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DO WOMEN BENEFIT FROM MINIMUM WAGES?

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Do Women Benefit from Minimum Wages?

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Abstract:
We study how the large and unexpected increase in the minimum wage in Poland impacted the gender wage gap. For this purpose, we employ a distribution regression model coupled with a difference-in-differences estimator that recovers changes in the gender wage gap with minimum assumptions on the counterfactual wage distribution. We find that the increase in minimum wage closes the gender wage gap by almost 4 percentage points at the bottom of the wage distribution with a small spillover effect around the minimum wage. By contrast, at the top of the wage distribution gender inequality continued to grow. Minimum wage increases reduced gender wage gap even in a context of growing inequality.

JEL: C2, I2, J16
Keywords: Minimum wage, wage gap, distribution-regression, difference-in-difference

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1. Introduction

The minimum wage legislation is an important component of the gender equality policy program. The most evident purpose of the minimum wage legislation is to squeeze the bottom of the wage distribution. Considering that women disproportionately constitute the low paid occupations and industries (Low Pay Commission and others, 2000), the higher wage floor should raise women's wages more than men's wages, which would close the gender wage gap. The size of this decrease may depend on different factors including an initial level of minimum wages, a ratio between the numbers of men and women receiving salaries below the *new* minimum wage, and the extent of gender wage gap before the corresponding minimum wage policy (Robinson, 2002). The aim of the proposed study is to investigate the impact of the abnormal increases in the minimum wage in Poland in 2008-2009 on the gender wage gap. We will provide the estimates of the effect by applying the methodology developed Bargain, Doorley and Van Kerm (2019) to the Polish setup.

In this research, we study the effects of a large, and sudden, increase in minimum wages that took place in Poland. Between 2008 and 2010, minimum wage increased by 35%, at that point, minimum wages reached over 40% of the average wage at the national level, and over 60% of the average wage in some regions (Kamińska and Lewandowski (2015)). More importantly, the increase was unexpected. It was much larger than the minimum wage increments in the preceding years, when raises did not keep up with the average wage. Moreover, unlike previous increases, the change in 2008 was announced on a different date, much closer to the actual implementation, leaving firms much less time to adjust labor demand.

Our paper relates to several branches of the gender wage gap literature. First, we contribute to the studies which document the existence of the gender wage gap. Early research on the gender wage gap decompose mean differences in earnings using the classical linear regression model. Blinder (1973) and Oaxaca (1973) develop the Blinder-Oaxaca technique to decompose the difference in gender payments in two parts, explained and unexplained. The first part refers to the difference in earnings caused by observed characteristics such as age, education, work experience, marital status, etc. The second part represents the group difference in unobserved factors.

A number of papers document the existence of the gender wage gap across different

countries. Arulampalam, Booth and Bryan (2007) compare the selected eleven countries in Europe with respect to the wage distribution in different sectors.[1] They find that women are paid less than men in all countries considered. The magnitude of the gap in payments significantly differs across the countries and the wage distribution. Beblo, Beninger, Heinze and Laisney (2003) reach a similar conclusion by analyzing the gender pay gap in five European countries (France, Germany, Italy, Spain and United Kingdom) using the Oaxaca-Blinder and Juhn-Murphy-Pierce technique. Furthermore, Olivetti and Petrongolo (2008) show that gender wage gaps across countries are negatively correlated with gender employment gaps.

Second, our study contributes to the literature on the difference in gender payments at different parts of the wage distribution. For instance, Albrecht et al. (2003) find that the gender wage gap in Sweden differs at different part of the wage distribution. They interpret this result as the evidence of "glass ceiling [2] ". In contrast, De La Rica, Dolado and Vegas (2010) investigate a glass ceiling effect in Spain and find that it is present at the top of the wage distribution for more educated people and at the bottom of the wage distribution for less educated people. Booth, Francesconi and Frank (2003) define a "sticky floor [3]" situation in the British labor market. Furthermore, Chzhen and Mumford (2011) document that gender wage gap gap persists within white-collar occupations carrying out managerial duties in Great Britain. Tyrowicz et al. (2018) show that gender wage-gap varies with the age in Germany and increases over a birth cohort's lifetime.

