all workers	males	females	all workers	males	females
years of education	0.060 [0.001]***	0.051 [0.001]***	0.086 [0.001]***	0.026 [0.000]***	0.023 [0.001]***	0.038 [0.000]***	0.071 [0.001]***	0.066 [0.001]***	0.079 [0.001]***	0.029 [0.000]***	0.026 [0.000]***	0.033 [0.000]***
vocational degree	0.121 [0.003]***	0.166 [0.004]***	0.003 [0.006]	0.012 [0.003]***	0.013 [0.003]***	–0.006 [0.004]	0.064 [0.006]***	0.056 [0.008]***	0.068 [0.008]***	0.016 [0.004]***	–0.003 [0.006]	0.032 [0.006]***
age	0.028 [0.001]***	0.030 [0.001]***	0.023 [0.001]***	0.028 [0.000]***	0.028 [0.000]***	0.028 [0.000]***	0.017 [0.001]***	0.019 [0.001]***	0.016 [0.001]***	0.026 [0.001]***	0.026 [0.000]***	0.026 [0.001]***
age squ. /100	–0.027 [0.001]***	–0.029 [0.001]***	–0.022 [0.001]***	–0.028 [0.001]***	–0.028 [0.000]***	–0.028 [0.001]***	–0.015 [0.001]***	–0.016 [0.001]***	–0.014 [0.001]***	–0.025 [0.001]***	–0.026 [0.001]***	–0.025 [0.001]***
tenure	0.014 [0.000]***	0.012 [0.000]***	0.017 [0.001]***	0.010 [0.000]***	0.009 [0.000]***	0.011 [0.000]***	0.012 [0.0001***	0.010 [0.000]***	0.014 [0.001]***	0.009 [0.000]***	0.008 [0.000]***	0.009 [0.000]***
tenure squ. /100	–0.007 [0.001]***	–0.006 [0.001]***	–0.003 [0.002]	–0.006 [0.001]***	–0.005 [0.001]***	0.001 [0.001]	–0.003 [0.001]**	–0.002 [0.001]	0.005 [0.002]*	–0.006 [0.001]***	–0.006 [0.001]***	0.001 [0.001]
female dummy	–0.167 [0.002]***	no	no	–0.168 [0.002]***	no	no	–0.166 [0.002]***	no	no	–0.167 [0.002]***	no	no
regional dummies	no	no	no	yes	yes	yes	no	no	no	yes	yes	yes
sectoral dummies	no	no	no	yes	yes	yes	no	no	no	yes	yes	yes
occupational dummies	no	no	no	yes	yes	yes	no	no	no	yes	yes	yes
firm size dummies	no	no	no	yes	yes	yes	no	no	no	yes	yes	yes
constant	0.946 [0.013]***	0.992 [0.017]***	0.571 [0.021]***	1.748 [0.014]***	1.803 [0.017]***	1.440 [0.023]***	1.089 [0.015]***	1.113 [0.019]***	0.845 [0.023]***	1.830 [0.014]***	1.868 [0.019]***	1.624 [0.024]***
R^2 adjusted	0.38	0.31	0.39	0.58	0.54	0.58	0.33	0.26	0.31	0.55	0.51	0.54
observations	93,702	63,091	30,611	93,702	63,091	30,611	85,404	52,944	32,460	85,404	52,944	32,460

Notes: Robust standard errors in brackets. Dependent variable: log hourly wages (according to the broad measure as defined in the text). * significant at 10%; ** significant at 5%; *** significant at 1%. Female dummy coefficients were transformed by $\exp(\beta_{female}) - 1$.

