Changes in the Wage Distribution in Austria: An Analysis Based on European Union Structure of Earnings Survey Data

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The dispersion of hourly wages in Austria hardly changed between 1996 and 2002. Somewhat weaker growth at the bottom of the distribution implies that wage inequality increased slightly. Compared with other EU countries, however, the distribution of wages remained remarkably stable in Austria. A decomposition of the changes in the wage distribution shows that the relatively small overall change is attributable to some contrasting developments. Apparently, both market-driven and predetermined factors contributed to this marginal increase in wage inequality. In particular, higher education levels and higher returns to education caused stronger growth in the upper wage dispersion range. At the same time, the rise in women's participation in the workforce was one of the main reasons for lower wages to grow less strongly. These developments caused higher wage inequality on the one hand; on the other hand, the returns to general work experience deteriorated, which, in turn, had an equalizing effect on wages. The data also show that the differences in wages for men and women remained almost unchanged over time.

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This study explores how the structure of wages and its determinants changed in Austria between 1996 and 2002. Supply and demand are essential determinants of wages in the labor market. New production processes require new qualifications, or the changing international division of labor renders certain production stages unprofitable and reduces the demand for low-skilled workers. The level of employees' education has increased markedly in most industrial nations over the past decades. Social and demographic change has often triggered higher labor participation rates of women and an increase in the average age of the workforce. The way in which the wage structure ultimately responds to these changes also depends on the institutional framework such as labor market regulation or wage-setting processes.

This paper is a concise presentation of the results of Pointner and Stiglbauer (2010a and 2010b). Interested readers may want to refer to these papers for comprehensive information on the data used and for more detailed results.

Section 1 of this paper considers various approaches to explaining the widespread increase in the inequality in hourly wages. Section 2 describes the Structure of Earnings Surveys, the data of which we used in our analysis. Section 3 provides the results of wage regressions, which we used to identify the factors influencing wages and their distribution. Building on the regression results, in section 4 we decompose the changes in wage distribution over time into detailed subcomponents, which we then divide into market-driven and predetermined factors. Section 5 provides a summary and an outlook.

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1 Background: Exploring the Causes of Changes in Wage Dispersion[2]

In many countries, wage dispersion has increased over the past 30 years.[3] Technological change leading to higher wages for better qualified workers, often referred to as "skill-biased technical change" (SBTC), is one of the common reasons given for explaining this rise in inequality. The SBTC hypothesis suggests that technological progress, in particular the increased use of computers and the Internet, entails an above-average rise in the productivity of highly skilled workers as unskilled labor is increasingly being replaced by these innovations. In other words, technological innovations foster inequality by causing higher wage increases in the upper part of the wage distribution, while crowding-out at the bottom results in stagnating or even declining wages. As opposed to unskilled workers, who compete directly with unqualified labor in low-cost countries, more highly qualified workers are in less danger of their jobs being outsourced abroad. It could even be the case that buying cheap labor abroad enhances the value added produced by better qualified domestic workers, whose wages, as a consequence, rise even more.

Other researchers point out the nonlinear relationship between qualification and wage growth as a result of SBTC or globalization, invoking a "polarization" of the wage distribution,[4] which means that the bottom and top groups of a distribution see higher wage growth and the middle group only moderate wage growth. They argue that it is not only the qualification required for a certain type of work that determines its substitutability by innovative technology, but also the amount of routine tasks it involves. There is a range of jobs in the middle wage group that demand higher qualifications but at the same time consist of many repetitive activities, the bulk of which could be automated. In addition, a large number of these processes do not require direct customer contact and can therefore be outsourced to other countries relatively easily.

All the approaches described so far are based on the assumption that changes in demand for particular qualifications and occupational groups prompt changes in the wage distribution. Obviously, however, supply-side factors such as the composition of the working population in terms of gender, education or age have an impact too. Contrary to demand-side factors, these developments on the supply side are more long-term in nature, predetermined by social, political and demographic trends. Distinguishing between market-driven and predetermined effects on the wage distribution will be key in this analysis at a later point.

An international comparison shows that while many countries experience similar supply- and demand-side effects, the resulting changes in wages may differ greatly. Technological progress, globalization or demographic trends impact on many OECD countries to a comparable extent; yet, wage inequality has increased more strongly in the U.K. and the U.S.A. than, for instance, in

[2] *For an overview of this topic, see Lemieux (2008) or Goldin and Katz (2007).*

[3] *The term "wage" as used here refers to the gross pay per hour worked of employees (blue-collar workers, white-collar workers, civil servants). Differences in gross pay due to different working time arrangements are therefore not taken into account.*

[4] *Autor et al. (2006) as well as Goos and Manning (2007) have found empirical evidence for this hypothesis in the U.S.A. and the U.K.*

continental Europe. This implies that the institutional labor market framework, including wage bargaining structures, employment protection legislation, or the role of minimum wages, has a substantial effect on the wage structure.