Finally, our paper is related to studies that evaluate the effect of the minimum wage increase on gender wage gap. A large strand of the literature investigates the problem of women predominantly occupying less paying positions. Macpherson and Hirsch (1995) show that levels of earnings are substantially lower in those workplaces that are dominated by women. The aim of the minimum wage policy is to increase earnings in those places and, therefore, this would generate equality between earnings for men and women.

[1]The authors study the data from European Community Household Survey for Austria, Belgium, Britain, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Spain.

[2]Glass ceiling means that the difference in the earnings between two genders increases through the wage distribution and is particularly high at the top.

[3]Sticky floor means that women tend to be promoted at almost the same rate as men, but the consequent salary increases upon the promotion are usually smaller.

There are several studies that directly examine the effect of minimum wages on gender wage inequality. Dex, Sutherland and Joshi (2000) analyze the impact of the minimum wage introduction on the overall gender wage gap in UK. They suggest that the wage floor introduction would have only a small effect on the overall gender wage difference. Intuitively, the minimum wage affects wages of both genders and mostly at the bottom of the wage distribution only and, therefore, it has a little impact on the average wage. Similarly, Dickens and Manning (2004) show that the minimum wage introduction in UK in 1999 had a very little impact on squeezing a gender wage gap as it affected very small proportion of workers. However, they find that the subsequent increase in minimum wages in 2001 contributed stronger to the decline in the wage gap. Bargain, Doorley and Van Kerm (2019) assess the overall impact of the minimum wage introduction on gender wage differences in UK and Ireland by analysing different quantiles of the wage distribution. They document a large decline in gender wage differences at the bottom of the wage distribution after the minimum wage introduction with small spillover effects in the middle of the distribution. Ganguli and Terrell (2009) show that the minimum wage increase in Ukraine decreases the difference in earnings between men and women, especially at the bottom of the wage distribution. In the polish context, Majchrowska and Strawiński (2018) analyze the impact of minimum wage increase on gender inequality in Poland. The authors conclude that higher wage floor affects young less experienced workers. Similarly to European studies, Lee (1999) and David, Manning and Smith (2016) explore the cross-state variation in federal minimum wages in USA and conclude that higher minimum wages reduce inequality in the lower tail of the wage distribution, especially for women.

To sum up, our research contributes to the literature that looks at the impact of minimum wage increase on gender wage gap in Poland. In contrast to Majchrowska and Strawiński (2018), we employ a fully non-parametric decomposition of gender wage difference and its change over time. Our estimates suggest that higher minimum wage reduces inequality in the lower tail of the wage distribution.

The paper proceeds as follows. Section 2 provides the description of minimum wage policy in Poland. Section 3 describes the modelling design of the study and empirical specification of the model together with robustness checks. Section 4 presents the data. Section 5 presents the preliminary results. Section 7 concludes.

2. Minimum Wage and Gender Wage Gap in Poland

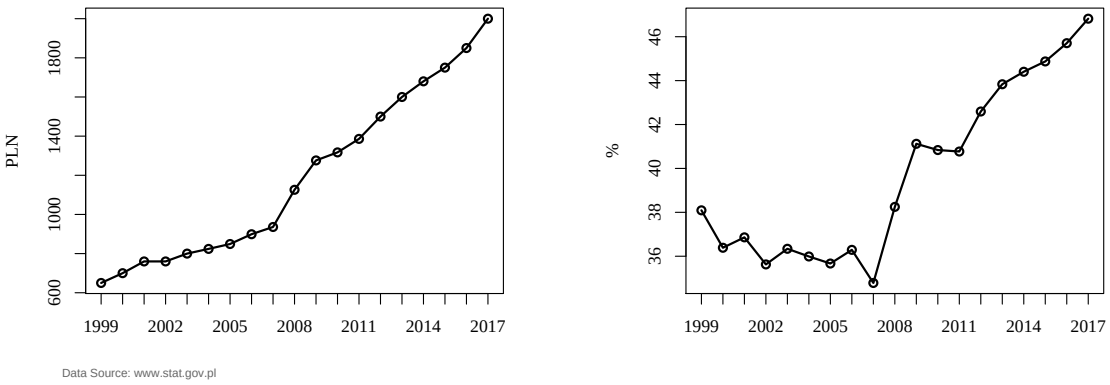
The government-mandatory minimum wage in Poland exists since 1956. Since 2002, the Tripartite Commission for Social and Economic Affairs updates the minimum wage annually. The commission includes government representatives, trade union members, and members of employers' organizations. The commission meets once a year with the goal of deciding the minimum wage level for the following year. To a certain extent, legislation constrains the choice set for the commission. The new minimum wage should not be lower than the previous level, adjusted to the estimated future level of consumer price index (CPI). Moreover, according to the modifications introduced in 2006, if the minimum wage falls below 50% of the average wage in the economy, then minimum wage growth in the following year cannot be smaller than two thirds of the forecast GDP growth.

