The Gender Wage Gap in Croatia – Estimating the Impact of Differing Rewards by Means of Counterfactual Distributions

Nestić, Danijel

The Gender Wage Gap in Croatia – Estimating the Impact of Differing Rewards by Means of Counterfactual Distributions

Danijel Nestić
The Institute of Economics, Zagreb, Croatia
dnestic@eizg.hr

CroEconSur
Vol. 12
No. 1
April 2010
pp. 83-119

Received: December 12, 2009
Accepted: March 23, 2010
Original Scientific Paper

Abstract

The aim of this paper is to estimate the size of, changes in, and main factors contributing to gender-based wage differentials in Croatia. It utilizes microdata from the Labor Force Surveys of 1998 and 2008 and applies both OLS and quantile regression techniques to assess the gender wage gap across the wage distribution. The average unadjusted gender wage gap is found to be relatively low and declining. This paper argues that employed women in Croatia possess higher-quality labor market characteristics than men, especially in terms of education, but receive much lower rewards for these characteristics. The Machado-Mata decomposition technique is used to estimate the gender wage gap as the sole effect of differing rewards. The results suggest that due to differing rewards the gap exceeds 20 percent on average - twice the size of the unadjusted gap - and that it increased somewhat between

1998 and 2008. The gap is found to be the highest at the lower-to-middle part of the wage distribution.

Keywords: gender wage gap, quantile regression, Machado-Mata decomposition, Croatia

JEL classification: J16, J31, J70

1 Introduction[1]

One of the most challenging fields for attaining the equal treatment of women and men is the labor market. In practically every country, women earn less than men. To explain this disparity, labor economists have usually looked at differences in human capital characteristics, such as education and experience. Since women in many countries have poorer education and less labor market experience than men, productivity gains due to these attributes could explain part of the gender wage gap. The role of job- and firm-specific factors has also been studied. However, the wage gap remains even after accounting for differences in all observed characteristics.

In former socialist countries, gender equality was a highly proclaimed policy goal during the communist regime and evidence shows that the difference in wages between women and men was rather low at that time (Brainerd, 2000). An egalitarian wage structure was a feature not only of centrally planned systems, but also of the self-management system in the former Yugoslavia (Orazem and Vodopivec, 1995). During the transition period, huge changes in the structure of the overall economy induced changes in the wage structure. Wage setting mechanisms were liberalized, which mostly produced higher wage inequality. However, it seems that these changes did not contribute to the widening of the gender wage gap in Central and Eastern European (CEE) countries in the first phase of transition (Brainerd, 2000;

1 This paper is a result of the research supported by a grant from the CERGE-EI Foundation under a program of the Global Development Network. All opinions expressed are those of the author and have not been endorsed by CERGE-EI or the GDN. The author would like to thank two anonymous referees for useful comments and suggestions. The author also thanks Hiau Joo Kee for providing his Stata code for the Machado-Mata wage decomposition. The usual disclaimer applies.

Newell and Reilly, 2001). Instead, there was a significant decline in the female participation rate. In countries of the former Soviet Union, however, female relative wages were reduced strongly, while female participation was kept high due to the continued labor hoarding practice (Pastore and Verashchagina, 2007). In the later stages of transition, the gender wage gap increased, although it remained rather modest by international standards (Rutkowski, 2001). The literature suggests that the relatively small gender wage gap in most transition economies is connected with the higher human capital endowments of women compared to men, such as education and experience (Paci and Reilly, 2004).

Croatia, as a post-socialist country, shares many labor market characteristics with other CEE countries. Therefore, it is not surprising that the unadjusted wage gap is relatively low. The average monthly gross wage of women was around 11 percent below that of men in 2008, making it one of the lowest unadjusted gaps in Europe - even one of the lowest among the former socialist countries.[2] This gap, measured by gender differences in the average wage, masks an even higher underlining wage disadvantage for women. Bisogno (2000) took into account gender differences in education, experience, and workplace-related factors in a regression analysis framework and found the adjusted gender wage gap to be much higher, 20 percent in 1998. In a similar setting, Nestić (2005) reported a mean gap of around 15 percent in 2003. This documented difference between the unadjusted and the adjusted gap is interesting for further exploration aimed to shed more light on its sources in the context of the transition in Croatia.

This study, therefore, considers changes in the gender wage gap in Croatia between 1998 and 2008, first in its unadjusted form and then by adjusting the gap in order to take into account differences in the labor market characteristics of men and women. Compared to previous studies for Croatia, the current study presents two novelties. First, it goes further in exploring the gender wage gap by using the quantile regression technique and estimating the wage gap at various points of

2 For 2007, Eurostat reports an unadjusted gender wage gap in Poland and Slovenia of 8 percent, Bulgaria 12 percent, Romania 13 percent, and Hungary 16 percent. The average for the "old" EU members (EU-15) was 18 percent; while Baltic States, the Czech Republic, and Slovakia had relatively high gender pay gaps.

the distribution, not only at the mean. The gender wage gap often varies across the distribution; for example, it is highest among the high-paid workers. Second, this study focuses on the part of the gap that is caused by differences in rewards for the same observable labor market characteristics of males and females in order to approximate the portion of the gap that is due to discrimination. However, the separation of the discriminatory part of the total gap in empirical work is complicated by unobserved worker characteristics and the effects of gender segmentation, and no single analytical method is provided in the literature to completely solve this problem.

In this paper, we employ the Machado-Mata (2005) decomposition analysis to extract the part of the gap that originates from differing rewards. The idea behind this method is to generate a female wage distribution that would emerge if women would have exactly the same labor market characteristics as men, but receive rewards for those characteristics as women. Such a counterfactual distribution is compared with the estimated male wage distribution, making the conditional gender wage gap. The Machado-Mata approach is appealing because it is compliant to the quantile regression framework. In addition, it has the advantage that the gender wage gap is decomposed into exactly two standard components, the one due to differing characteristics and the other due to differing rewards, without residual terms.

We found the relatively low raw (unadjusted) wage gap in Croatia to be around 10 percent on average in 2008, down from 13.5 percent in 1998. However, the counterfactual gender wage gap, i.e., the part of the gender gap that arises from differing rewards, is found to be almost two times higher than the raw gap; and it even increased between 1998 and 2008. This difference between the raw and the conditional gaps indicates that the observed educational advantage of women was not adequately transposed to their wage increases and, hence, questions the equal treatment principle in the Croatian labor market setting in the recent past.

The paper is organized as follows. Section 2 reviews basic characteristics of the female labor market in Croatia. Section 3 presents the data, basic statistics on the wage distribution, and the raw gender wage gap. Section 4 describes the methodology used in the estimation of the conditional gender wage gap and discusses empirical findings. Section 5 concludes.

2 The Situation of Women in the Labor Market in Croatia

The relatively low unadjusted gender wage gap in most of the former socialist countries, as well as in Croatia, may be misleading in judging the status of women in the labor market in at least three aspects. The first is the situation in which a stable gap could be connected with a considerable decline of female participation and employment rates. The second is the emerging educational advantage of female employees over their male counterparts, which might not be adequately accounted for in the determination of female wages. The third is the overproportional burden of family responsibilities on women. The transition brought important changes in the situation of women in the labor market, and it seems that Croatia fits quite well in the story of CEE countries, although with some specificities.

Unlike most other former socialist countries, Croatia has never had an extremely high female participation rate. Census data available for 1971, 1981, and 1991 indicate that the female participation rate was rather stable over the last two decades of socialism, at the rate of around 43 percent of the population aged 15 years and more.[3] At the same time, the male participation rate declined from 76 to 63 percent, causing the female share in the labor supply to increase from 39 percent in 1971 to 43 percent in 1991. Female participation rates lower than in most centrally planned economies, where they were as high as male rates (Paci and

3 If not stated otherwise, all figures on participation and employment in Croatia in this section are taken from the Statistical Yearbook by the Central Bureau of Statistics, various years.

Reilly, 2004: 1), can be linked to a specific "soft" model of socialism which existed in the former Yugoslavia and Croatia as one of its federative states.[4]

The transition brought about a substantial decline in employment and increased joblessness, although it appears that the trend of an increasing share of women in employment and the labor supply has not been disrupted.[5] In 1990, women composed 43 percent of all the employed (including the self-employed) and by 1993 their share increased to 45 percent in the situation of a cumulative employment drop of more than 20 percent and the GDP decline of almost 40 percent. In the following years, the female employment share has remained more or less stable. Matković (2008) found a declining share of women among the unemployed and an increasing share in paid employment in the first years of transition, while the opposite tendencies have been present more recently. It appears that the relative position of women in terms of employment did not worsen in the early 1990s, although this conclusion is partially dependent on the missing data on military employment, mostly held by men. It would be interesting to compare the development of female employment with the changes in their relative wages, but there is no comparative data on male and female wages either in the socialist period or in the first phase of the transition in Croatia.

Following the Russian crisis, coupled with the domestic banking crisis in the period 1998-1999, the Croatian economy began to bear the fruits of the market reforms with considerable economic growth and increased employment. The average annual growth rate during the period 2000-2008 was 4.3 percent. The year 2001 was a turning point. It was the first year with more favorable labor market flows. By 2008, employment increased by more than 20 percent, while the unemployment rate declined from 16 to 8 percent. However, it is also possible that favorable economic growth, which was driven largely by expanding domestic demand and

4 For basic features of the labor market under the self-management system in former Yugoslavia, see, for example, Orazem and Vodopivec (1995).