Identifying and analyzing the causes of changes in wage dispersion is of key importance to monetary policy in the euro area. The primary objective of the Eurosystem is the maintenance of price stability, defined as a year-on-year increase in the HICP in the euro area of below, but close to 2%. Since wages are a crucial cost factor for enterprises and hence influence price setting and the level and distribution of wages affects domestic demand for goods, wage dynamics are a major determinant of the inflation rate. For this reason, the ESCB established the Wage Dynamics Network (WDN), a research network investigating these mechanisms in depth. One of the findings of the WDN was that there are significant differences between euro area countries in terms of wage structures and how they have changed over time (ECB, 2009).

In the following, we will present an analysis of the wage distribution in Austria on the basis of Austrian micro data, which was part of a country study undertaken in the WDN. For an over-

Box 1

The ESCB Wage Dynamics Network

The ESCB established the WDN in July 2006 to analyze the characteristics and causes of wage dynamics in the EU and their implications for monetary policy, investigating the relationship between wages, labor costs and prices both at the macroeconomic and the firm level.

Following the model of earlier research networks (the Monetary Transmission Network and the Inflation Persistence Network), the WDN was guided by the questions of how wages and their individual components respond to the business cycle, how labor costs respond to macroeconomic shocks and to what extent these reactions had changed owing to the single monetary policy in the euro area. In addition, the WDN looked into the different types of wage rigidities in the EU and their main determinants. Other research groups analyzed the channels through which changes in wages affect enterprises' price setting and the roles labor market institutions or the intensity of competition in the relevant goods markets play in this process.

The WDN was organized around three research groups:

- *a macro group, carrying out country- and sector-specific analyses of wage dynamics;*
- *a micro group, exploring how firms respond to changes in the economic environment through employment, wage and price setting decisions as well as how the size and causes of wage rigidities in EU countries should be identified; and*
- *a survey group, analyzing wage and price-setting at the firm level on the basis of a harmonized questionnaire.*

The WDN was headed by Frank Smets, Director General of the ECB's Directorate General Research; the micro group, within which this paper was prepared, was chaired by Juan F. Jimeno of the Banco de España. In addition to representatives of 23 European central banks, the WDN also included observers from the U.S. Federal Reserve System and the Bank of Japan. From academia, Professor Giuseppe Bertola and Professor Julian Messina contributed substantially to the research. Other renowned researchers, such as Truman Bewley, Alex Cukierman and Jordi Galí were also involved in various research topics.

For further information on the work of the WDN, its publications, presentations and conference contributions as well as a summary of its findings, see www.ecb.int/home/html/researcher_wdn.en.html.

view of similar studies and a cross-country analysis, see Christopoulou et al. (2010).

2 First-Time Analysis of 1996 and 2002 Structure of Earnings Surveys Data by External Researchers

Our empirical analysis is based on the data of the European Union Structure of Earnings Surveys (ESES) conducted in 1996 and 2002. All EU Member States carry out the ESES at regular intervals (since 2002 every four years[5]) in accordance with the relevant EU regulation. The surveys provide information about the wages of employees in firms with ten or more employees in manufacturing and market services (sections C to K of the ÖNACE 2003 classification). The employee data compiled comprise gross earnings and their components like base, overtime and holiday pay, premiums and compensation for night, shift and holiday work as well as personal characteristics like gender, age, education level and tenure with the current employer. The employer data cover industry affiliation, the region in which the enterprise is based, the number of employees and the type of collective bargaining agreement that must be applied.

For reasons of confidentiality, usually only Statistics Austria and Eurostat staff have access to ESES data. Thanks to the WDN's cooperation with Statistics Austria, however, we were able to use the data for this study.

2.1 Scope and Type of the Surveys

In the first ESES launched in 1996, data from 8,687 firms, covering 121,926 employees, were compiled. The 2002 survey yielded information on 140,115 employees from 10,036 firms. The data are representative of some 1.75 million employees in the above-mentioned sectors.

Compared with other sources of data on earnings, ESES data have considerable advantages. First, the data relating to the level of an individual employee's wages are collected directly from the employer, which ensures a greater degree of accuracy. A number of papers on wage dispersion are based on household surveys, and such data are only partially reliable, as many people can or want to give only rough information about their earnings situation. Another comprehensive data source, the Austrian social insurance institutions, records wages only up to the maximum contribution base and therefore lacks information on the right tail of the wage distribution. Second, ESES records regular working and overtime hours, which allows the precise calculation of gross hourly wages.

2.2 Achieving Comparability of Survey Data

The 1996 ESES was limited to what we termed "core employees," i.e. persons who were in employment throughout the entire year (or seasonal workers with a job guarantee) and did not include the marginally employed. In the 2002 ESES, 24% of those surveyed were not employed for the full year, and 4% were marginally employed. To achieve the greatest comparability of data possible, we adjusted the 2002 dataset by the observations that related to persons not employed for the full year or to marginally employed persons.