The polish legislation requires all labour-market participants to obey the minimum wage law. However there are certain exceptions. The wage floor allows wages below the minimum level for workers at the beginning at their professional career. Workers in the first year of their employment face a minimum wage equal to 80 percent of the statutory minimum wage. Moreover, between 2002 and 2006, workers with less than two years of experience faced a minimum wage equal to 90 percent of the statutory level. Another restriction in the minimum wage legislation does not cover employees in non-standard work agreements, i.e., those cover by civil law contracts. The compliance with minimum wage legislation in Poland appears to be at the level similar to other Central and Eastern European countries

Figure 1 represent the historical fluctuations in the level of minimum wage in Poland from 1999 to 2017.

The size of the wage up-ratings fluctuated considerably from 0% between 2001 and 2002, when the minimum wage stayed flat at 760 PLN, to 20.3% in 2008, when the wage floor was increased from 936 PLN in the previous year to 1,126 PLN. The first noticeable rise of around 8% happened between 2000 and 2001. In the subsequent period from 2002 to 2007, minimum wage growth was slower and relatively stable leading to an increase from 760 PLN to only 936 PLN over the whole five-year period. After 2007 there were two consecutive episodes when the national wage floor was significantly raised. These raises were of 20.3% in 2008 and 13.3% in 2009. This rapid growth was followed by

Figure 1: Dynamics of minimum wage in Poland



(a) Minimum wage

(b) Minimum-to-average wage ratio

increases smaller than 5% in 2010-2011,. Minimum wage growth picked up again in the period 2012-2018, though it never reached rates observed in 2008 and 2009. Analyzing the entire period, the minimum wage increased more than threefold from 650 PLN in 1999 to 2,000 PLN in 2017. According to Eurostat, in the same two decades, the price index grew by around 53%. In other words, the minimum wage in Poland increased by more than what was needed to keep up with inflation.