5 Unfortunately, there are no reliable figures on participation rates in the first years of transition in Croatia due to the missing Labor Force Surveys and important demographic changes that were caused by the war for independence and war-related migrations (1991-1995). Also, military service was not counted as employment at that time.

made possible by extensive capital inflows, actually postponed further market reforms and induced some sluggishness in the evolution of the wage patterns.

It appears that the more recent changes in female labor market participation contain an important age component.[6] The female participation rate was on the decline for the population of 15 years of age or more (from 46 percent in 1998 to 42 percent in 2008). However, it has been relatively stable for the female population of 15 to 64 years of age (56 percent in 1998, 55 percent in 2003, and 56 percent again in 2008), while it is on the rise for the prime-age cohort of 25 to 49 years (from 78 percent in 1998 to 80 percent in 2008). Similar trends are also observed in the participation rates for males, meaning that the female share in the labor supply remained roughly constant from 1998 to 2008 in each age group. Compared to other countries, Croatia is again somewhere between the East and the West. It has a somewhat lower female participation rate than the EU-10 countries (post-socialist EU member states). Whereas in comparison with the EU-15 ("old" EU countries), its female participation rate for the 25 to 49-year-old cohort is slightly higher, and for the 15 to 64-year-old cohort it is substantially lower.[7]

As for wage employment in the prime working age, it is worth noting that the female share was around 49 percent between 1998 and 2008. This high share can be considered an important accomplishment having in mind that part-time employment is negligible in Croatia, around 1 percent of the total paid employment for males and 3 percent for females.

The different trends in the female participation rates for different age groups are caused by deagrarianization, changes in the pension system, increased tertiary education, and, more recently, improved childcare facilities. A declining rural population, which is usually active at a very old age, led to lower participation for

6 The main labor market indicators for Croatia are available since 1998 and they are based on the Labor Force Surveys. There were also two survey rounds in 1996 and 1997, but results are not fully comparable with the subsequent surveys.

7 According to Eurostat, the average female participation rate (unweighted) of the ten post-socialist EU countries was relatively stable between 1998 and 2008, around 62 percent for the population of 15 to 64-year-olds and 82 percent for the population of 24 to 49-year-olds. In "old" European market economies (EU-15), female participation rates have been on the rise, reaching 65 percent for the group of 15 to 64-year-olds and 79 percent for the group of 24 to 49-year-olds in 2008.

the cohort aged 15 and more, both for males and females. As for the impact of the pension system, Nestić and Rašić-Bakarić (2008) argued that the 1998 pension reform that mandated an increase in the legal pension age actually resulted in an increased participation rate for older workers (55 to 64-year-olds). However, this gain has been offset by increased length of education and higher age of entrance to the labor market. Therefore, we saw only a little change in the participation rates for the 15 to 64-year-old cohort. Women tend to be better and better educated, with a significant and increasing advantage over men. For example, in 2008, women composed 60 percent of graduates in higher education in Croatia. The prime-age female labor supply (24 to 49-year-olds) is on the rise, and this is happening in parallel with increased enrollment rates in kindergartens and other institutions of pre-primary education. The gross enrollment rate for 3 to 6-year-old kids rose from 42 percent in 2001 to 58 percent in 2008, and from 11 percent to 17 percent, respectively, for 2 to 3-year-old kids.[8]

The gender wage gap might be considerably affected by an unequal division of child-rearing responsibilities. In the case of entitlements for long periods of child-related absence, employers may be less willing to hire women and provide them with high wages or offer them promotions. Croatia is a country with relatively generous entitlements for child-related leaves, more in terms of the length of a leave and less in terms of compensation. Most women take a one-year leave after childbirth. Mothers exclusively use the first part of the leave (maternity leave - a minimum of 42 days and up to six months), while the next six months can be shared between the parents (paternal leave). In addition, parents with young children are entitled to an absence from work to take care of a sick child. A vast majority of these entitlements are traditionally used by mothers. An underdeveloped child day care scheme makes the labor market situation of women with children vulnerable, in spite of some improvements in recent years – for example, the above-mentioned coverage of pre-primary school child care. The relatively short opening hours of these facilities are, however, a limiting factor. In addition, the primary education

8 Presented figures are based on the number of children enrolled in pre-primary education and the official estimates of the population of a given age.

system provides relatively poor in-school child care arrangements, whereas schools often alternate the morning and the afternoon shift, making the care of school-age children even more complicated.

3 Data and the Raw Gender Wage Gap

3.1 Data Description

The data employed in this study were obtained from the Labor Force Survey (LFS). The LFS is administered by the Central Bureau of Statistics (CBS) to a random sample of Croatians living throughout the country. Face-to-face interviews provide information on the activity status, gender, age, work experience, and education of all individuals in the surveyed households. Data on the employer and job characteristics, such as company size, industry sector, ownership status, occupation, and working conditions are also collected for all employed household members. Also important for this study, the survey gathers information on the usual monthly wage of a person's main job (net of contributions and taxes) and the usual hours of work performed per week, thus, making it possible to calculate the hourly wage rate.

We used data for 1998 and 2008, the first and the most recent year for which the LFS provides comparable data on wages. In 1998, the survey was conducted on two semi-annual waves. We have pooled data from both waves and constructed an annual database in order to increase the precision of our estimates. The sampling procedure applied by the CBS allows for such data pooling. The sample is actually chosen once for the whole year and then divided in two parts, one for each half of the year. At that time, the sample did not have panel components. In 2008, survey design was somewhat different and included quarterly data collection and a rotation of the sample within the "2-2-2" scheme. The household is interviewed in two consecutive quarters, then left out in the following two quarters and interviewed again in two consecutive quarters. In order to increase the number of observations in 2008, we decided to merge observations collected in quarterly

surveys throughout the year. However, we took data for non-overlapping units only. In practice, we took observations from the second and the fourth quarter of the 2008 LFS that are, according to survey design, all unique, i.e., the same person cannot be counted twice. Then we added those households from the first and the third quarter that are not interviewed in other waves within the year.[9]

For the purpose of this study, the initial sample is restricted to employees in paid employment. More precisely, we included only those over 15 years of age who are in paid employment. The self-employed are excluded because entrepreneurial skills and capital invested in self-employment generate remuneration that cannot be separated from payment for work. Occasional and family workers, as well as working retirees, are also excluded as their earnings exhibit an unclear link to human capital and other productive attributes. A total of 10,066 individuals were included in the 1998 sample, and a total of 6,072 individuals in the 2008 sample.

Table 1 presents the summary statistics on wages for the sampled individuals, as well as the means and standard deviations of the main variables used in the study. The sample included a slightly lower number of women than men, around 47 percent in 1998 and 46 percent in 2008. Almost the same proportion of women in paid employment in Croatia was reported in the official statistical data based on establishment surveys.

Men earned more than women in both 1998 and 2008. This holds true for the average wage as well as for the wages at the different parts of the wage distribution. Table 1 shows the data for the five points at the distribution of the log of hourly wages, i.e., for the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles. In our study, hourly wages are preferred to monthly wages originally reported in the LFS. This is done to compensate for dispersion in the number of hours actually worked. It is important to note that we report results using the log transformation of the hourly wage as it offers the ease of data manipulation.

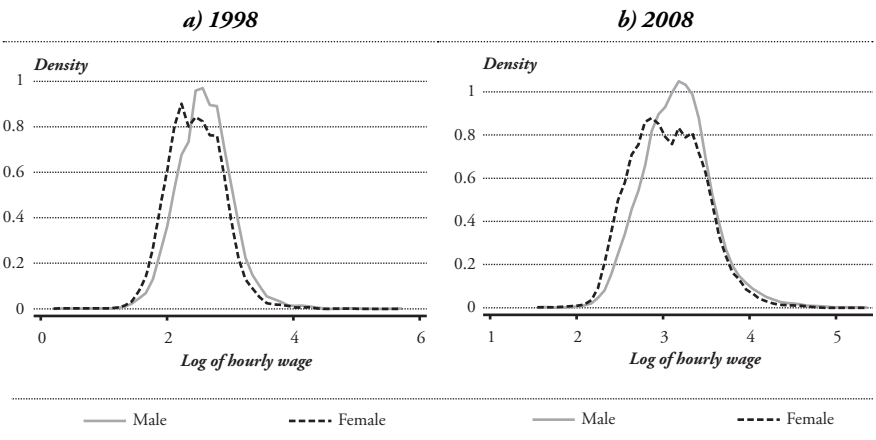
9 We checked the main characteristics of our sample with the official data released by the Central Bureau of Statistics for the entire 2008; for example, participation, employment, and unemployment rates by gender and age. We found minor differences. For participation rates, they were below +/- 0.2 percentage points.