Furthermore, there was a difference in sampling in the two surveys: While

[5] *Due to time constraints, we were not able to include ESES 2006 data in this analysis during the project. First descriptive results can be found in Geisberger (2008). Since 2006, a larger number of sectors have been added to the survey.*

in 1996 the data were provided by establishments, in 2002 enterprises were covered. In addition, in 2002 the enterprises surveyed were asked to provide data about certain, previously selected employees, unlike in 1996, when the establishments were required to deliver information about a certain number of employees the selection of whom had been up to them.

Finally, we excluded persons younger than 16 and older than 65 years from our analysis. Neither did we consider employees whose wages were below the 1st and above the 99th percentile of the distribution in order to correct for statistical outliers.

2.3 Higher Share of Women, Rise in Education, Higher Average Age

After sample selection, our wage distribution analysis covered 93,702 observations (employees) for 1996 and 85,404 for 2002. A simple statistical evaluation of these data reveals that the following changes took place in the Austrian labor market between 1996 and 2002 (table 1).

The share of women in the total number of employees increased by 5.3 percentage points; also, there was a slight rise in the age and education level of employees in general, while the average tenure with an employer decreased. The number of years in education refers to statutory school years, i.e. the years required to attain a certain level of education. As regards employers, there was a trend towards smaller firms; in the 2002 sample, almost half of all employees worked at enterprises with 25 or fewer employees. The regional composition[6] is also relatively stable, showing a slight increase in employment in eastern Austria at the cost of employment in the southern provinces.

The average nominal gross hourly wage[7] rose from EUR 10.39 in 1996 to EUR 11.84 in 2002, or by 13.9%. Adjusted for HICP inflation, hourly wages increased by 4.3% in real terms in this period. The distribution of wages changed only marginally over these years. The Gini coefficient, a widely

Table 1

Composition of Samples in 1996 and 2002

	1996	2002	Difference
	%		*Percentage points*
Men	67.3	62.0	–5.3
Women	32.7	38.0	5.3
	Years		
Age	37.0	38.4	1.4
Formal education	10.4	10.7	0.3
Tenure with current employer	9.5	9.1	–0.4
	%		*Percentage points*
Firm size			
≤ 25 employees	38.7	45.1	6.4
26 to 50 employees	23.5	24.3	0.8
51 to 100 employees	14.6	10.4	–4.2
101 to 250 employees	11.9	9.3	–2.6
251 to 500 employees	5.2	5.0	–0.2
> 501 employees	6.2	6.0	–0.2
Region			
Eastern Austria	35.8	39.9	4.1
Southern Austria	24.8	20.7	–4.1
Western Austria	39.4	39.4	0.0
Number of observations	93,702	85,404	×

Source: 1996 and 2002 European Union Structure of Earnings Surveys.

[6] *We apply the NUTS 1 classification of regions, which divides Austria into eastern Austria (Burgenland, Lower Austria, Vienna), southern Austria (Carinthia and Styria) and western Austria (Upper Austria, Salzburg, Tyrol, Vorarlberg).*

[7] *The wage measure used here is calculated by dividing gross earnings including overtime and shift premiums by the number of hours worked.*

used measure of inequality,[8] increased from 0.209 to 0.214, which can be attributed to the particularly strong rise in the wages at the top of the distribution. While the real increase in wages was 2.8% at the 10th percentile, 4.6% at the median and 4.3% at the 90th percentile, it was as high as 8.1% at the 99th percentile. In international terms, however, the widening of wage inequality in Austria can be considered very moderate. Christopoulou et al. (2010) analyzed the wage structure in nine EU Member States and found more pronounced changes in each of these countries than in Austria.

Therefore we would like to stress that, due to the data limitations described in section 2.2, this paper cannot provide an assessment of the *general* distribution of wages, since the dataset consists of only those employed for the full year and does not include marginally employed people. It is likely that including the groups of employees that we have omitted in this analysis would point toward more inequality and a higher increase of wage dispersion over time.

A breakdown by gender reveals considerable differences in the hourly wages of men and women. In 1996, men earned an average EUR 11.10 per hour worked, women only EUR 8.93. On average, male employees' wages were EUR 2.17 or 24.4% higher than those of female employees. In 2002, men's hourly wage at current prices averaged EUR 12.75, whereas the equivalent wage for women was EUR 10.36. These figures show that the (unadjusted) wage differential contracted somewhat but still amounted to a noteworthy 23.1%.

The descriptive statistics illustrate the inequality in the distribution and gender-specific or other differences in wages but cannot provide information on the extent to which individual factors contribute to these differences. Therefore, we continue in section 3 by presenting a model explaining the different wage levels.