Table 5: Results of the Machado-Mata decomposition

	decile								
	1	2	3	4	5	6	7	8	9
	(a) all workers								
observed log wage change	0.027	0.033	0.037	0.041	0.045	0.043	0.040	0.040	0.042
explained by regression	0.008	0.029	0.034	0.033	0.045	0.043	0.064	0.049	0.043
residual	0.019	0.004	0.003	0.008	–0.001	0.000	–0.024	–0.009	–0.001
predetermined composition effects	–0.002	–0.004	0.004	–0.004	0.009	0.010	0.010	0.020	–0.007
age composition	0.013	0.012	0.014	0.008	0.009	0.006	–0.003	0.006	–0.003
educational attainment	0.004	0.008	0.003	0.002	0.009	0.012	0.015	0.012	0.002
gender composition	–0.019	–0.024	–0.014	–0.014	–0.009	–0.008	–0.002	0.002	–0.006
market-driven effects	0.010	0.033	0.030	0.037	0.037	0.033	0.054	0.029	0.050
tenure characteristics	0.000	0.001	0.002	–0.009	–0.007	–0.007	–0.005	–0.008	–0.012
workplace characteristics	–0.023	–0.007	–0.012	0.004	0.010	0.009	0.024	0.003	0.020
individual returns	–0.020	–0.046	–0.040	–0.038	–0.052	–0.029	–0.017	–0.034	–0.055
workplace returns	–0.010	–0.033	–0.021	–0.015	–0.037	–0.042	–0.029	–0.034	–0.028
constant	0.064	0.119	0.103	0.094	0.123	0.102	0.081	0.102	0.126
	(b) male workers								
observed log wage change	0.042	0.048	0.053	0.055	0.053	0.052	0.049	0.049	0.047
explained by regression	0.033	0.049	0.048	0.061	0.070	0.056	0.068	0.061	0.056
residual	0.010	–0.001	0.005	–0.006	–0.017	–0.004	–0.019	–0.013	–0.009
predetermined composition effects	0.012	0.012	0.007	0.015	0.019	0.017	0.024	0.014	0.017
age composition	0.007	0.008	0.005	0.012	0.006	0.011	0.012	0.006	0.001
educational attainment	0.005	0.004	0.002	0.003	0.013	0.006	0.013	0.009	0.017
market-driven effects	0.021	0.037	0.040	0.046	0.052	0.039	0.044	0.047	0.039
tenure characteristics	–0.001	0.000	–0.003	0.006	–0.004	0.004	0.002	–0.005	–0.005
workplace characteristics	–0.008	–0.003	0.001	0.000	0.025	–0.002	0.009	0.017	0.013
individual returns	0.044	–0.050	–0.048	–0.058	–0.044	–0.019	–0.016	–0.032	–0.023
workplace returns	0.014	–0.004	–0.001	–0.004	–0.015	–0.025	–0.023	–0.015	–0.029
constant	–0.027	0.094	0.090	0.102	0.090	0.081	0.071	0.082	0.083
	(c) female workers								
observed log wage change	0.058	0.048	0.046	0.049	0.053	0.056	0.056	0.051	0.058
explained by regression	0.070	0.065	0.046	0.043	0.054	0.078	0.036	0.063	0.056
residual	–0.012	–0.017	0.000	0.006	0.000	–0.022	0.020	–0.012	0.002
predetermined composition effects	0.021	0.026	0.020	0.016	0.014	0.015	0.013	0.024	0.019
age composition	0.011	0.016	0.015	0.018	0.010	0.009	0.007	0.006	–0.002
educational attainment	0.010	0.010	0.005	–0.002	0.004	0.006	0.005	0.018	0.021
market-driven effects	0.049	0.039	0.026	0.027	0.040	0.063	0.024	0.039	0.037
tenure characteristics	–0.002	0.001	0.008	0.003	–0.002	–0.002	–0.010	–0.001	–0.019
workplace characteristics	0.011	0.004	–0.013	–0.009	0.004	0.023	–0.010	–0.009	0.004
individual returns	–0.112	–0.082	–0.090	–0.076	–0.093	–0.102	–0.116	–0.101	–0.127
workplace returns	–0.087	–0.096	–0.066	–0.069	–0.062	–0.057	–0.075	–0.062	–0.046
constant	0.239	0.211	0.187	0.178	0.192	0.202	0.235	0.211	0.226

Figures

Figure 1: Demeaned wage distribution (according to the broader and the narrow measure) for all workers in 1996 and 2002