Table 1: *Descriptive Statistics*

	1998		*2008*	
	Male	**Female**	**Male**	**Female**
Number of observations	5,354	4,712	3,291	2,781
Mean log hourly wage	2.59 (0.43)	2.45 (0.43)	3.16 (0.40)	3.06 (0.41)
Percentiles of the log hourly wage distribution				
10^{th}	2.05	1.93	2.67	2.53
25^{th}	2.30	2.17	2.90	2.75
50^{th}	2.57	2.46	3.17	3.04
75^{th}	2.88	2.75	3.40	3.34
90^{th}	3.09	2.95	3.62	3.59
Dispersion (percentile of the log hourly wage)				
90^{th} - 10^{th}	1.04	1.02	0.96	1.06
75^{th} - 25^{th}	0.58	0.58	0.50	0.59
Age	38.63 (10.56)	36.88 (9.66)	40.20 (11.84)	40.20 (10.76)
Work experience (years)	17.23 (10.41)	15.07 (9.47)	18.00 (11.62)	16.91 (10.93)
Tenure (years)	10.97 (9.95)	10.69 (9.35)	11.39 (10.84)	11.55 (10.61)
Public sector (proportion)	0.63 (0.48)	0.60 (0.49)	0.36 (0.48)	0.40 (0.49)
Schooling (years)	11.51 (2.65)	11.84 (2.72)	11.62 (2.19)	12.14 (2.42)
Education (proportion)				
Primary or less	0.19 (0.39)	0.18 (0.38)	0.13 (0.34)	0.13 (0.34)
Secondary	0.64 (0.48)	0.61 (0.49)	0.72 (0.45)	0.63 (0.48)
Tertiary	0.17 (0.37)	0.21 (0.41)	0.15 (0.36)	0.24 (0.43)

Note: Standard deviations are in parentheses. Log hourly wages are expressed in the current values of a given year without inflation adjustment.
Source: Author's calculations based on the 1998 and 2008 Labor Force Surveys.

Figure 1: *Kernel Density Estimates of Log Hourly Wage by Gender*



Source: Author's calculations based on the 1998 and 2008 Labor Force Surveys.

In 1998, the dispersion of male wages was similar to that of females, but the situation changed by 2008. We found that female wages were more dispersed than male wages, as suggested by the distance between the 90th and the 10th percentiles, as well as between the 75th and 25th percentiles.[10] Between 1998 and 2008, the dispersion of male wages decreased, while the dispersion of female wages increased somewhat. These interesting features might have been connected with the changes in the education structure of the workforce and differing rewards at comparable education levels for males and females, as indicated later in the study. However, a more thorough explanation calls for another study devoted to wage inequality. Differences in the shape of male and female wage distributions in 1998 and 2008 are shown in Figure 1, where the probability density of the sampled observations is approximated by the kernel density estimators. This illustration also indicates that the problem of low-wage workers more strongly hits women because there is a larger proportion of women among low-wage workers than men. If we take the threshold of 12.5 kuna per hour in 2008, which is roughly the amount of the statutory minimum wage expressed in after-tax hourly terms and valid for the

10 The Gini coefficient calculated over the distribution of the hourly wage indicated the same pattern of changes.

second half of 2008, then around 5 percent of men and 11 percent of women are paid below such a threshold.

The characteristics of employed men and women changed between 1998 and 2008. The average age of female workers increased by more than three years and became comparable to that for male workers by 2008. An increase in the average age of workers in Croatia is a result of the 1998 pension reform that raised the legal pension age and increased length of education. However, a comparable average age for men and women in paid employment is somewhat surprising since the legal retirement age for women is five years lower than for men. Two explanations could be given. One relates to the retirement schemes for war veterans and military personal, mostly men, which enable retirement at an earlier age than the legal age. The other is the longer formal education of the female population, which results in a postponement of their labor market participation until a more advanced age.

The better educational attainment of employed women is an important feature of the labor market in Croatia, which might notably have an impact on the gender wage gap. Women spend more years in school than men, 12.1 years compared to 11.6 years, as shown by the data for 2008 in Table 1. A substantially higher portion of female employees completed tertiary education compared to male employees, 24 percent compared to 15 percent in 2008.[11] Changes in the actual work experience correspond to changes in the average age. It should be noted that in 2008 the actual work experience for women was one year lower than that for men, but this difference has shrunk since 1998 when it was more than two years. Tenure (the number of years with the same employer) increased between 1998 and 2008 for both male and female workers to more than eleven years, reflecting a consolidation of the Croatian business sector. This also points to relatively weak worker flows on average, although these flows can be significant in certain segments of the labor

11 A significant educational advantage of women is a characteristic of CEE countries, and it can be illustrated by the Eurostat data on the share of employees with tertiary education. For 10 former socialist countries and the current EU member states, 28 percent of female workers had tertiary education, as compared to 19 percent among male workers in 2005 (unweighted averages). In the "old" EU-15 countries, the female educational advantage was lower than in the CEE countries, with 31 percent of highly educated female workers versus 26 percent among male workers.

market.[12] A decreasing share of employment in the public sector was a result of the ongoing process of privatization in the economy. It should be noted that the public/private sector distinction is based on ownership status, with the public sector including also state-owned companies. One may notice a tendency towards the segregation of women in the public sector in 2008 in comparison with 1998. The public sector more often employs workers with higher education but offers lower wages in exchange for some other non-monetary benefits, and this segmentation might have an impact on the gender gap.

3.2 The Raw Gender Wage Gap

The raw gender wage gap is the result of a simple comparison between the average wage earned by men and women. Sometimes we call it the unadjusted gap to differentiate it from the conditional (adjusted) gender wage gap, which is estimated by taking into account differences between male and female labor market characteristics in order to find a "better" measure of the gap. The raw gap could also be calculated by comparing male and female wages at certain points of the wage distributions, for example, by comparing between the 10th percentile of the male and female wage distributions. In this study, we calculate the raw gender wage gap as the difference in log hourly wages between female and male workers. Table 2 presents the raw gap calculated over the entire sample, but also differentiated by sector and education. We calculate it for the average wage and for five points of the wage distribution.

12 The Croatian labor market is characterized by substantial rigidity, which is connected to strict employment protection and the dominance of inflexible employment forms. Flexibility is, however, more common in particular segments of the market, such as small and medium-sized enterprises and the informal sector (Crnković-Pozaić, 2004).

Table 2: *The Raw Gender Wage Gap by Sector and Education Level*

	Mean	*Percentile*				
		10th	25th	50th	75th	90th
1998						
Total	-0.139	-0.123	-0.134	-0.116	-0.134	-0.145
Sector						
Private sector	-0.169	-0.097	-0.134	-0.223	-0.223	-0.154
Public sector	-0.114	-0.203	-0.182	-0.093	-0.089	-0.092
Education						
Primary or less	-0.226	-0.151	-0.192	-0.234	-0.258	-0.300
Secondary	-0.149	-0.124	-0.122	-0.105	-0.148	-0.164
Tertiary	-0.142	-0.051	-0.128	-0.105	-0.182	-0.182
2008						
Total	-0.105	-0.140	-0.148	-0.123	-0.065	-0.038
Sector						
Private sector	-0.149	-0.126	-0.182	-0.154	-0.144	-0.134
Public sector	-0.069	-0.182	-0.098	-0.069	-0.058	-0.105
Education						
Primary or less	-0.189	-0.105	-0.141	-0.223	-0.231	-0.251
Secondary	-0.156	-0.143	-0.168	-0.201	-0.118	-0.095
Tertiary	-0.113	-0.003	-0.054	-0.134	-0.154	-0.169

Note: The raw gender wage gap is calculated as the difference between the female and male log hourly wages.
Source: Author's calculations based on the 1998 and 2008 Labor Force Surveys.

The unadjusted gender gap for the average wage was 13.9 percent in 1998, and it declined to 10.5 percent in 2008.[13] The declining tendency in the average gap is seen in both the private and the public sector. The decline is stronger in the public sector because of structural changes in the sector. The privatization of former state-

13 Note that the raw gender wage gap is calculated as the difference between the female and male log hourly wage and then, for ease of explanation, described in terms of percentage deviation. This is not entirely correct in an arithmetic sense, but more a reasonable and convenient approximation. To be more precise, the raw gap in the average wage of -0.139 in 1998 should be recalculated as 100*(e-0.139 – 1) = -13.0 percent. For 2008, this should be done as 100*(e-0.105 – 1) = -10.0 percent. So, it would be more correct to say that the mean unadjusted gap declined from 13 percent in 1998 to 10 percent in 2008. This same transformation could be done for all the results in the study.

owned enterprises has lowered the influence of such enterprises in the public sector. The sector is more recently dominated by the budgetary part of the public sector, which usually operates with a more equitable wage policy.

The mean gender gap, which is typically lower when approaching higher levels of education, indicates that education in Croatia might be a tool that hinders unequal wage treatment. Also, the gap for tertiary education decreased between 1998 and 2008. The economic background of these changes has been a stable economic growth and an increased demand for highly productive workers. The wage setting mechanisms became more and more market driven and less affected by government policy. Therefore, increased inequality in returns to various productive characteristics was expected. The decline in the mean raw gender gap is an encouraging sign for Croatia in such an environment.

The gender gap may vary depending on the part of the distribution where it is observed. In that respect, we consider two potentially important phenomena – *the glass ceiling* and *the sticky floor*. The glass ceiling is a term used in the literature to describe an unacknowledged barrier that prevents women from advancing to positions of power and responsibility, or more generally to better-paid jobs. In contrast, the sticky floor can be viewed as a situation in which women workers are kept in low-level positions with poor prospects for advancing. If one finds evidence of a widening gap at the upper end of the wage distribution, it could signal the presence of a glass ceiling. If the gap is wider at the bottom end of the distribution, a sticky floor could be in place.