Figure 2: Gender Wage Gap in Poland 2000-2014

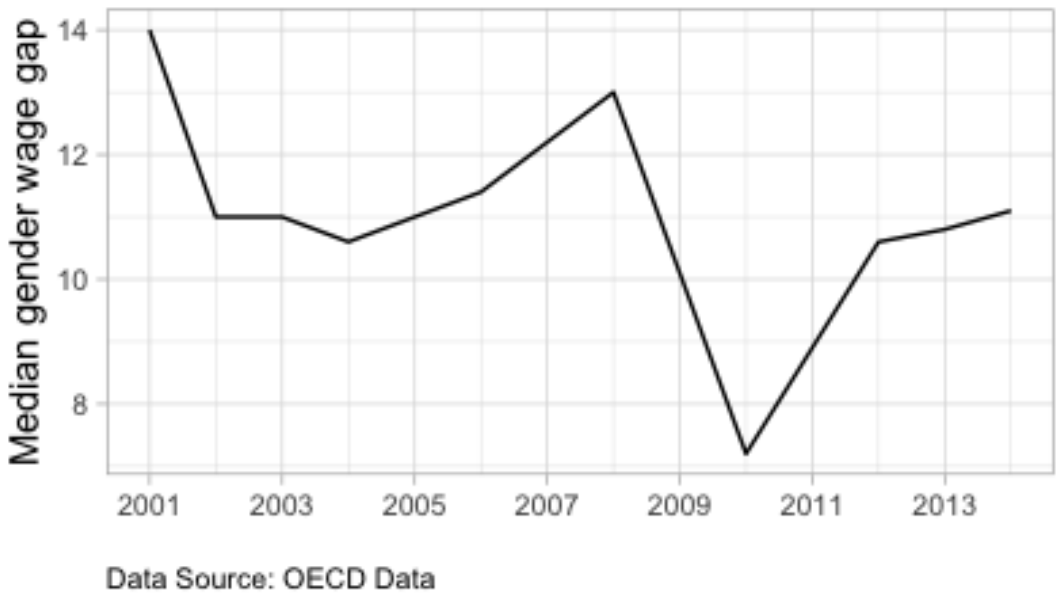


Figure 2 presents the dynamics of the gender wage gap in Poland over the period

2000-2014. According to the OECD definition, the wage gap is defined as the difference between the median earnings of men and of women as a proportion of the median earnings of men. This measure is unadjusted: it is not corrected for differences in characteristics between men and women that may explain a part of the earnings gap. According to the graph, the gap was positive and relatively stable between 2001-2008, with the median men's earnings being 11-13% higher than median women's earnings. However, the unadjusted gender wage gap in Poland decreased by almost half from 13% 2008 to 7% in 2010. The decline is also documented in Goraus and Tyrowicz (2014), who demonstrates a similar fall in the adjusted gender wage gap at the mean.

This decline in the gender wage gaps (adjusted or otherwise) is subsequent to the two largest increases in minimum wages, which were observed in 2008 and 2009. But, clearly the period also coincides with the apex of the recent financial crisis. During a crisis period, the wage structure might be more compressed, as workers have lower bargaining power. This might be true in Poland as well, even though the country famously managed to grow during the financial crisis.

Arguably, the wage compression effect could decrease the gender wage gap by reducing wages at the top of the income distribution. By contrast, minimum wage increases should have a stronger effect in closing the gap among those at the bottom of the income distribution. Given the context of a positive gender wage gap, the financial crisis would have equalized earnings by bringing down men's earnings, whereas minimum wage increases led to raises in women's earnings. To disentangle the two possible effects, we use the quantile decomposition presented in Bargain, Doorley and Van Kerm (2019) and described in the next section.

3. Gender Wage Gap and Distribution Regression Model

Since the now classical contributions of Oaxaca (1973) and Blinder (1973), it is recognized that studying differences in mean outcomes is insufficient to understand the true extent of inequality in outcomes between two groups. Both Oaxaca (1973) and Blinder (1973) advocated the use of parametric decompositions that break-down differences in outcomes into two components. The first component refers to the difference in economic outcomes that is expected given differences in productive characteristics. In the context of gender, it might be related to the fact that men and women chose different career

paths or retire at different ages. The second component identifies the differences that cannot be explained away by productive characteristics. This component is usually referred to as adjusted or unexplained, and it serves as a proxy for discrimination in wages, employment, or any other economic outcome. In this research, we employ the approach suggested by Bargain, Doorley and Van Kerm (2019) to study changes in the unexplained component over time. [4]

As it is common in the context of Oaxaca-Blinder decompositions (see Fortin et al., 2011, for a convenient summary), it is possible to define two types of wage distributions: observed and counterfactual. The observed distribution function is just the empirical wage distribution function observed in the data. This distribution can describe the whole population, or it can be obtained independently for population subgroups, such as those defined on the basis of education attainment, country of origin, or gender. The counterfactual wage distribution function, by contrast, cannot be observed directly. It answers the question on what is the distribution of wages that women (men) would observe if they had the same distribution of characteristics as men (women). Clearly, except for the extremely unlikely case where men and women had the exact same distribution of characteristics, one has to construct the counterfactual wage distribution from the available data.

Obtaining the counterfactual wage distribution defines the entire decomposition method. Bargain, Doorley and Van Kerm (2019) propose a relatively straightforward approach to computing the observed and the counterfactual wage distribution, which will later be used to computed adjusted gender wage gap, and its differences over time. In a nutshell, their approach amounts to estimating the conditional wage distribution independently for members of each subgroup (men-women) using a generalized linear model. Having obtained parameters from the GLM models, one can employ them to obtain estimates of the own conditional wage distribution (when parameters come from them model using observations of the same gender) or the counterfactual conditional wage distribu-

[4]Double decomposition was introduced earlier to the literature by Smith and Welch (1989) in the context of a decomposition. Blau and Kahn (1992) propose a similar double-decomposition, though in their case, the double part refers to countries and not time periods. More recently Tyrowicz et al. (2018) use a double decomposition employing cross sectional data and a non-parametric first stage. These articles decompose changes in the *raw* wage gaps, while Bargain, Doorley and Van Kerm (2019) decompose changes in the *adjusted* wage gap.

tion (when parameters come from them model using observations of the same gender). Bargain, Doorley and Van Kerm (2019) propose to then move to the unconditional wage distribution by simply computing the averages over the sample. The difference between the actual and the counterfactual wage distributions represents the adjusted gender wage gap.