3 Wage Regressions: Determinants and Wage Levels

Based on Mincer (1974), the wage level can be expressed as a function of human capital, with the latter representing all employee characteristics that contribute to productivity such as education or general work experience. It is assumed that enterprises are willing to pay higher wages for employees with higher human capital. In order to empirically determine the relationship between education and wage level, we estimate a Mincer wage regression:

$$\ln \omega_i = \beta_0 + \beta_1 s_i + \beta_2 a_i + \\ + \beta_3 a_i^2 + \beta_4 t_i + \beta_5 t_i^2 \quad (1)$$

We regress the logarithm of wage ω of an employee i on a constant β_0, the number of years s of formal education and age a as well as tenure with the employer in years t. The employees' age a represents their (potential) work experience under the assumption that firms are willing to pay employees with more experience (and who have undergone continuing professional education too) higher wages. Longer tenure with an employer t creates more firm- and sector-specific human capital, which also enhances labor productivity. We

[8] *The Gini coefficient is a ratio with values between 0 and 1, with a higher value indicating more inequality in a distribution.*

model the effect of this experience variable on the wage level in a nonlinear way. The coefficients β_3 and β_5 to the squared variables a^2 and t^2 should be negative.

In the semilogarithmic specification of equation 1, the parameter β_1 expresses in percent by how much the real wage ω will be higher if school or university education increases by one year. Therefore, this parameter is also referred to as the returns to (formal) education; the coefficients β_2 and β_4 could analogously be interpreted to stand for general and firm-specific work experience.

3.1 Average Quantitative Relationships

Table 2 summarizes the results of these regressions in the years 1996 and 2002 for all employees as well as for women and men separately. It shows that in 1996, each additional school year increased an employee's wage by 6%; by 2002, this effect had risen to 7.1%.[9] The decline in the returns to education that Fersterer and Winter-Ebmer (2003) found for the period 1981 to 1997 apparently did not continue.

The result means that in 2002 employees holding university degrees earned hourly wages that were more than 28% higher than those of upper

Table 2

Results of Simple Wage Regressions

	1996			2002		
	All	Women	Men	All	Women	Men
School years	0.060	0.086	0.051	0.071	0.079	0.066
	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***
Age	0.028	0.023	0.030	0.017	0.016	0.019
	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***
$Age^2/100$	–0.027	–0.022	–0.029	–0.015	–0.014	–0.016
	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***
Tenure with current employer	0.014	0.017	0.012	0.012	0.014	0.010
	[0.000]***	[0.001]***	[0.000]***	[0.000]***	[0.001]***	[0.000]***
Tenure with current $employer^2/100$	–0.007	–0.003	–0.006	–0.003	0.005	–0.002
	[0.001]***	[0.002]	[0.001]***	[0.001]**	[0.002]*	[0.002]
Women	–0.168			–0.165		
	[0.002]***			[0.002]***		
Number of observations	93,702	30,611	63,091	85,404	32,460	52,944
R^2	0.380	0.390	0.310	0.330	0.310	0.260

Source: OeNB.

*Note: Standard errors in brackets. *, **, *** denote significance at the 10%, 5% and 1% level respectively. The coefficients of the gender dummy variable are OLS coefficients transformed with ($\exp(\beta_{Women})-1$).*

[9] *In the specification of the Mincer wage equations with age a as an explanatory variable, as applied by the WDN, the returns to formal education do not simply equal β_1 from equation 1, but reads, strictly speaking, $\beta_1 + \beta_2 + 2\beta_3\bar{a}$, with $\bar{a}$ representing the mean age. The results are very similar, however (the increase in the returns to education would be 0.9 percentage points), particularly as regards the differences between men and women. In the following, we continue to interpret β_1 not quite accurately as the returns to education as it is irrelevant in the decomposition into market-driven and predetermined factors that will be performed at a later point.*

secondary education graduates who had acquired the same number of years of work experience. Both in 1996 and 2002, the returns to additional education were higher for women than for men although the difference became a little smaller over time. The coefficient of 0.079 for women in 2002 means that, ceteris paribus, an additional year of education increased a female employee's wage by 7.9%.

The effects of the experience variables decreased for both groups over time. Both age and tenure showed lower coefficients in 2002 compared with 1996. The effects of the squared experience variables are, as expected, negative. The decrease[10] of the age coefficient may also indicate that the seniority principle, according to which older employees are paid higher wages, may have lost some importance. This is in line with the findings of Fersterer and Winter-Ebmer (2003). In both years, the age coefficients for women are smaller than for men, which can be attributable to more women than men experiencing career interruptions; this implies that women's work experience tends to be overestimated, which results in a downward bias of the coefficient.

The wage regression for all employees also included a dummy variable for gender, which showed that women's wages were 16.8% (16.5%) lower than men's in 1996 (2002) even if differences in education and work experience are taken into account. In section 2.3, we identified a wage differential of 23.1% between men and women (2002). This result, however, referred to average wages without taking into consideration differences in human capital. Put differently, only 6.6% of total gender-specific differences in wages in 2002 (23.1%) were attributable to differences in education or experience, while 16.5% cannot be ascribed to these factors.