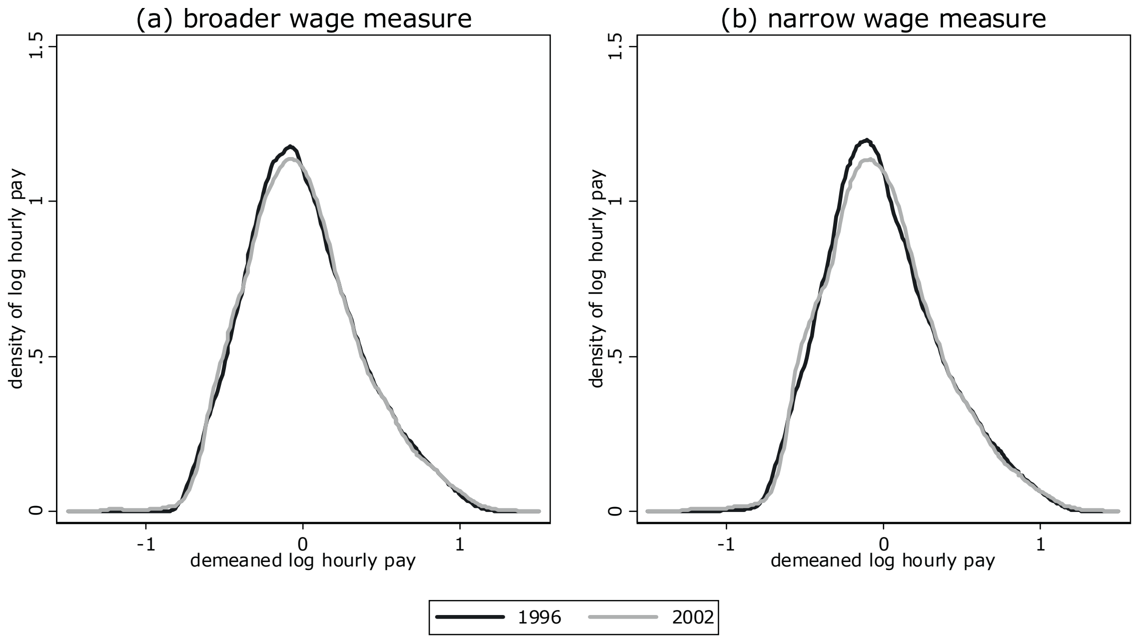
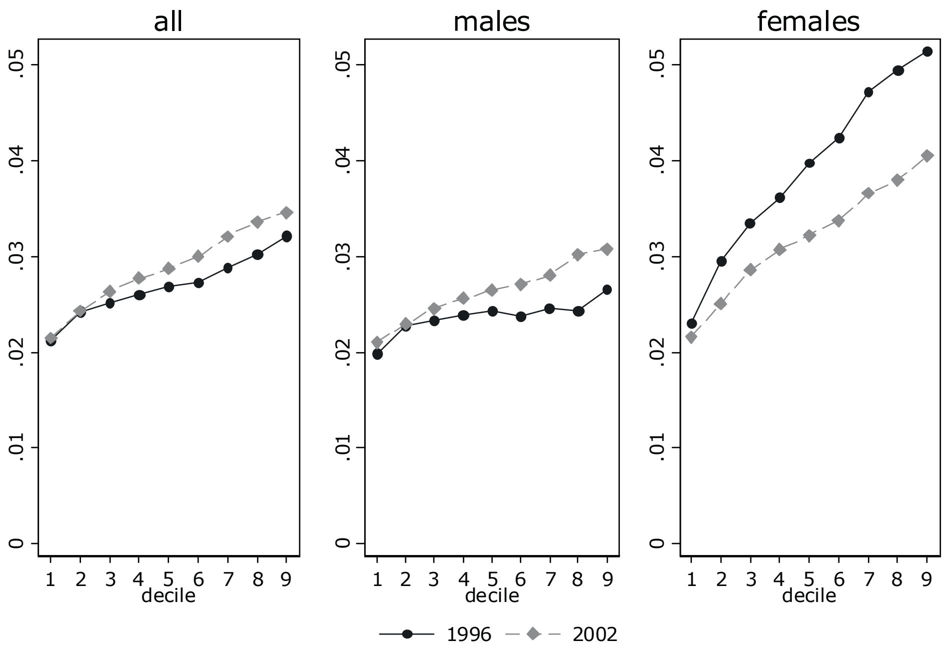
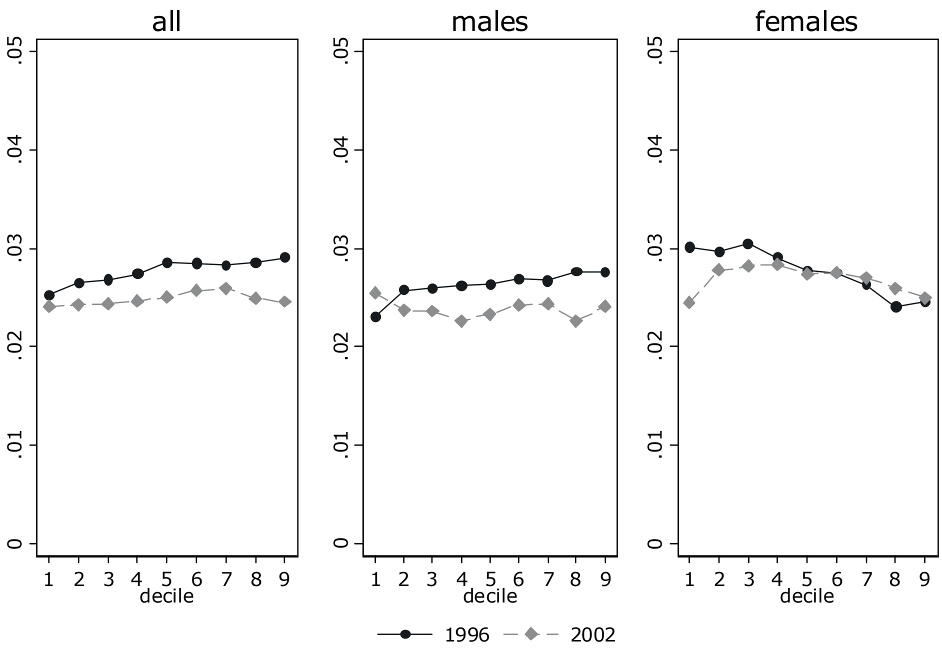