In more detail, the decomposition proposed by Bargain, Doorley and Van Kerm (2019) starts by defining the conditional distribution function as follows:

$$F_{s,p}^{g,t}(w) = \int_{\Omega_h} \int_{\Omega_j} F^{g,t}(w|x,c) h_{s,p}(x,c) dc dx, \tag{3.1}$$

where $F^{g,t}(\cdot|x,c)$ is the conditional wage distribution function given job-related x and individual-specific characteristics c in the gender group $g \in \{m,f\}$ and time period $t \in \{b,a\}$. Here b represents the period before the minimum wage increase, and a after. Further, $h_{s,p}$ is the density distribution function of the job related and individual-specific characteristics in group $s \in \{m,f\}$ and period $p \in \{b,a\}$. Thus, in the expression $F_{s,p}^{g,t}$ the superscript refers to the conditional wage distribution and the subscript refers to the covariate distribution. Hence, $F_{s,p}^{g,t}$ can be used to represent the observed wage distributions (when subscripts matched superscripts) or counterfactual wage distribution (when they do not match). For instance, the notation $F_{f,a}^{f,a}$ stands for $female\ after$ the minimum wage increase period, with $female\ after$ covariate characteristics, in other words an observed distribution. We can derive the sample estimate of $\hat{F}_{f,a}^{f,a}$ by estimating a probit model where the dependent variable is the probability that an individual earns a wage below w among women in $after$ period, computing the predicted probability for each observation, and then averaging over all female workers in $after$ period. Mathematically,

$$\widehat{F}_{f,a}^{f,a}(w) = \frac{1}{N_{f,a}} \sum_{i=1}^{N_{f,a}} \widehat{F}^{f,a}(w|x_i, c_i) \tag{3.2}$$

Similarly, $F_{f,a}^{m,a}(w)$ represents a counterfactual wage distribution function. It can be interpreted as the wage distribution that female workers would observe in the $after$ period, had they have the same distribution of characteristics as male workers. The empirical equivalent of this counterfactual wage distribution is given by:

$$\widehat{F}_{f,a}^{m,a}(w) = \frac{1}{N_{f,a}} \sum_{i=1}^{N_{f,a}} \widehat{F}^{m,a}(w|x_i, c_i) \tag{3.3}$$

The model estimates $\widehat{F}_{f,a}^{m,a}$ from a probit model estimated over the *male after* sample, where the dependent variable is the probability that wages are smaller or equal than w. Then, coefficients are used to recover predicted probabilities in the *female after* sample. Following these definitions, one can define the *adjusted* gender wage gap in period $t \in \{b, a\}$ as the difference between the counterfactual distribution and the observed [5]:

$$\begin{aligned} \widehat{GAP}^{b}(w) &= \hat{F}_{f,t}^{f,t}(w) - \hat{F}_{f,t}^{m,t}(w) \\ &= \frac{1}{N_{f,t}} \sum_{i=1}^{N_{f,t}} \left(\hat{F}^{f,t}(w|x_i, c_i) - \hat{F}^{m,t}(w|x_i, c_i) \right) \end{aligned} \tag{3.4}$$

In this decomposition, a positive difference indicates the existence of a gender wage gap in favour of men, whereas negative values have the opposite interpretation. To understand why, we need to remind the interpretation of each term. The first term indicates the predicted proportion of women that earn wages below w in t, whereas the second term indicates the predicted proportion of women that *would* earn wages below w in t if they were remunerate at par with men. Given that equation 3.4 analyzes a difference in proportions, it takes only values between negative one and one. And again, a value of zero does not necessarily mean that men and women earn similar wages, it means that if any difference exists, it is only due to differences in productive characteristics.