3.2 Variable Influencing Factors alongside the Wage Distribution

So far we have used ordinary least square (OLS) regressions in our analysis, which assume a stable relationship between wages and education across the entire wage distribution. The returns to one year of formal education estimated at 7.1% for 2002 correspond to the mean value of all observations in our sample. To examine the possibility of the relationship changing across the distribution, we estimated the wage equations also as quantile regressions (box 2).

Estimating equation 1 as a quantile regression for 1996 and 2002 yields the following (chart 1): The returns to education increase across the distribution; for instance, for 1996, in the entire sample, an additional year of secondary or tertiary education raised the hourly wage by 3.2% at the 10th percentile and by 7.2% at the 90th percentile. As mentioned earlier, the returns to education in general rose from 1996 to 2002, with the increase having been highest at the lower end of the distribution (left-hand panel in chart 1). However, only men benefited from this development (right-hand panel). For women, the returns to education even decreased over time. This notwithstanding, in 2002 it was still higher than the returns to education for men (middle panel in chart 1). Between the median and the 70th percentile, an additional year of formal education still meant 8% to 9% higher wages for women (2002).

The coefficients of the age variables also trend upward across the distribu-

[10] *The effects of work experience and tenure with an employer also decline when the results for the squared terms are taken into account.*

Box 2

Quantile Regressions

Regression analyses are usually carried out to approximate the mean value of a conditional distribution by minimizing the sum of deviation squares (OLS). If, however, more than the mean relationship between dependent and independent variables is of interest, quantile regressions can be run to estimate the effects of the explanatory variables in different quantiles of the distribution. Since it can be assumed, for instance, that the returns to formal education increase the higher an employee's wage is, we have also used this method in our analysis. Further information about other areas of application and a short introduction can be found in Koenker and Hallock (2001). Starting from a wage equation

$$\omega_i = z_i \beta_\theta + u_{\theta i} \text{ where } Q_\theta(\omega_i | z_i) = z_i{}' \beta_\theta$$

with $Q_\theta(.)$ referring to the θth quantile of the distribution of the wage ω estimated from the variable z_i, we aim to obtain a solution for β by minimizing the least absolute deviation (LAD):

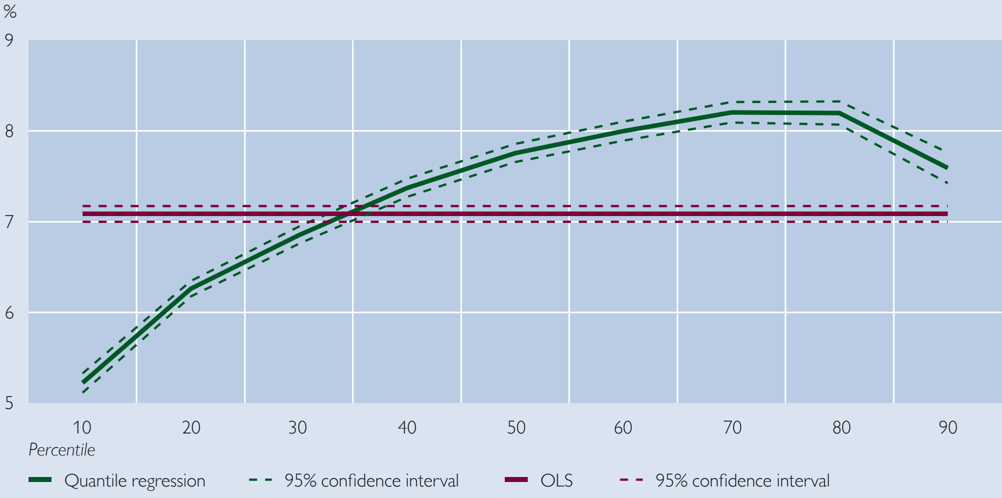
$$\min_\beta \sum_i \rho_\theta \left(\omega_i - z_i \beta_\theta\right)$$

where $p_\theta(\omega_i - z_i \beta_\theta)$ can take the following values:

$$\rho_\theta\left(\omega_i - z_i\beta_\theta\right) = \begin{cases} 2\theta\left(\omega_i - z_i\beta_\theta\right) & \text{if} \quad \left(\omega_i - z_i\beta_\theta\right) \geq 0 \\ 2(1-\theta)\left(\omega_i - z_i\beta_\theta\right) & \text{if} \quad \left(\omega_i - z_i\beta_\theta\right) < 0 \end{cases}$$

This implies that an unweighted minimum for the deviations will be identified for the median ($\theta = 0{,}5$), while in all other quantiles the optimization will be carried out through weighted deviations.