Figure 2: Quantile regression results – coefficients of years of education



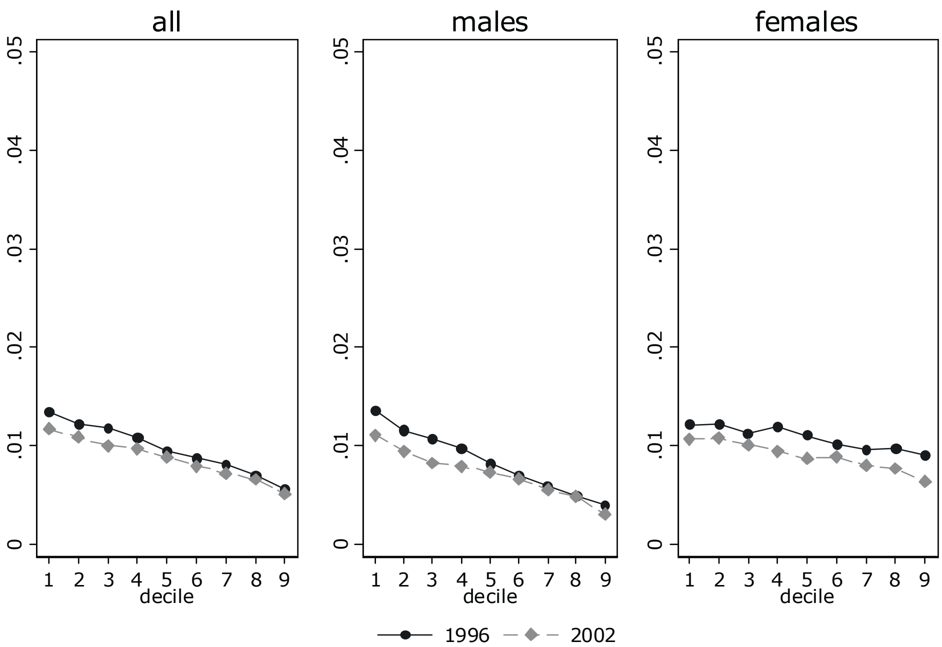
Notes: Coefficients of years of schooling (see the text).

Figure 3: Quantile regression results – coefficients of age (in years)



Notes: Only linear effects.

Figure 4: Quantile regression results – coefficients of years of tenure



Notes: Only linear effects.

Additional Tables

Table A.1: Quantile regression results 1996 (model 2)