Having defined the adjusted gender wage gap for each period t, one can analyze its changes before and after institutional changes, in this case the increase in the minimum wage. The change in the adjusted wage gap is given by:

$$\widehat{GAP}(w) = \widehat{GAP}^{b}(w) - \widehat{GAP}^{a}(w) \tag{3.5}$$

We cannot interpret this difference as the change in unjustified inequality. In fact, two elements change simultaneously, unjustified inequality and the distribution of characteristics over which the unjustified inequality was computed in each period. While in "normal times" one could dismiss the second component and assume that the distribution of characteristics is constant, the assumption becomes more problematic when changes involve raises in the minimum wages, which are likely to impact selection into employment. To identify the pure changes in inequality, we follow Bargain, Doorley and Van Kerm (2019). They showed that the change in the adjusted gender wage gap can

[5] Similarly to Bargain et al. (2019), we use a counterfactual wage distribution of female workers, to estimate the gender wage gap at different along the wage distribution.

be decomposed into two subcomponents a "pure wage effect," which reflects changes in which individuals are remunerated, and a "composition effect", which represents changes on employment structure. The change in the gap can then be decomposed in the following terms

$$\begin{aligned}\widehat{GAP}(w) &= \left[\left(\hat{F}^{f,b}_{f,b}(w) - \hat{F}^{m,b}_{f,b}(w)\right) - \left(\hat{F}^{f,a}_{f,b}(w) - \hat{F}^{m,a}_{f,b}(w)\right)\right] \\ &+ \left[\left(\hat{F}^{f,a}_{f,b}(w) - \hat{F}^{m,a}_{f,b}(w)\right) - \left(\hat{F}^{f,a}_{f,a}(w) - \hat{F}^{m,a}_{f,a}(w)\right)\right]\end{aligned} \tag{3.6}$$

where the first difference in squared brackets captures the price effect (unexplained factors) and the second difference captures the composition effect of the change in characteristics (explained factors). A positive sign of the first difference indicates that prices moved in a direction that favors women. In a context of a persisting gender wage gap favoring men, as observed in Poland (Goraus and Tyrowicz, 2014), it means that the price effect is becoming less relevant. By contrast, when the difference is negative, prices moved in a direction that favors men, and the gender wage gap grew over time. Following the earlier discussion, we expect that increases in the minimum wage are associated with decreases in the unexplained factors, at least for the lower percentiles. [6]

4. Data and Descriptive Statistics

The paper uses Structure of Wages and Salaries by Occupations (SWSO) in Poland as a main source of data. This database is a matched employer-employee database that collects information on workers' individual earnings (and its components) directly from the firms. Given that firm and worker characteristics are reported directly by the firm, these data are much less likely to be subject to collection biases that plague labor force surveys. The SWSO is carried out with biennial frequency among firms that hire at least 9 employees.

Real hourly wages is of particular interest in our study.[7] The definition of this variable excludes all the premium and overtime payments as they are not covered by the minimum wage legislation. We further restrict our sample to workers between 22

[6] Smith and Welch (1989) derives analogous components for raw gender wage gaps at the mean, see equation 1, terms .ii and .iv. Smith and Welch (1989) include two additional components to decompose raw gap exactly.

[7] We adjust the earnings of the workers by the Consumer Price Index with the base year 1999.

and 65 years old and those not at the first year of their employment. The Structure of Wages and Salaries in Poland records information on individual characteristics of the employees: age, experience, tenure and education. We use those variables as controls for the main analysis. The survey records also information about NACE of the place of work and information about workers occupation. Additionally, the study separates between part-time and full-time workers. The definition of the part-time worker requires an employee to work less than thirty hours in a particular week. While the Structure of Wages and Salaries database is very rich, some individual characteristics of the workers are still missing. For instance, the survey does not provide information on marital status as well as number of children. Therefore, we cannot control for them in our model. The descriptive statistics of main variables are presented in Table 1. The descriptive statistics from Table 1 are consistent with the Figure 1 where minimum wage consists almost 40 percents of the average wage. The minimum wage to average wage ratio is slightly higher in our sample than in the overall economy. The difference is mostly driven by the definition of the earnings in our identification strategy. Logically, additional payments, end-of-year bonuses, etc., might increase the average wage, but it will not affect the bottom of the wage distribution where minimum wage workers are concentrated.

Table 2 summarizes the information about minimum wage workers in Poland. The definition of minimum wage worker requires that the average wage of the worker in $(t-2)$ was smaller than minimum wage in year t Following the values presented in Table 2the proportions of female minimum wage workers is always higher. Moreover, the fraction of minimum wage female workers decreases over the observed period. The table 2 presents the statistics consistent with the results reported by Kamińska and Lewandowski (2015). However, our results are higher [8]. The difference in the wages between female and male workers at the bottom of the wage distribution further motivates to recover a gender wage gap at the distributional regression approach.