Effect of an Additional Year of Education on the Wage Level (2002)



Source: OeNB.

The chart shows the coefficients of years of formal education from equation 1 in an OLS and a quantile regression across the distribution; it also displays the 95% confidence intervals for both estimators. While the OLS coefficient necessarily remains constant in all quantiles, the quantile regression shows that the returns to education increase across large parts of the distribution. For employees at the 10th percentile, each additional school year entails a 5% higher wage; from the 70th percentile, the returns already exceed 8%. The confidence intervals show that the difference between the results of the OLS estimation and the quantile regression is statistically highly significant.

tion, which means that work experience pays more for employees with higher wages. The decline in the returns to general experience was moderate compared with the returns to education. In 2002, it amounted to only 0.6% per additional year at the 10th percentile and to 3.6% at the 90th percentile. Tenure with an employer increases wages only marginally for higher (male) wage earners; for women, this effect is relatively constant across the distribution. Firm- or sector-specific skills seem to carry more weight for low-wage earners, whereas general skills and formal education play a more important role in the higher wage groups.

As mentioned above (table 2), the gender-specific difference in wages (as measured by the gender dummy variable) averages 17%. The quantile regressions show that this difference is smaller in the lower part of the distribution. At the 10th percentile, it was only 13.5% in 2002 (14.3% in 1996); at the 90th percentile, women earned as much as 20.9% (1996: 19.7%) less than men with the same human capital characteristics.

4 Decomposition of Changes in Distribution by Subcomponents

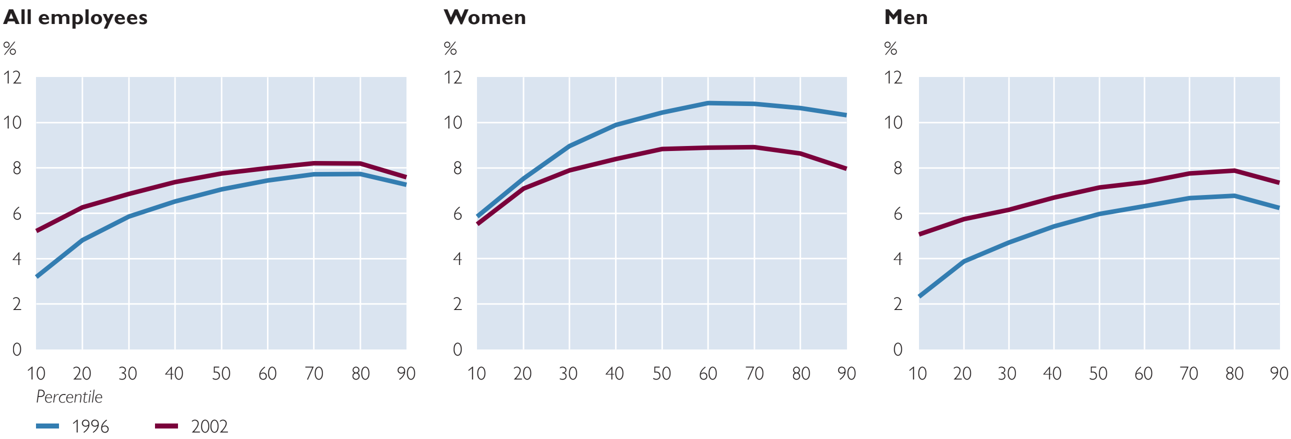
As we mentioned at the beginning, changes in the distribution of wages can be broken down into two groups: price effects and quantity effects. Price effects occur when the level of wages paid for certain characteristics of employees changes. For instance, if demand for human capital increases and the supply of labor remains unchanged, higher educated employees will earn more. Quantity effects may occur as the composition of the workforce changes over time. If the number of people attaining higher education levels increases and, as a consequence, these people accumulate more human capital and earn higher wages, the wage structure will change, even if the returns for each year of education remain constant. In the following, we will introduce a method allowing a breakdown of the observed wage dynamics into price changes and quantity changes.

4.1 Machado-Mata Method

The Machado-Mata method is based on quantile regressions. For these we use an extended specification, comprising

Chart 1

Returns to Education in Quantile Regressions



Source: OeNB.

– in addition to the human capital variables used so far – workplace characteristics that influence wage levels. The ESES data include employer information, such as firm size, sector (according to the ÖNACE classification), the region in which the enterprise is located (according to NUTS), as well as information about the professional position of employees (according to ISCO). When these variables are incorporated in the wage regression one can see that, for instance, larger enterprises pay their employees higher wages than those with a smaller number of employees, or that the wage level is lower in southern Austria than in the rest of the country. At the same time, the effects of the human capital variables (formal education, potential experience, tenure with an employer) decrease; the picture obtained previously does not change qualitatively, however.