Percentile	10	20	30	40	50	60	70	80	90
				(a) all workers					
years of education	0.021 [0.001]***	0.024 [0.001]***	0.025 [0.001]***	0.026 [0.001]***	0.027 [0.000]***	0.027 [0.001]***	0.029 [0.000]***	0.030 [0.001]***	0.032 [0.001]***
vocational degree	0.006 [0.004]	–0.004 [0.003]	–0.005 [0.003]	–0.004 [0.003]	–0.002 [0.003]	0.001 [0.004]	0.000 [0.003]	0.004 [0.004]	0.012 [0.005]**
age	0.025 [0.001]***	0.027 [0.001]***	0.027 [0.001]***	0.027 [0.001]***	0.029 [0.001]***	0.029 [0.000]***	0.028 [0.001]***	0.029 [0.001]***	0.029 [0.001]***
squared age/100	–0.029 [0.001]***	–0.029 [0.001]***	–0.029 [0.001]***	–0.029 [0.001]***	–0.029 [0.001]***	–0.029 [0.001]***	–0.027 [0.001]***	–0.027 [0.001]***	–0.026 [0.001]***
tenure	0.013 [0.000]***	0.012 [0.000]***	0.012 [0.000]***	0.011 [0.000]***	0.009 [0.000]***	0.009 [0.000]***	0.008 [0.000]***	0.007 [0.000]***	0.006 [0.001]***
squared tenure/100	–0.016 [0.001]***	–0.012 [0.001]***	–0.010 [0.001]***	–0.007 [0.001]***	–0.003 [0.001]***	–0.002 [0.001]	–0.001 [0.001]	0.001 [0.001]	0.003 [0.002]
female dummy	–0.142 [0.003]***	–0.154 [0.002]***	–0.161 [0.002]***	–0.166 [0.002]***	–0.171 [0.002]***	–0.177 [0.002]***	–0.180 [0.002]***	–0.185 [0.002]***	–0.187 [0.003]***
constant	1.499 [0.020]***	1.572 [0.016]***	1.658 [0.016]***	1.722 [0.014]***	1.754 [0.014]***	1.822 [0.015]***	1.883 [0.016]***	1.950 [0.020]***	2.031 [0.026]***
				(b) male workers					
years of education	0.020 [0.000]***	0.023 [0.000]***	0.023 [0.000]***	0.024 [0.000]***	0.024 [0.000]***	0.024 [0.000]***	0.025 [0.000]***	0.024 [0.000]***	0.027 [0.001]***
vocational degree	–0.004 [0.005]	–0.013 [0.004]***	–0.010 [0.004]**	–0.001 [0.004]	0.001 [0.004]	0.009 [0.004]**	0.009 [0.004]*	0.015 [0.005]***	0.020 [0.007]***
age	0.023 [0.001]***	0.026 [0.000]***	0.026 [0.000]***	0.026 [0.000]***	0.026 [0.000]***	0.027 [0.001]***	0.027 [0.000]***	0.028 [0.001]***	0.028 [0.001]***
squared age/100	–0.025 [0.001]***	–0.027 [0.001]***	–0.027 [0.001]***	–0.027 [0.001]***	–0.027 [0.001]***	–0.027 [0.001]***	–0.025 [0.001]***	–0.026 [0.001]***	–0.025 [0.001]***
tenure	0.014 [0.000]***	0.012 [0.000]***	0.011 [0.000]***	0.010 [0.000]***	0.008 [0.000]***	0.007 [0.000]***	0.006 [0.000]***	0.005 [0.000]***	0.004 [0.001]***
squared tenure/100	–0.019 [0.001]***	–0.013 [0.001]***	–0.011 [0.001]***	–0.008 [0.001]***	–0.004 [0.001]***	–0.001 [0.001]	0.001 [0.001]	0.002 [0.001]	0.003 [0.002]
constant	1.580 [0.024]***	1.631 [0.020]***	1.723 [0.018]***	1.782 [0.018]***	1.845 [0.019]***	1.904 [0.019]***	1.975 [0.021]***	2.046 [0.023]***	2.143 [0.031]***
				(c) female workers					
years of education	0.023 [0.001]***	0.030 [0.001]***	0.034 [0.001]***	0.036 [0.001]***	0.040 [0.001]***	0.042 [0.001]***	0.047 [0.001]***	0.049 [0.001]***	0.051 [0.001]***
vocational degree	0.017 [0.005]***	–0.010 [0.005]*	–0.019 [0.005]***	–0.023 [0.002]***	–0.030 [0.005]***	–0.036 [0.006]***	–0.032 [0.005]***	–0.037 [0.006]***	–0.021 [0.009]**
age	0.030 [0.001]***	0.030 [0.001]***	0.030 [0.001]***	0.029 [0.001]***	0.028 [0.001]***	0.028 [0.001]***	0.026 [0.001]***	0.024 [0.001]***	0.025 [0.001]***
Squared age/100	–0.035 [0.001]***	–0.033 [0.001]***	–0.034 [0.001]***	–0.031 [0.001]***	–0.028 [0.001]***	–0.027 [0.001]***	–0.024 [0.001]***	–0.021 [0.001]***	–0.020 [0.002]***
tenure	0.012 [0.000]***	0.012 [0.000]***	0.011 [0.000]***	0.012 [0.000]***	0.011 [0.000]***	0.010 [0.001]***	0.010 [0.000]***	0.010 [0.000]***	0.009 [0.001]***
squared tenure/100	–0.009 [0.002]***	–0.004 [0.002]*	0.002 [0.002]	0.002 [0.002]	0.005 [0.002]**	0.007 [0.002]***	0.009 [0.002]***	0.006 [0.002]**	0.005 [0.003]
constant	1.185 [0.030]***	1.219 [0.028]***	1.277 [0.025]***	1.352 [0.026]***	1.427 [0.025]***	1.468 [0.029]***	1.499 [0.028]***	1.623 [0.031]***	1.699 [0.044]***

Notes: Standard errors in brackets; dependent variable: log hourly wages. Independent variables also include regional, sectoral, occupational, and size dummies. * significant at 10%; ** significant at 5%; *** significant at 1%. Female dummy coefficients were transformed by $\exp(\beta_{female}) - 1$.