The results are inconclusive in terms of the glass ceiling and the sticky floor for the total raw gap in 1998. In 2008, the gap is notably higher in the lower part of the distribution than at the upper part, but without concentration at the very bottom, i.e., at the 10^{th} percentile. Between 1998 and 2008, the gender wage gap declined at the mean, as we noted above, but such a trend is not observed over the whole wage distribution. The gap actually increased at the lower half of the wage distribution, or more precisely at the 10^{th}, 25^{th}, and 50^{th} percentiles, indicating that the first

impression of an improvement in gender equality in the 2000s does not reflect correctly developments among low- and mid-paid workers.

The public sector, which is characterized by a relatively low gender wage gap on average, appears to be more unfair in terms of payment for low-wage jobs, indicating the presence of a sticky floor. At the 10th percentile of the wage distribution, female wages are about 20 percent lower than male wages. Having assumed compliance with the equal wage regulation in the public sector, one might only conclude that this difference is partially because of the composition effect, where most of the low-wage jobs in the public sector are occupied by women. In 1998 in the private sector, the raw gap was the lowest at the bottom end of the distribution (the 10th percentile) and increased as one moves upward along the wage distribution, but declined again at the 90th percentile, rejecting in this case the glass ceiling hypothesis. In 2008, the pattern of the gap in the private sector somewhat changed – it was the highest at the 25th percentile and declined as one approaches the upper tail of the wage distribution.

As for the gender wage gap at different levels of education, the larger raw gap is observed at higher percentiles of the wage distribution for groups with primary and tertiary education in both 1998 and 2008, while for groups with secondary education a mixed pattern is found. In 1998, the middle part of the distribution is found to have the lowest raw gap, while in 2008 it has the highest gap.

One may notice that the raw gender wage gap for the total workforce might be higher than the gap at each and every education level, such as at the mean or median (the 50th percentile), which seems strange at first sight. The key is the differing gender composition within each level of education. Relatively more women than men are in the group with tertiary education, while the opposite case exists with secondary education. Because tertiary education most often provides higher wages than secondary education, this composition makes it possible for the overall gap to be lower than the gap for each particular education level. This situation leads us to

the heart of the story of the unequal treatment of men and women, the story that is well hidden behind simple comparisons given by the raw gender gap.

4 The Conditional Gender Wage Gap

As the previous section suggested, the size of and changes in the raw gender wage gap are affected by differences in the labor market characteristics of men and women, such as education, and not only by individual wages. If the observed raw gender gap is caused by differences in the stock of human capital between men and women, this implies differences in productivity gains. Wage inequality caused by different productivity can be seen as efficient by economists because of its compliance with the notion of the optimal allocation of resources. However, differing rewards for the same productive characteristics lead to the inefficient allocation of resources. It is, therefore, important to separate the effect of differing productive characteristics from the effect of differing rewards, where the latter is often treated as discrimination. In empirical work, this task is complicated by the existence of unobserved worker and job characteristics, as well as by the gender segmentation of occupations and activities that all influence the gender wage gap, but should not be attributed to the part of the gap pertaining to discrimination. The Machado-Mata (2005) decomposition analysis employed in our study aims to find a possible solution to the problem that is extensively studied in the literature going back to the pioneering works of Blinder (1973) and Oaxaca (1973).

4.1 Methodology

A regression estimate of the wage function is the first step in the decomposition procedure. We have applied wage functions that follow the standard Mincer-type specification (Mincer, 1974), where the log wage rate is regressed to the set of variables representing the individual human capital characteristics of workers, such

as education and experience. Other variables are added to control for the effects of job and employer characteristics.

In addition to the model estimated by the OLS, quantile regressions are employed to enable further insights into the wage structure.[14] The quantile regression technique allows us to explore the effect of each of the explanatory variables across the whole distribution, rather than just the effect upon the mean as is the case with the least squares estimates. The estimation procedure in the quantile regression model can be viewed as the problem of minimizing a sum of absolute residuals.[15] Basically, the solution at different quantiles is found by the asymmetrical weighting of absolute residuals. For the estimation at lower quantiles, the higher weights are given to the negative residuals, and the opposite is done at upper quantiles.

The quantile regression model is formulated as:

$$\ln W_i = X_i'\beta_\theta + u_{\theta i}, \qquad \text{Quant}_\theta\,(\ln W_i \mid X_i) = X_i'\beta_\theta, \tag{1}$$

where $\ln W_i$ denotes the log wage of worker i, X_i is a vector of explanatory variables, $X_{i1} = 1$, and β_θ is a vector of coefficients. $\text{Quant}_\theta(\ln W \mid X)$ denotes the θ^{th} conditional quantile of $\ln W$, conditional on the regressor vector X. The partial derivative of the conditional quantile of $\ln W$ with respect to regressor j, $\partial \text{Quant}_\theta\,(\ln W \mid X) / \partial x_j$ could be interpreted as a marginal change in the θ^{th} conditional quantile due to a marginal change in the j^{th} element of X. Each of these derivatives is given just by $\beta_{\theta j}$, measuring the marginal change mentioned above. An important case appears if the $\beta_{\theta j}$ coefficients vary systematically across θ's, indicating that the marginal effect of a particular explanatory variable is not uniform across different quantiles of the conditional distribution of $\ln W$.

14 Studies using the quantile regression approach include, for example, Bushinsky (1994; 1998) for the analysis of the US wage structure, Machado and Mata (2001) for the wage structure in Portugal, and Garcia, Hernandez and Lopez-Nicolas (2001) for Spain. Newell and Reilly (2001) have used this technique for studying the gender wage gap in transition countries.

15 The method of minimizing absolute deviation (MAD), which embraces the idea of quantile regression, was first proposed by the cosmopolitan Croatian Jesuit Ruđer Josip Bošković (Ruggero Giuseppe Boscovich) in his observations on the Earth's flattening in 1757, even before the least squares work of Gauss in 1809 (see, for example, Teunissen, 2000).

With respect to varying coefficients indicating the gender gap (the coefficient for the gender dummy in the model that includes such a variable, for example), the quantile regression approach enables us to more accurately explore the possible existence of the glass ceiling and the sticky floor.

One possible way of dealing with the problem of differing characteristics is to estimate a single regression model for the entire population and include the gender dummy. The coefficient for the gender dummy could be treated as the gender wage gap. However, wage regressions that include the gender dummy assume equal returns for the observed characteristics of women and men, which may not hold in reality. The coefficients from the wage regressions that have been estimated separately for women and men, if substantially different, point to the unequal rewards to the labor market characteristics included. Our interest is in the effect of such differing rewards. Therefore, we estimate the regression model separately for men and women, as the first step in the decomposition analysis.

In the second step of the decomposition, our aim is to isolate a part of the wage gap that could be explained by the difference in observable productive characteristics between women and men from the part which is due to the difference in rewards for these characteristics between women and men.

In order to decompose the gap into these two parts, we employ the methodology proposed by Machado and Mata (2005), which extends the Oaxaca-Blinder wage decomposition method to quantile regressions.[16] The general idea is to generate a female wage distribution that would emerge if women were given men's labor market characteristics, but continued to receive rewards based on those characteristics as women. Such a counterfactual distribution is compared with the estimated male wage distribution.[17] The gap between identical men and women in terms of their

16 In empirical studies, the Machado-Mata approach was used, for instance, in Albrecht, Björklund and Vroman (2003) for Sweden, Arulampalam, Booth and Bryan (2007) for the EU countries, de la Rica, Dolado and Llorens (2005) for Spain, and Kee (2006) for Australia.

17 Note that this decomposition is not immune to the index number problem, and it could also be made with the counterfactual distribution calculated for women if they retain their own labor market characteristics, but supposedly are paid as men. However, we decide to use the female earnings structure as a reference point.

characteristics could then be attributed to unequal gender treatment. It is called the counterfactual gender wage gap.

The decomposition of the difference between male and female log wage distributions is given by:

$$X^{m'}\beta_{\theta}^{m} - X^{f'}\beta_{\theta}^{f} = (X^{m} - X^{f})'\beta_{\theta}^{f} + X^{m'}(\beta_{\theta}^{m} - \beta_{\theta}^{f}), \quad (2)$$

where superscripts *m* and *f* stand for male and female, respectively. The first term on the right-hand side describes the part of the gap that is based on differing characteristics, while the second term is the part of the gap that is based on differing rewards.

In this study, the Machado-Mata bootstrap technique is applied with certain simplifications, as suggested by Albrecht, Björklund and Vroman (2003). The estimation procedure can be summarized as follows:

1) Using the male and female datasets separately, the quantile regression coefficient vectors β_{θ}^{m} and β_{θ}^{f} are estimated for each single percentile ($\theta = 1, \ldots 99$).

2) From the male dataset, a sample of size M=100 is drawn at random with replacement for each percentile. The total of M x 99 draws is made.

3) For each percentile, the characteristics of the sampled males are used to predict wages by using the estimated coefficient vectors β_{θ}^{m} and β_{θ}^{f}. This process generates two sets of 9,900 predicted wages, covering the whole distribution, and enables one to calculate the wage distribution for males from one set and the counterfactual wage distribution for females if they have male characteristics from the other set.

4) The counterfactual gap is estimated by taking the difference between the calculated male and female wage distributions.

The procedure has been repeated 200 times in order to estimate standard errors for the calculated distributions.

The gap estimated by the described procedure at various points of the wage distribution is the second part of the decomposed gender wage gap from Equation (2). It points to the wage difference which women would face even if they had the same characteristics as men. This wage difference is due to differing rewards for labor market characteristics, and it is called the counterfactual gender wage gap.