The Machado-Mata method is a refinement of the Blinder-Oaxaca decomposition, which was originally used to measure discrimination in the labor market. The latter involves, essentially, the estimation of wage regressions, and the differences between wage levels are attributed to differences in the explanatory variables (human capital factors) and to differences in the coefficients (pay for human capital factors). Machado and Mata (2005) extended this decomposition across an entire distribution instead of using differences in the means.

$$\ln(\omega_\theta^{2002}) - \ln(\omega_\theta^{1996}) =$$
$$= \left(\bar{z}_\theta^{2002} - \bar{z}_\theta^{1996}\right)\beta_\theta^{2002} - \qquad (2)$$
$$- \bar{z}_\theta^{1996}\left(\beta_\theta^{2002} - \beta_\theta^{1996}\right) + \left(\varepsilon_\theta^{2002} - \varepsilon_\theta^{1996}\right)$$

As equation 2 shows, the difference between the log real wage at a specific quantile θ in the years 1996 and 2002, $\ln(\omega_\theta^{2002}) - \ln(\omega_\theta^{1996})$, is related to two counterfactual changes. The first term on the right-hand side of the equation specifies by how much wages would have changed if the observable characteristics of the employees alone

$$\left(\bar{z}_\theta^{2002} - \bar{z}_\theta^{1996}\right)$$

had changed (quantity effect); the second term specifies by how much wages would have changed if the pay for the characteristics had changed between 1996 and 2002 while the distribution of these characteristics had remained at the 1996 level (price effect). This decomposition implicitly assumes that both price effects and quantity effects change independently of each other.

The two counterfactual changes cannot be observed but are approximated by the results of the quantile regressions. However, the average expected value of a characteristic at a certain quantile $\bar{z}_\theta$ cannot be measured, as each quantile is just a single observation. Therefore, we approximate these values by bootstrapping as suggested by Albrecht et al. (2003).

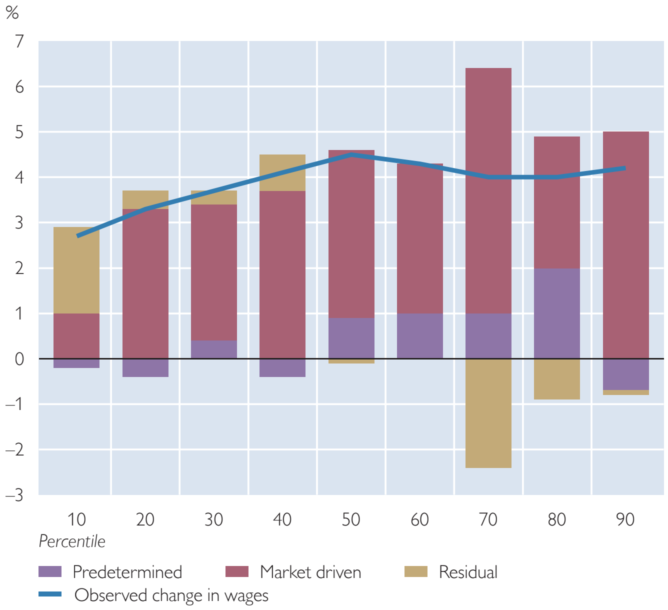
4.2 Market-Driven and Predetermined Changes in Wage Dispersion

Following WDN conventions, we divided the effects into two groups: Quantity effects in employment as regards female participation rates, age structure and education level are considered "predetermined" since they are attributable to long-term social or demographic change and hence hardly subject to the influence of market processes. All other changes, especially price effects like changes in the returns to education or work experience, are considered to be market-driven. In addition, tenure or the sectoral distribution of employment is very much influenced by the markets.

Chart 2 shows the composition of wage changes across the distribution, clearly illustrating that the wage increases between 1996 and 2002 were attributable to a large extent to market-driven factors. The model we used provides a fairly satisfactory explanation of the observed wage changes, albeit somewhat underestimating the 1st decile and overestimating the 7th decile. The wage changes shown in chart 2 refer to all employees (men and women). While from 1996 to 2002 the wage increase was only 2.7% at the 1st decile, wages above the median rose by more than 4% over the same period. The market-driven contributions to the wage changes were positive – and somewhat higher in the upper quantiles – across the entire distribution. The predetermined changes caused negative changes in particular in the lower wage groups and – mostly – positive contributions in the upper part of the distribution. This means that the increase in wage inequality was attributable to both market-driven and predetermined factors.

Chart 2

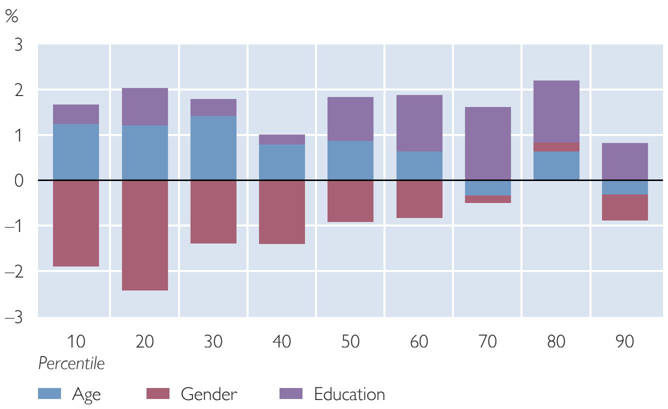
Composition of Wage Changes (1996 to 2002)



Source: OeNB.