Table A.2: Quantile regression results 2002 (model 2)

Percentile	10	20	30	40	50	60	70	80	90
				(a) all workers					
years of education	0.021	0.024	0.026	0.028	0.029	0.030	0.032	0.034	0.035
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.001]***
vocational degree	–0.014	–0.008	0.004	0.013	0.018	0.014	0.018	0.026	0.043
	[0.006]**	[0.005]	[0.005]	[0.004]***	[0.005]***	[0.005]***	[0.005]***	[0.006]***	[0.008]***
age	0.024	0.024	0.024	0.025	0.025	0.026	0.026	0.025	0.025
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.001]***
squared age/100	–0.027	–0.026	–0.025	–0.025	–0.025	–0.025	–0.024	–0.022	–0.020
	[0.001]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.00!]***	[0.000]***	[0.001]***	[0.001]***
tenure	0.012	0.011	0.010	0.010	0.009	0.008	0.007	0.007	0.005
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
squared tenure/100	–0.013	–0.010	–0.008	–0.007	–0.005	–0.003	–0.001	–0.001	0.001
	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]**	[0.001]	[0.001]	[0.001]
female dummy	–0.135	–0.149	–0.159	–0.167	–0.173	–0.178	–0.185	–0.189	–0.197
	[0.003]***	[0.002]***	[0.002]***	[0.002]***	[0.002]***	[0.002]***	[0.002]***	[0.002]***	[0.004]***
constant	1.563	1.691	1.761	1.816	1.877	1.923	1.964	2.052	2.157
	[0.020]***	[0.017]***	[0.016]***	[0.014]***	[0.016]***	[0.017]***	[0.017]***	[0.020]***	[0.029]***
				(b) male workers					
years of education	0.021	0.023	0.025	0.026	0.027	0.027	0.028	0.030	0.031
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.001]***
vocational degree	–0.041	–0.015	–0.009	–0.004	–0.002	–0.001	0.003	0.002	0.015
	[0.009]***	[0.007]*	[0.006]	[0.007]	[0.006]	[0.006]	[0.007]	[0.009]	[0.011]
age	0.025	0.024	0.024	0.023	0.023	0.024	0.024	0.023	0.024
	[0.001]***	[0.001]***	[0.000]***	[0.001]***	[0.000]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***
squared age/100	–0.028	–0.025	–0.024	–0.022	–0.022	–0.023	–0.022	–0.019	–0.020
	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***
tenure	0.011	0.009	0.008	0.008	0.007	0.007	0.006	0.005	0.003
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
squared tenure/100	–0.013	–0.009	–0.006	–0.006	–0.005	–0.004	–0.002	–0.001	0.002
	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]	[0.001]	[0.002]
constant	1.553	1.725	1.813	1.884	1.935	1.985	2.046	2.128	2.226
	[0.028]***	[0.023]***	[0.019]***	[0.020]***	[0.019]***	[0.020]***	[0.023]***	[0.026]***	[0.035]***
				(c) female workers					
years of education	0.022	0.025	0.029	0.031	0.032	0.034	0.037	0.038	0.041
	[0.001]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.001]***	[0.001]***	[0.001]***
vocational degree	0.001	0.005	0.020	0.025	0.030	0.032	0.034	0.039	0.065
	[0.008]	[0.006]	[0.006]***	[0.006]***	[0.006]***	[0.007]***	[0.008]***	[0.009]***	[0.012]***
age	0.024	0.028	0.028	0.028	0.027	0.028	0.027	0.026	0.025
	[0.001]***	[0.000]***	[0.001]***	[0.000]***	[0.000]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***
Squared age/100	–0.028	–0.031	–0.031	–0.030	–0.028	–0.028	–0.026	–0.023	–0.020
	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.002]***	[0.002]***
tenure	0.011	0.011	0.010	0.009	0.009	0.009	0.008	0.008	0.006
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
squared tenure/100	–0.006	–0.003	0.001	0.003	0.007	0.007	0.008	0.008	0.009
	[0.002]**	[0.001]	[0.001]	[0.001]*	[0.001]***	[0.002]***	[0.002]***	[0.002]***	[0.003]***
constant	1.424	1.430	1.464	1.529	1.619	1.671	1.734	1.834	1.925
	[0.032]***	[0.023]***	[0.024]***	[0.023]***	[0.023]***	[0.026]***	[0.031]***	[0.033]***	[0.045]***

Notes: Standard errors in brackets; dependent variable: log hourly wages. Independent variables also include regional, sectoral, occupational, and size dummies. * significant at 10%; ** significant at 5%; *** significant at 1%. Female dummy coefficients were transformed by $\exp(\beta_{female}) - 1$.