In addition, we calculate *the mean* counterfactual gap by employing the Oaxaca-Blinder technique (Blinder, 1973; Oaxaca, 1973) for the sake of comparison. The mean counterfactual gap is calculated as the difference between the predicted average wages for men and the predicted counterfactual average wages for women. Both predicted wages are calculated as a product of the average male labor market characteristics and the gender specific OLS coefficient estimates.

4.2 Estimates of the Counterfactual Gender Wage Gap

The counterfactual gender wage gap estimates are shown in Table 3. Estimates calculated following the Machado-Mata decomposition approach are shown at five points of the log hourly wage distribution; the 10^{th}, 25^{th}, 50^{th} (median), 75^{th}, and 90^{th} percentiles. Estimates of standard errors are obtained by bootstrapping. Table 3 also reports the counterfactual gender wage gap calculated from the comparable OLS method, as well as the raw gender wage gap.

The counterfactual gender wage gap is estimated using three models that differ in the set of explanatory variables used in wage regressions. Model (1) includes basic human capital variables - education level, experience, and experience squared. The extended Model (2) includes a broad set of variables representing the characteristics that are usually important in wage determination such as employer size, sector of employment, atypical working hours, and rural residence, but without occupation.[18] The "full" Model (3) is the same as the previous one

18 In these regressions we use four dummies for company size, defined with respect to the number of employees. The dummy variable for atypical working hours is defined in order to pick up the effect of unfavorable working conditions and takes the value 1 in two cases: (i) if one always works at nights, and (ii) if one sometimes works at nights and sometimes on Saturdays and Sundays. The public sector dummy variable is introduced for individuals working in state-owned institutions and enterprises.

but includes a set of occupational dummies as regressors.[19] Occupation is usually significant in accounting for the gender wage differences, although it can be rather strongly linked to educational attainment. The inclusion of an occupation variable in the model, together with the education variable, introduces a potential problem with the endogenity of explanatory variables. However, an advantage of having two otherwise identical models, one with and the other without occupation, is that this enables one to account for the additional impact of occupation on the gender wage gap.[20]

An illustration of the models that we applied and the rewards to the above mentioned worker characteristics that are estimated by the quantile regression models is given in Tables A1 and A2 in Appendix. The estimated coefficients indicate differing rewards for men and women, stressing the importance of accounting for gender specific remuneration for labor market characteristics while controlling for the differing characteristics.[21]

The estimated counterfactual gender wage gap is substantially higher than the raw gap on average, as well as at practically all of the observed points of the wage distribution in both years (the 90th percentile gap for Model (3) is an exception). In 2008, the gender wage gap is found to be around 22 percent at the mean in Model (3), which includes the broadest set of explanatory variables. That is more than two times the raw (unadjusted) gap. This finding indicates that, first, there is a rather large "unjustifiable" gender wage gap that can be attributed to women's lower rewards for particular labor market characteristics as compared to men's rewards; and second, the labor market characteristics of employed women are much better than those of employed men, which explains why the raw gap is lower than if

19 Occupation is actually represented by a set of dummy variables for each of the ten main occupation categories defined according to the standard (ISCO) classification.

20 We have considered the inclusion of other control variables such as industry affiliation. Industry wage differentials might be substantial, but in Croatia they might be affected by ownership since there are industries that are clearly dominated by state-ownership such as utilities, education, health care, and public administration. Since we have already covered the ownership effect, variables for industry affiliation are not incorporated in the analysis.

21 As suggested by Tables A1 and A2 in Appendix, which contain estimated coefficients from Model (3) for 1998 and 2008, rewards for experience and education for men are higher than the corresponding rewards for women.

women and men are assumed to have the same distribution of characteristics as in the counterfactual gap estimates.[22]

Table 3: *The Counterfactual Gender Wage Gap*

	OLS	*Percentile*				
		10th	**25th**	**50th**	**75th**	**90th**
1998						
Raw gender wage gap	-0.139 (0.009)	-0.123 (0.018)	-0.134 (0.011)	-0.116 (0.021)	-0.134 (0.010)	-0.145 (0.019)
Counterfactual gender wage gap:						
(1) Gap with education and experience as control variables	-0.167 (0.007)	-0.151 (0.007)	-0.180 (0.006)	-0.183 (0.007)	-0.158 (0.006)	-0.148 (0.010)
(2) Gap with the broad set of control variables, without occupation	-0.167 (0.008)	-0.171 (0.007)	-0.182 (0.006)	-0.178 (0.006)	-0.155 (0.007)	-0.153 (0.009)
(3) Gap with the broad set of control variables, including occupation	-0.201 (0.010)	-0.221 (0.008)	-0.234 (0.006)	-0.235 (0.007)	-0.168 (0.009)	-0.109 (0.010)
2008						
Raw gender wage gap	-0.105 (0.010)	-0.140 (0.016)	-0.148 (0.019)	-0.123 (0.024)	-0.065 (0.017)	-0.038 (0.022)
Counterfactual gender wage gap:						
(1) Gap with education and experience as control variables	-0.191 (0.008)	-0.177 (0.006)	-0.211 (0.006)	-0.214 (0.005)	-0.180 (0.007)	-0.143 (0.007)
(2) Gap with the broad set of control variables, without occupation	-0.187 (0.009)	-0.185 (0.006)	-0.200 (0.005)	-0.196 (0.005)	-0.169 (0.007)	-0.146 (0.008)
(3) Gap with the broad set of control variables, including occupation	-0.220 (0.011)	-0.230 (0.008)	-0.255 (0.006)	-0.251 (0.007)	-0.184 (0.009)	-0.140 (0.009)

Note: The reported counterfactual gap is based on female counterfactuals constructed by using male characteristics and female rewards. The broad set of explanatory variables includes education, experience, employer size, sector, rural residence, atypical working hours, and, if specified, occupation. The standard errors are in parentheses; for the counterfactual gap, they are computed using the bootstrap estimator. All the coefficients are statistically significant at the 1 percent level.
Source: Author's calculations based on the 1998 and 2008 Labor Force Surveys.

22 It should be noted that the counterfactual gender wage gap is estimated as the difference between the male wage distribution and the counterfactual female wage distribution - the latter being the distribution that would emerge if women were given men's labor market characteristics, but continued to receive rewards for those characteristics as women.

Women's higher-quality labor characteristics compensate for a part of the gap. Therefore, in the unadjusted form we observe a gap of around 10.5 percent at the mean in 2008. The feature of having the counterfactual gap wider than the raw gap is not common in market economies. In fact, the opposite is found by Albrecht, Björklund and Vroman (2003) for Sweden and de la Rica, Dolado and Llorens (2005) for Spain. Studying the gap in eleven Western European countries, Arulampalam, Booth and Bryan (2007) found that in the public sector in six countries (Austria, Belgium, France, Ireland, Italy, and Spain), women have better characteristics than men; but this is the case in only one country (Italy) in the private sector. The reasons why women pursue a better education more vigorously than men may be manifold, and compensation for unfair pay practices might be an important one.

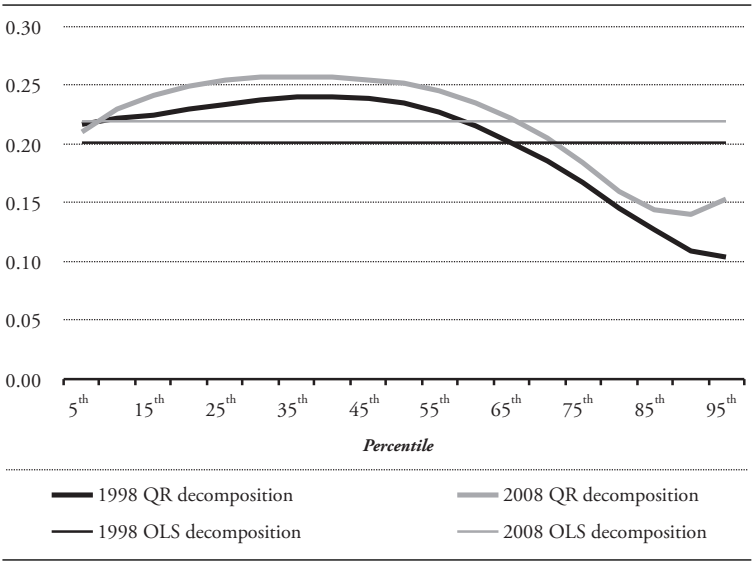
A comparison between the gender wage gaps, estimated using three models - as shown in Table 3 - reveals the importance of differing rewards for education and experience, on one hand, and occupation, on the other hand. Model (1), which contains education and experience as control variables, or more precisely, the model which accounts for differing rewards for education and experience, reveals a relatively large "unjustifiable" gender wage gap (around 17 percent in 1998 and 19 percent in 2008, as estimated by the OLS). The additional control variable in Model (2) did not influence the result strongly. However, there are notable differences in the estimated gap between Models (2) and (3). Model specification is identical except for the inclusion/exclusion of the occupation dummy variables. The addition of occupation increases the gender gap on average in the low and the middle part of the distribution, but decreases it a little at the top of the distribution (the 90th percentile) in both 1998 and 2008. Differing rewards between men and women for responsibilities and competences related to certain occupations apparently contribute to an increase in the counterfactual gap at almost all parts of the distribution.[23]

23 We use only ten broad occupational categories and, therefore, this finding cannot be interpreted as evidence of the discriminatory practice of a "different wage rate for the same job".