Chart 3

Contribution of Predetermined Changes to Wage Growth (1996 to 2002)



Source: OeNB.

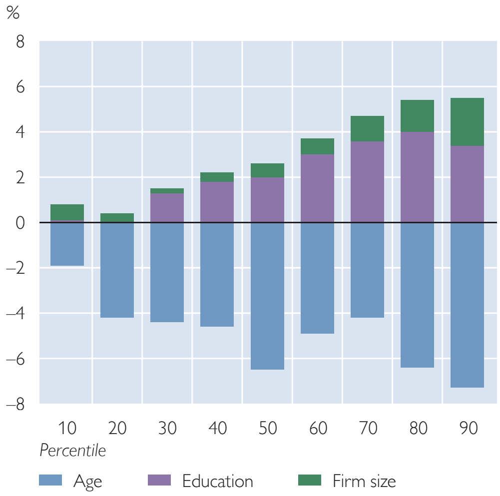
Chart 3 provides a more detailed picture of the contribution of predetermined factors to the changes in the wages of all employees, illustrating that the effects of the factors discussed here were working in different directions. While the changes in the composition of the labor force in terms of education and age led to higher wages in 2002, the changes in the gender distribution prompted a decline in the wages below the median. Chart 3 also shows that the share of women in the total number of employees clearly rose above all in jobs where wages were below the median. Hence, the increase in the number of women in employment resulted overall in more inequality in the distribution of hourly wages.

Employees' higher average age, by contrast, provided for more equality in the wage structure. At the same time, higher education levels led to higher wage increases in the upper part of the distribution, thus contributing to more wage inequality.

Chart 4 highlights some market-driven components of the changes in

Chart 4

Contributions of Market-Driven Changes of Selected Characteristics to Wage Growth (1996 to 2002)



Source: OeNB.

wages: The rise in the returns to education, for instance, fueled wage growth at the upper end of the distribution by between 3.5% and 4% between 1996 and 2002, while having no such strong effect at the bottom of the distribution. Employment in large enterprises was found to work in the same direction – albeit at a much lesser scale. From 1996 to 2002, the difference in wages paid by small and large firms increased – more strongly at the upper wage levels than at the lower levels. Both effects led to more inequality in the wage distribution.

By contrast, the returns to age (our proxy for general work experience), which diminished over time, contributed to more equality in the wage distribution. While the returns to experience decreased by between 2% and 4% at the lower wage level, the decline amounted to up to 7% at the upper percentiles. The changes in the returns to these three characteristics (age, education, firm size) almost canceled each other out in the upper half of the distribution.

5 Summary and Outlook

In this study, we discuss the results of a country study conducted within the framework of the ESCB research network WDN, using the data of the 1996 and 2002 European Union Structure of Earnings Surveys (ESES). It was the first time that researchers outside national statistical offices were given access to these data.

The dispersion of wages in Austria changed only marginally between 1996 and 2002. Real hourly wages rose by 4.3%, an increase which was seen across almost the entire wage distribution; wage growth was smaller only in the lower part of the distribution, which implies a moderate increase in wage inequality. An international comparison shows that wage dispersion changed significantly more strongly in other countries.

From wage regressions we find that the returns to formal education rose in the period under review, which seems to have compensated for at least some of the decline seen here earlier. A systematic decomposition of changes in the wage distribution over time shows that the moderate (net) changes can be traced to some contrasting developments. We classified the factors contributing to the changes in wage dispersion to be either market driven or predetermined and found that both types impacted on the distribution of wages. The returns to education increased along with the number of higher educated employees, and both factors triggered higher wage increases in the upper part of the wage structure. At the same time, the rise in women's participation in the workforce was one of the main reasons for lower wages to grow less strongly. In other words, these changes fostered wage inequality. In contrast, the returns to other personal characteristics of employees led to a decline in inequality. The returns to general work experience, for instance, deteriorated more markedly for higher wage earners.

The gender wage gap remained surprisingly constant over the period under review. Even when accounting for differences in education, age and tenure with an employer, the average difference in wages for men and women was some 17% in both 1996 and 2002. This difference increases in the upper wage groups, amounting to 14% in the lower part of the distribution and to 20% in the upper part, a fact that hardly changed over time.

Since the ESES has many advantages compared with alternative data sources and are carried out at regular intervals, in future researchers will be able to investigate changes in the distribution of wages over longer periods of time.

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