Table A.3: Detailed decomposition results (all workers)

	quantile								
	10	20	30	40	50	60	70	80	90
observed log wage change	0.027	0.033	0.037	0.041	0.045	0.043	0.040	0.040	0.042
total characteristics effect	–0.025	–0.010	–0.007	–0.009	0.012	0.012	0.029	0.015	0.001
total coefficients effect (incl. constant)	0.034	0.039	0.041	0.042	0.034	0.031	0.035	0.033	0.043
explained by regression	0.008	0.029	0.034	0.033	0.045	0.043	0.064	0.049	0.043
residual	0.019	0.004	0.003	0.008	–0.001	0.000	–0.024	–0.009	–0.001
mechanical composition	–0.002	–0.004	0.004	–0.004	0.009	0.010	0.010	0.020	–0.007
market-driven	0.010	0.033	0.030	0.037	0.037	0.033	0.054	0.029	0.050
individual characterictics									
age	0.013	0.012	0.014	0.008	0.009	0.006	–0.003	0.006	–0.003
sex	–0.019	–0.024	–0.014	–0.014	–0.009	–0.008	–0.002	0.002	–0.006
education	0.004	0.008	0.003	0.002	0.009	0.012	0.015	0.012	0.002
tenure	0.000	0.001	0.002	–0.009	–0.007	–0.007	–0.005	–0.008	–0.012
workplace characteristics									
occupation	–0.015	–0.007	–0.003	0.011	0.010	0.009	0.020	0.012	0.014
sector	–0.008	0.003	–0.004	–0.004	0.012	0.004	0.004	–0.003	0.013
size	–0.003	–0.004	–0.006	–0.004	–0.010	–0.004	–0.004	–0.006	–0.010
region	0.003	0.002	0.001	0.004	–0.002	0.002	0.005	0.001	0.004
private ownership	–0.001	–0.001	–0.001	–0.002	–0.001	–0.001	–0.001	–0.001	–0.001
individual coefficients									
age	–0.019	–0.042	–0.044	–0.046	–0.065	–0.049	–0.042	–0.064	–0.073
education	0.001	0.000	0.013	0.018	0.020	0.030	0.036	0.040	0.034
sex	0.005	0.002	0.001	0.000	0.000	0.000	–0.002	–0.001	–0.002
tenure	–0.007	–0.007	–0.010	–0.010	–0.008	–0.009	–0.010	–0.008	–0.014
constant	0.064	0.119	0.103	0.094	0.123	0.102	0.081	0.102	0.126
workplace coefficients									
occupation	0.007	0.000	0.018	0.011	–0.011	–0.020	–0.019	–0.036	–0.044
sector	–0.034	–0.037	–0.038	–0.033	–0.035	–0.035	–0.032	–0.034	–0.030
size	0.007	0.004	0.002	0.004	0.006	0.007	0.011	0.014	0.021
region	–0.006	–0.004	–0.005	–0.005	–0.004	–0.007	–0.007	–0.006	–0.007
private ownership	0.016	0.005	0.001	0.009	0.007	0.013	0.018	0.028	0.032

Notes: Mechanical composition effects are individual characteristics (except tenure), market-driven effects are all other estimated effects (i. e. workplace and tenure coefficients and workplace characteristics).

Table A.4: Detailed decomposition results (male workers)