A comparison of the counterfactual gaps between 1998 and 2008, as calculated using the broadest set of control variables and depicted in Figure 2, shows moderate but indicative changes. In 1998, the average gender wage gap resulting from differing rewards based on the broad set of labor market characteristics was around 20 percent, and it increased to 22 percent in 2008. A similar increase in the wage gap is found practically at all points of the wage distribution (and in all three models, as Table 3 shows). An increase in this ten-year period, although relatively mild, indicates missing results in the fight to address the true causes of gender inequality in spite of an improved legislative situation in which the Labor Law and the Gender Equality Law (the latter enacted in 2003) both stipulate equal treatment of women in the labor market. Instead, women improve their labor market characteristics, specifically through education and compensate partially for "discrimination" - defined here as receiving differing rewards for the same observed characteristics. Overall, such improvements in the quality of the female workforce lead to a reduction in the gender gap, measured by the difference in the average wages, i.e., by the raw gap, between 1998 and 2008.

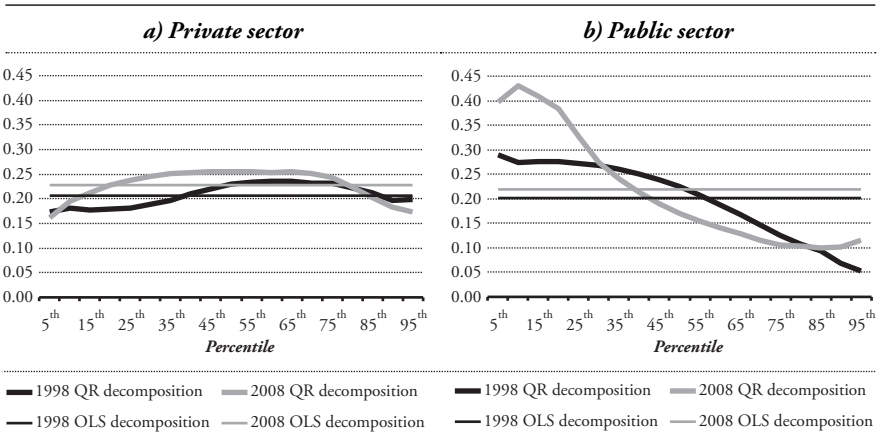
Figure 2 also reveals that the gender wage gap is the highest in the low-to-middle part of the distribution (between 25th and 50th percentiles) and declines as one approaches the upper-middle part of the distribution. This indicates that for relatively well-paid jobs, there is less "discriminatory" practice in giving different rewards for the same characteristics. In 2008, unlike in 1998, the counterfactual gap tends to increase a little at the very top of the distribution. For now, this increase does not provide enough evidence for the presence of the glass ceiling effect. At the bottom part of the wage distribution, the gap is even lower than in the lower-middle part, suggesting that the sticky floor phenomenon is also not valid in describing the gap calculated across the whole economy.

Figure 2: *The Counterfactual Gender Wage Gap*



Note: The counterfactual gap is calculated using the broad set of control variables, including occupation.
Source: Author's calculations based on the 1998 and 2008 Labor Force Surveys.

Figure 3: *The Counterfactual Gender Wage Gap in the Public/Private Sector*



Note: The counterfactual gap is calculated using the broad set of control variables, including occupation.
Source: Author's calculations based on the 1998 and 2008 Labor Force Surveys.

The counterfactual wage gap, estimated separately for the public and the private sector and shown in Figure 3, reveals a differing sectoral pattern of the gap over the wage distributions. In the private sector, the gap varies modestly according to the position within the distribution, from 15 to 25 percent in both 1998 and 2008, being the highest in the middle of the distribution. In the public sector, the sticky floor effect seems evident and more emphasized in 2008 than in 1998. The gap gradually declines towards the upper end of the distribution, although in 2008 it moderately increased at the very end, indicating that the public sector might not be inherently immune to the glass ceiling effect. These findings for Croatia can be compared with the results of Arulampalam, Booth and Bryan (2007) for the EU countries. They found sticky floors in the public sector in Austria, Belgium, France, and Spain; but at the same time, there were indications of glass ceilings in Denmark, Finland, Italy, and the Netherlands. As for the private sector, they found the glass ceiling effect in Denmark, France, Italy, and the Netherlands and some evidence of sticky floors, but only in Austria and Italy. It appears that the pattern of the gap is nation-specific.

As for our estimates for the public sector, one may notice the average counterfactual gap to be at a level comparable to the private sector. However, public sector in this study includes state-owned enterprises. The estimates of the separate gaps for state-owned enterprises and the budgetary public sector (results are not shown here) indicate that the counterfactual gap is on average substantially higher in these enterprises than in the narrow public sector; but the pattern of the gap along the wage distribution is remarkably similar and confirms the existence of a sticky floor in both segments of the public sector.

Anecdotal evidence from newspaper articles have led us to expect to find glass ceilings in the private sector in Croatia, but our results fail to detect that. Our estimates are based on survey data that surely suffer from the problem of underreported wages. This problem might be more articulated in the private sector compared to the public sector where individual wages are more or less well known for the given position and the occupation, and there is no point in hiding them in the

interviews. To overcome this problem, one could use matched employer-employee data, where wages and other information are be taken from company registers. This matched database may also provide important methodological advantages over our current approach. Job characteristics could constitute an important determinant of gender wage differences. If they are unobserved, as in most household surveys, then the decomposition results might be misleading, especially in accounting for occupational and sector segregation. Kunze (2008) notes that the use of such data might reduce the bias resulting from the unobserved heterogeneity of workers. Dohmen, Lehmann and Zaiceva (2008) in their empirical work have used personnel data for a Russian firm and found that the observed individual worker characteristics only explain a small fraction of the gender wage gap. The gap is found to be largely driven by job characteristics, even more than by differences in rewards within the same job level. The extraction of the portion of the total wage gap that is due to discrimination might, therefore, be more convincing if the matched employer-employee data is used.

5 Conclusion

This paper has provided an account of the gender wage gap in Croatia. The empirical evidence was gathered from the LFS microdata and analyzed by applying both the OLS and quantile regression techniques. Our main finding is that women in Croatia receive much lower rewards for their labor market characteristics than men and that such practice worsened between 1998 and 2008. We calculated the counterfactual gender wage gap, that is, the gap which appears by comparing male wages and counterfactual female wages - the latter being defined as wages that would emerge if women were given men's labor market characteristics but continued to receive rewards based on those characteristics as women. The counterfactual gender wage gap can be attributed to differing rewards between men and women. We found that this gap increased from an average of around 20 percent in 1998 to about 22 percent in 2008 in the model that includes the broad set of labor characteristics as control variables. This is probably the best measure of women's

disadvantaged status in the wage setting in Croatia, since it is conditioned on the same observable characteristics for men and women. The counterfactual gap is the largest at the middle of the wage distribution; while at the tails, it is somewhat lower, indicating that the glass ceiling and the sticky floor effects are not relevant for Croatia.

The above findings resulting from Machado-Mata decomposition can be contrasted to the raw gap, which measures gender wage differences without adjustment, either for labor characteristics or for rewards. The unadjusted gender wage gap in Croatia is relatively low within the international context. In 2008, it was estimated to be around 10 percent on average, and it appeared to be lower than in 1998. The counterfactual gap that is higher than the raw gap (by around two times) suggests that employed women possess better labor characteristics than men, and that this advantage compensates for the part of the gap that is due to lower rewards for these characteristics. The estimated counterfactual gender wage gap for Croatia and its relation to the raw gap could be illustrative for other countries in Central and Eastern Europe. A relatively low raw gender wage gap might be higher after accounting for labor characteristics, above all education, as women in many of these countries possess a relative education advantage over men.

The counterfactual gender wage gap tends to isolate the effect of male/female differences in rewards for otherwise identical labor market characteristics. This could be due to discrimination, but also due to the unobserved characteristics of employees and jobs. Future studies may shed more light on these issues. It is worth considering the use of matched employer-employee data as a way to better control heterogeneity, in addition to using alternative decomposition, for example, to provide information on the impact of each variable on the gender wage gap, which was not possible with the Machado-Mata technique. A possible future research could also include a better account of the sample selection bias. The role of institutions should also be studied, especially those aimed at helping to balance work and family life.

Appendix

Table A1: *OLS and Quantile Regressions by Gender, 1998 (Dept. Var.: Log of Hourly Wage)*

	OLS	*Female*			OLS	*Male*		
		10th	50th	90th		10th	50th	90th
Experience	**0.006 (0.002)**	0.006 (0.003)	**0.007 (0.002)**	**0.009 (0.003)**	**0.007 (0.002)**	**0.007 (0.003)**	**0.009 (0.002)**	**0.009 (0.003)**
Experience sq. (/100)	0.000 (0.006)	-0.006 (0.010)	-0.003 (0.006)	-0.002 (0.010)	*-0.008 (0.005)*	*-0.012 (0.007)*	*-0.013 (0.006)*	*-0.016 (0.008)*
Education (vs. unfinished primary)								
Primary	0.044 (0.035)	0.063 (0.046)	**0.072 (0.031)**	-0.013 (0.092)	*0.065 (0.032)*	0.041 (0.042)	*0.102 (0.034)*	0.056 (0.056)
Voc. secondary	*0.077 (0.036)*	*0.102 (0.049)*	*0.088 (0.035)*	0.031 (0.097)	**0.150 (0.033)**	*0.108 (0.044)*	**0.186 (0.035)**	**0.154 (0.056)**
Gen. secondary	**0.184 (0.037)**	**0.206 (0.052)**	**0.201 (0.032)**	*0.161 (0.097)*	**0.202 (0.033)**	**0.172 (0.043)**	**0.243 (0.035)**	**0.197 (0.056)**
2-year college	**0.272 (0.041)**	**0.383 (0.057)**	**0.251 (0.034)**	*0.229 (0.108)*	**0.351 (0.038)**	**0.384 (0.049)**	**0.364 (0.046)**	**0.320 (0.067)**
University graduate	**0.368 (0.045)**	**0.378 (0.066)**	**0.390 (0.043)**	**0.419 (0.112)**	**0.451 (0.048)**	**0.374 (0.066)**	**0.499 (0.058)**	**0.466 (0.082)**
Postgraduate	**0.538 (0.073)**	**0.564 (0.089)**	**0.538 (0.069)**	*0.503 (0.254)*	**0.591 (0.071)**	**0.516 (0.080)**	**0.565 (0.068)**	**0.813 (0.168)**
Occupation (vs. elementary)								
Plant/Machine operator	-0.041 (0.023)	*-0.084 (0.042)*	-0.022 (0.033)	-0.038 (0.036)	0.069 (0.021)	0.007 (0.037)	0.090 (0.023)	*0.076 (0.035)*
Craftsman	**-0.065 (0.026)**	**-0.121 (0.039)**	-0.015 (0.030)	-0.059 (0.054)	0.081 (0.020)	0.045 (0.035)	0.073 (0.022)	0.055 (0.034)
Farming	-0.073 (0.181)	-0.695 (0.430)	0.077 (0.242)	0.188 (0.283)	-0.055 (0.051)	-0.089 (0.080)	-0.020 (0.073)	-0.015 (0.072)
Service and sales	**0.068 (0.020)**	*0.052 (0.031)*	**0.085 (0.023)**	0.023 (0.039)	0.025 (0.022)	-0.039 (0.041)	0.038 (0.029)	*0.062 (0.036)*
Clerk	**0.265 (0.021)**	**0.235 (0.036)**	**0.288 (0.023)**	**0.234 (0.044)**	**0.124 (0.023)**	**0.107 (0.041)**	**0.118 (0.026)**	*0.078 (0.041)*
Technician	**0.363 (0.024)**	**0.345 (0.033)**	**0.399 (0.025)**	**0.302 (0.047)**	**0.218 (0.024)**	**0.185 (0.039)**	**0.212 (0.027)**	**0.200 (0.045)**
Professional	**0.465 (0.034)**	**0.462 (0.053)**	**0.457 (0.039)**	**0.389 (0.077)**	**0.321 (0.042)**	**0.363 (0.058)**	**0.276 (0.051)**	**0.287 (0.071)**
Management and administration	**0.673 (0.064)**	**0.689 (0.097)**	**0.613 (0.049)**	**0.704 (0.252)**	**0.527 (0.052)**	**0.487 (0.092)**	**0.432 (0.069)**	**0.731 (0.108)**
Military	**0.842 (0.112)**	*0.673 (0.264)*	**0.942 (0.194)**	**0.724 (0.152)**	**0.570 (0.029)**	**0.496 (0.070)**	**0.580 (0.042)**	**0.480 (0.053)**

	OLS	*Female*			OLS	*Male*		
		10th	**50th**	**90th**		**10th**	**50th**	**90th**
Firm size (vs. <10 employees)								
10-50 employees	0.006 (0.014)	0.037 (0.026)	0.000 (0.018)	-0.018 (0.026)	0.036 (0.015)	-0.002 (0.029)	0.049 (0.019)	0.010 (0.022)
50-200 employees	0.010 (0.015)	0.028 (0.027)	0.001 (0.015)	-0.012 (0.025)	0.018 (0.015)	0.002 (0.029)	0.006 (0.018)	0.009 (0.026)
Over 200 employees	**0.050** **(0.014)**	**0.067** **(0.024)**	*0.036* *(0.016)*	0.034 (0.027)	**0.085** **(0.016)**	**0.095** **(0.026)**	**0.070** **(0.018)**	**0.049** **(0.023)**
Public	*0.030* *(0.012)*	**0.071** **(0.021)**	**0.045** **(0.013)**	-0.031 (0.021)	**0.040** **(0.012)**	**0.108** **(0.018)**	**0.064** **(0.015)**	*-0.043* *(0.025)*
Rural	**-0.068** **(0.010)**	**-0.055** **(0.019)**	**-0.064** **(0.011)**	**-0.078** **(0.018)**	**-0.045** **(0.011)**	**-0.059** **(0.019)**	**-0.063** **(0.012)**	*-0.034* *(0.019)*
Atypical working hours	0.035 (0.024)	0.016 (0.039)	0.037 (0.027)	0.057 (0.058)	**0.061** **(0.015)**	**0.077** **(0.025)**	**0.052** **(0.017)**	*0.045* *(0.023)*
Constant	**1.975** **(0.038)**	**1.591** **(0.048)**	**1.930** **(0.034)**	**2.414** **(0.093)**	**2.131** **(0.035)**	**1.765** **(0.054)**	**2.074** **(0.036)**	**2.620** **(0.056)**
(Adj. R^2) Pseudo R^2	0.466	0.351	0.434	0.382	0.315	0.223	0.255	0.282

Note: The robust standard errors from the OLS and bootstrap standard errors from quantile regressions are in parentheses. Bold numbers indicate statistical significance at the 1 percent level, whereas italics indicate significance at the 10 percent level.
Source: Author's calculations based on the 2008 LFS.

Table A2: *OLS and Quantile Regressions by Gender, 2008 (Dept. Var.: Log of Hourly Wage)*

	OLS	*Female*			OLS	*Male*		
		10th	**50th**	**90th**		**10th**	**50th**	**90th**
Experience	**0.010**	**0.008**	**0.009**	**0.012**	**0.014**	**0.013**	**0.013**	**0.021**
	(0.002)	**(0.002)**	**(0.002)**	**(0.003)**	**(0.002)**	**(0.003)**	**(0.002)**	**(0.003)**
Experience sq. (/100)	**-0.013**	-0.010	**-0.010**	**-0.020**	**-0.027**	**-0.023**	**-0.025**	**-0.044**
	(0.004)	(0.007)	**(0.005)**	**(0.007)**	**(0.004)**	**(0.009)**	**(0.005)**	**(0.008)**
Education (vs. unfinished primary)								
Primary	-0.002	-0.032	-0.022	-0.038	0.057	-0.051	0.062	0.109
	(0.062)	(0.176)	(0.071)	(0.156)	(0.049)	(0.100)	(0.058)	(0.080)
Voc. secondary	0.027	-0.066	0.019	0.019	**0.167**	0.081	**0.165**	*0.200*
	(0.063)	(0.180)	(0.071)	(0.154)	**(0.048)**	(0.103)	**(0.061)**	*(0.081)*
Gen. secondary	*0.112*	0.032	0.105	0.136	**0.201**	0.101	**0.192**	**0.239**
	(0.063)	(0.177)	(0.071)	(0.157)	**(0.050)**	(0.105)	**(0.062)**	**(0.084)**
2-year college	**0.275**	0.211	**0.276**	0.254	**0.323**	**0.283**	**0.295**	**0.359**
	(0.065)	(0.185)	**(0.072)**	(0.161)	**(0.054)**	**(0.105)**	**(0.065)**	**(0.101)**
University graduate	**0.290**	0.188	**0.266**	*0.322*	**0.397**	**0.265**	**0.406**	**0.420**
	(0.068)	(0.176)	**(0.075)**	*(0.177)*	**(0.072)**	**(0.128)**	**(0.096)**	**(0.118)**
Postgraduate	**0.562**	*0.322*	**0.601**	**0.744**	**0.547**	**0.319**	**0.601**	**0.655**
	(0.094)	*(0.192)*	**(0.105)**	**(0.213)**	**(0.098)**	**(0.203)**	**(0.121)**	**(0.215)**
Occupation (vs. elementary)								
Plant/Machine operator	**-0.060**	0.002	-0.036	-0.056	**0.099**	**0.105**	**0.095**	**0.145**
	(0.024)	(0.036)	(0.031)	(0.047)	**(0.023)**	**(0.039)**	**(0.033)**	**(0.044)**
Craftsman	0.014	0.058	0.036	-0.008	**0.126**	**0.116**	**0.110**	**0.158**
	(0.032)	(0.060)	(0.043)	(0.075)	**(0.022)**	**(0.034)**	**(0.031)**	**(0.042)**
Farming	*-0.142*	-0.103	-0.110	-0.026	0.019	0.042	0.053	0.101
	(0.076)	(0.330)	(0.089)	(0.101)	(0.048)	(0.064)	(0.071)	(0.081)
Service and sales	**0.100**	**0.164**	**0.123**	**0.064**	**0.089**	**0.101**	*0.083*	*0.111*
	(0.021)	**(0.034)**	**(0.026)**	**(0.040)**	**(0.026)**	**(0.037)**	*(0.036)*	*(0.045)*
Clerk	**0.282**	**0.326**	**0.304**	**0.201**	**0.146**	**0.206**	**0.124**	**0.143**
	(0.022)	**(0.038)**	**(0.026)**	**(0.047)**	**(0.026)**	**(0.055)**	**(0.040)**	**(0.043)**
Technician	**0.382**	**0.415**	**0.395**	**0.335**	**0.351**	**0.358**	**0.335**	**0.408**
	(0.025)	**(0.042)**	**(0.029)**	**(0.054)**	**(0.027)**	**(0.044)**	**(0.036)**	**(0.060)**
Professional	**0.523**	**0.541**	**0.513**	**0.512**	**0.410**	**0.418**	**0.357**	**0.550**
	(0.034)	**(0.049)**	**(0.040)**	**(0.085)**	**(0.059)**	**(0.076)**	**(0.085)**	**(0.088)**
Management and administration	**0.817**	**0.861**	**0.834**	**0.906**	**0.701**	**0.409**	**0.608**	**1.027**
	(0.058)	**(0.091)**	**(0.080)**	**(0.149)**	**(0.081)**	**(0.120)**	**(0.113)**	**(0.093)**
Military	**0.549**	*0.859*	*0.585*	*0.237*	**0.307**	**0.462**	**0.265**	*0.205*
	(0.035)	*(0.405)*	*(0.284)*	*(0.127)*	**(0.036)**	**(0.063)**	**(0.056)**	*(0.090)*