	quantile								
	10	20	30	40	50	60	70	80	90
observed log wage change	0.042	0.048	0.053	0.055	0.053	0.052	0.049	0.049	0.047
total coefficients effect (incl. constant)	0.031	0.040	0.042	0.040	0.031	0.037	0.032	0.035	0.031
total characteristics effect	0.002	0.009	0.006	0.021	0.039	0.019	0.036	0.026	0.026
explained by regression	0.033	0.049	0.048	0.061	0.070	0.056	0.068	0.061	0.056
residual	0.010	–0.001	0.005	–0.006	–0.017	–0.004	–0.019	–0.013	–0.009
mechanical composition effects	0.012	0.012	0.007	0.015	0.019	0.017	0.024	0.014	0.017
market-driven effects	0.021	0.037	0.040	0.046	0.052	0.039	0.044	0.047	0.039
individual characterictics									
age	0.007	0.008	0.005	0.012	0.006	0.011	0.012	0.006	0.001
education	0.005	0.004	0.002	0.003	0.013	0.006	0.013	0.009	0.017
tenure	–0.001	0.000	–0.003	0.006	–0.004	0.004	0.002	–0.005	–0.005
workplace characteristics									
occupation	–0.009	0.002	0.003	0.011	0.019	0.007	0.019	0.034	0.023
sector	0.003	0.002	0.011	–0.003	0.011	–0.005	–0.003	–0.011	0.004
size	–0.003	–0.006	–0.009	–0.009	–0.005	–0.007	–0.007	–0.005	–0.015
region	0.002	0.001	0.001	0.003	0.002	0.005	0.002	0.001	0.002
private ownership	–0.002	–0.003	–0.004	–0.002	–0.001	–0.002	–0.001	–0.001	–0.002
individual coefficients									
age	0.045	–0.040	–0.045	–0.064	–0.054	–0.045	–0.044	–0.087	–0.055
education	0.011	0.001	0.013	0.018	0.021	0.034	0.036	0.064	0.048
tenure	–0.011	–0.012	–0.015	–0.012	–0.011	–0.008	–0.008	–0.009	–0.016
constant	–0.027	0.094	0.090	0.102	0.090	0.081	0.071	0.082	0.083
workplace coefficients									
occupation	0.031	0.015	0.024	0.022	0.000	–0.010	–0.007	–0.027	–0.042
sector	–0.014	–0.019	–0.017	–0.026	–0.030	–0.027	–0.033	–0.030	–0.031
size	0.009	0.006	0.005	0.006	0.008	0.008	0.011	0.016	0.024
region	–0.007	–0.006	–0.004	–0.004	–0.004	–0.006	–0.006	–0.003	–0.004
private ownership	–0.004	0.000	–0.009	–0.001	0.010	0.010	0.011	0.029	0.024

Notes: Mechanical composition effects are individual characteristics (except tenure), market-driven effects are all other estimated effects (i. e. workplace and tenure coefficients and workplace characteristics).

Table A.5: Detailed decomposition results (female workers)

	quantile								
	10	20	30	40	50	60	70	80	90
observed log wage change	0.058	0.048	0.046	0.049	0.053	0.056	0.056	0.051	0.058
total coefficients effect (incl. constant)	0.040	0.034	0.031	0.033	0.038	0.043	0.044	0.049	0.052
total characteristics effect	0.030	0.032	0.015	0.010	0.015	0.035	–0.008	0.014	0.004
explained by regression	0.070	0.065	0.046	0.043	0.054	0.078	0.036	0.063	0.056
residual	–0.012	–0.017	0.000	0.006	0.000	–0.022	0.020	–0.012	0.002
mechanical composition	0.021	0.026	0.020	0.016	0.014	0.015	0.013	0.024	0.019
market-driven	0.049	0.039	0.026	0.027	0.040	0.063	0.024	0.039	0.037
individual characterictics									
age	0.011	0.016	0.015	0.018	0.010	0.009	0.007	0.006	–0.002
education	0.010	0.010	0.005	–0.002	0.004	0.006	0.005	0.018	0.021
tenure	–0.002	0.001	0.008	0.003	–0.002	–0.002	–0.010	–0.001	–0.019
workplace characteristics									
occupation	0.001	0.007	–0.008	–0.012	0.007	0.032	0.000	–0.008	0.002
sector	0.014	–0.002	–0.002	0.005	–0.003	–0.004	–0.005	0.001	0.000
size	–0.003	–0.002	–0.004	–0.005	–0.004	–0.006	–0.007	–0.003	0.001
region	–0.002	0.002	0.002	0.004	0.004	0.002	0.003	0.002	0.002
private ownership	0.000	0.000	0.000	0.000	0.000	–0.001	–0.001	–0.001	0.000
individual coefficients									
age	–0.093	–0.033	–0.037	–0.011	–0.007	–0.010	0.003	0.029	0.009
education	–0.014	–0.042	–0.046	–0.050	–0.069	–0.081	–0.104	–0.111	–0.106
tenure	–0.005	–0.007	–0.007	–0.016	–0.016	–0.011	–0.015	–0.019	–0.030
constant	0.239	0.211	0.187	0.178	0.192	0.202	0.235	0.211	0.226
workplace coefficients									
occupation	–0.088	–0.082	–0.056	–0.055	–0.072	–0.066	–0.085	–0.058	–0.050
sector	–0.041	–0.051	–0.050	–0.051	–0.039	–0.030	–0.031	–0.034	–0.030
size	0.008	0.003	0.003	0.001	0.004	0.005	0.012	0.015	0.022
region	–0.003	0.001	–0.002	–0.005	–0.005	–0.006	–0.006	–0.010	–0.014
private ownership	0.037	0.033	0.040	0.042	0.052	0.039	0.035	0.025	0.026

Notes: Mechanical composition effects are individual characteristics (except tenure), market-driven effects are all other estimated effects (i. e. workplace and tenure coefficients and workplace characteristics).