	OLS	*Female*			OLS	*Male*		
		10th	**50th**	**90th**		**10th**	**50th**	**90th**
Firm size (vs. <10 employees)								
10-50 employees	**0.059 (0.014)**	0.029 (0.022)	**0.065 (0.019)**	**0.074 (0.025)**	0.025 (0.016)	*0.039 (0.021)*	0.023 (0.017)	-0.009 (0.023)
50-200 employees	**0.061 (0.015)**	**0.058 (0.021)**	**0.057 (0.019)**	*0.057 (0.029)*	**0.054 (0.016)**	**0.084 (0.020)**	*0.044 (0.019)*	0.005 (0.021)
Over 200 employees	**0.106 (0.016)**	**0.058 (0.021)**	**0.122 (0.021)**	**0.122 (0.030)**	**0.101 (0.016)**	**0.115 (0.026)**	**0.095 (0.017)**	**0.074 (0.024)**
Public	**0.035 (0.013)**	**0.163 (0.020)**	*0.042 (0.017)*	*-0.051 (0.027)*	**0.078 (0.012)**	**0.153 (0.021)**	**0.095 (0.015)**	-0.017 (0.016)
Rural	**-0.076 (0.010)**	**-0.091 (0.016)**	**-0.053 (0.013)**	*-0.048 (0.022)*	**-0.069 (0.012)**	**-0.070 (0.018)**	**-0.072 (0.015)**	-0.027 (0.020)
Atypical working hours	**0.057 (0.019)**	0.034 (0.030)	**0.079 (0.024)**	*0.078 (0.044)*	**0.073 (0.015)**	0.016 (0.023)	**0.066 (0.016)**	**0.097 (0.021)**
Constant	**2.557 (0.064)**	**2.282 (0.178)**	**2.533 (0.072)**	**2.884 (0.149)**	**2.610 (0.054)**	**2.320 (0.101)**	**2.644 (0.072)**	**2.870 (0.085)**
(Adj. R^2) Pseudo R^2	0.622	0.351	0.434	0.382	0.416	0.223	0.255	0.282

Note: The robust standard errors from the OLS and bootstrap standard errors from quantile regressions are in parentheses. Bold numbers indicate statistical significance at the 1 percent level, whereas italics indicate significance at the 10 percent level.
Source: Author's calculations based on the 2008 LFS.

Literature

Albrecht, James, Anders Björklund and Susan Vroman, 2003, "Is There a Glass Ceiling in Sweden?", *Journal of Labor Economics* 21(1), pp. 145-177.

Arulampalam, Wiji, Alison L. Booth and Mark L. Bryan, 2007, "Is There a Glass Ceiling over Europe? Exploring the Gender Pay Gap across the Wages Distribution", *Industrial and Labor Relations Review*, 60(2), pp. 162-186.

Bisogno, Marcelo, 2000, "Croatian Labor Market in Transition" in World Bank, "Croatia: Economic Vulnerability and Welfare Study", Volume II: Technical Papers, Document of the World Bank, Washington, DC: The World Bank.

Blinder, Alan, 1973, "Wage Discrimination: Reduced Form and Structural Estimates", *The Journal of Human Resources*, 8(4), pp. 436-455.

Brainerd, Elizabeth, 2000, "Women in Transition: Changes in Gender Wage Differentials in Eastern Europe and the Former Soviet Union", *Industrial and Labor Relations Review*, 54(1), pp. 138-162.

Buchinsky, Moshe, 1994, "Changes in the U.S. Wage Structure 1963-1987: Application of Quantile Regression", *Econometrica*, 62(2), pp. 405-458.

Buchinsky, Moshe, 1998, "The dynamics of changes in the female wage distribution in the USA: a quantile regression approach", *Journal of Applied Econometrics*, 13(1), pp. 1-30.

Central Bureau of Statistics of the Republic of Croatia, various years, *Statistical Yearbook*, Zagreb: Central Bureau of Statistics of the Republic of Croatia.

Crnković-Pozaić, Sanja, 2004, "Flexibility and Security in the Labour Market. Croatia's Experience", Flexicurity papers, No. 2004/1, Budapest: International Labour Office.

De la Rica, Sara, Juan J. Dolado and Vanesa Llorens, 2005, "Ceiling and Floors: Gender Wage Gaps by Education in Spain", IZA Discussion Papers, No. 1483, Bonn: Institute for the Study of Labor (IZA).

Dohmen, Thomas, Hartmut Lehmann and Anzelika Zaiceva, 2008, "The gender earnings gap inside a Russian firm: First evidence from personnel data -1997 to 2002", *Journal for Labour Market Research*, 41(2/3), pp. 157-180.

Garcia, Jaume, Pedro J. Hernandez and Angel Lopez-Nicolas, 2001, "How wide is the gap? An investigation of gender wage differences using quantile regression", *Empirical Economics*, 26(1), pp. 149-167.

Kee, Hiau Joo, 2006, "Glass Ceiling or Sticky Floor? Exploring the Australian Gender Pay Gap", *The Economic Record*, 82(259), pp. 408-427.

Kunze, Astrid, 2008, "Gender wage gap studies: consistency and decomposition", *Empirical Economics*, 35(1), pp. 63-76.

Machado, José A. F. and José Mata, 2001, "Earnings functions in Portugal 1982-1994: evidence from quantile regressions", *Empirical Economics*, 26(1), pp. 115-134.

Machado, José A. F. and José Mata, 2005, "Counterfactual decomposition of changes in wage distributions using quantile regression", *Journal of Applied Econometrics*, 20(4), pp. 445-465.

Matković, Teo, 2008, "Tko što radi? Dob i rod kao odrednice položaja na tržištu rada u Hrvatskoj" (Who Does What? Age and Gender as Determinants of the Position on the Labour Market in Croatia), *Revija za socijalnu politiku*, 15(3), pp. 479-502.

Mincer, Jacob, 1974, *Schooling, Experience and Earnings*, New York: National Bureau of Economic Research.

Nestić, Danijel, 2005, "The Determinants of Wages in Croatia: Evidence from Earnings Regressions" in Željko Lovrinčević et al., eds., *65th Anniversary Conference of the Institute of Economics, Zagreb, Proceedings*, pp. 131-162, Zagreb: The Institute of Economics.

Nestić, Danijel and Ivana Rašić-Bakarić, 2008, "From work to retirement: Pension system incentives to continued labour market participation in Croatia" in Maja Vehovec, ed., *New Perspectives on a Longer Working Life in Croatia and Slovenia*, pp. 81-99, Zagreb: The Institute of Economics and Friedrich-Ebert-Stiftung.

Newell, Andrew T. and Barry Reilly, 2001, "The gender pay gap in the transition from communism: some empirical evidence", *Economic Systems*, 25(4). pp. 287-304.

Oaxaca, Ronald L., 1973, "Male-Female Wage Differentials in Urban Labor Markets", *International Economic Review*, 14(3), pp. 693-709.

Orazem, Peter F. and Milan Vodopivec, 1995, "Winners and Losers in Transition: Returns to Education, Experience, and Gender in Slovenia", *The World Bank Economic Review*, 9(2), pp. 201-230.

Paci, Pierella and Barry Reilly, 2004, *Does Economic Liberalization Reduce Gender Inequality in the Labor Market? The Experience of the Transitional Economies of Europe and Central Asia*, Washington DC: The World Bank.

Pastore, Francesco and Alina Verashchagina, 2007, "When Does Transition Increase the Gender Wage Gap? An Application to Belarus", IZA Discussion Papers, No. 2796, Bonn: The Institute for the Study of Labor (IZA).

Rutkowski, Jan, 2001, "Earnings Inequality in Transition Economies of Central Europe Trends and Patterns During the 1990s", Social Protection Discussion Paper Series, No. 117, Washington DC: The World Bank.

Teunissen, Peter J. G., 2000, "A Brief Account on the Early History of Adjusting Geodetic and Astronomical Observations", *De Hollandse Cirkel*, 2(1/2), pp. 12-17.