The research analysis focuses on the years from 2004 to 2010. We use the years 2006-2010 for the benchmark analysis of the gender wage gap: 2006 serves for "before" minimum wage increase period while 2008 and 2010 correspond to the implementation of

[8]Unfortunately, the Structure of Wages and Salaries by Occupations does not provide information about earnings at each consecutive years and we cannot compare the wages at time $t-1$ with the minimum wage at time t as Kamińska and Lewandowski (2015) do.

"after" minimum wage increase period. We will use the year 2004 for a placebo test.

Table 1

Descriptive Statistics of the Polish Structure of Wages and Salaries by Occupations

	2006	2008	2010
Minimum wage	4.75	6.49	7.60
Hourly wage	12.178	14.462	18.739
Monthly working hours	160.149	159.223	143.280
Age	40.732	40.331	40.845
Experience	18.393	17.387	17.809
Tenure	10.132	9.542	10.203
College	0.314	0.338	0.380
High school	0.363	0.351	0.344
Primary	0.322	0.310	0.275

Note: This table presents the summary statistics of main variables used in the gender wage gap decomposition. Hourly wage, monthly working hours, age, experience, tenure are calculated in actual units, college, high school and primary levels of education are calculated as a proportion of workers with those levels of education.

Table 2

Proportions of minimum wage workers by gender and working hours

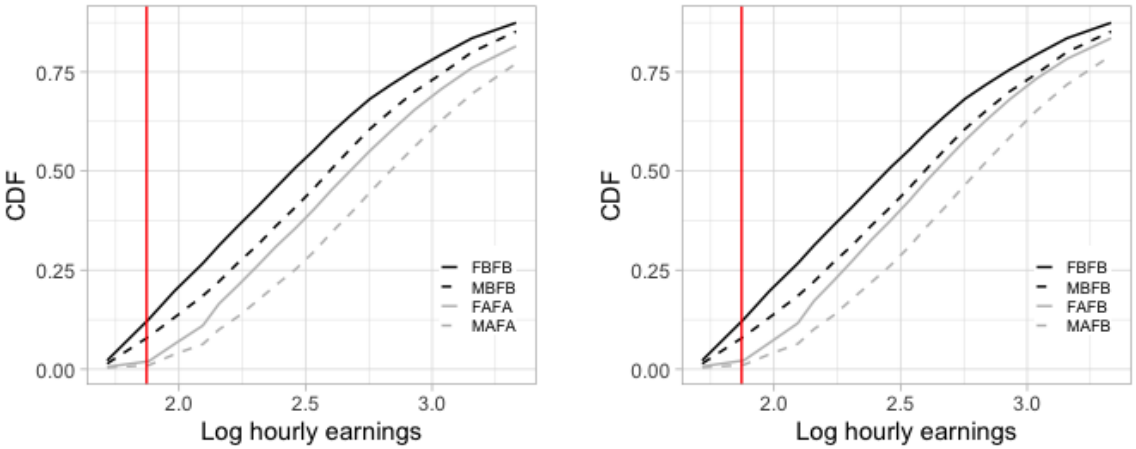
	2004	2006	2008	2010
Female	0.159	0.265	0.235	0.173
Male	0.134	0.246	0.187	0.151
Full-time		0.258	0.211	0.163
Part-time	0.146	0.053	0.071	0.051

Note: This table presents the proportions of minimum wage workers by gender. The minimum wage worker is defined as a worker with $W_{t-2} < MW_t$. The year $(t-2)$ was chosen due to the biennial availability of the Polish Structure of Wages and Salaries.

5. Results

The empirical analysis of the paper starts with the Figure 3 which depicts the results from the distribution regression model. For the clarity purposes, the authors distinguish two types of counterfactual distribution: with respect to time and with respect to gender. The first pair "GT" of the distribution function "$GTGT$" denotes the conditional wage distribution of the gender $G \in \{m, f\}$ and time period $T \in \{b, a\}$ and the second represents the covariate distribution. The **"before period"** refers to the period before minimum wage increase, consequently the **"after period"** refers to the period after minimum wage increase. The Figure 3 represents the predicted and counterfac-

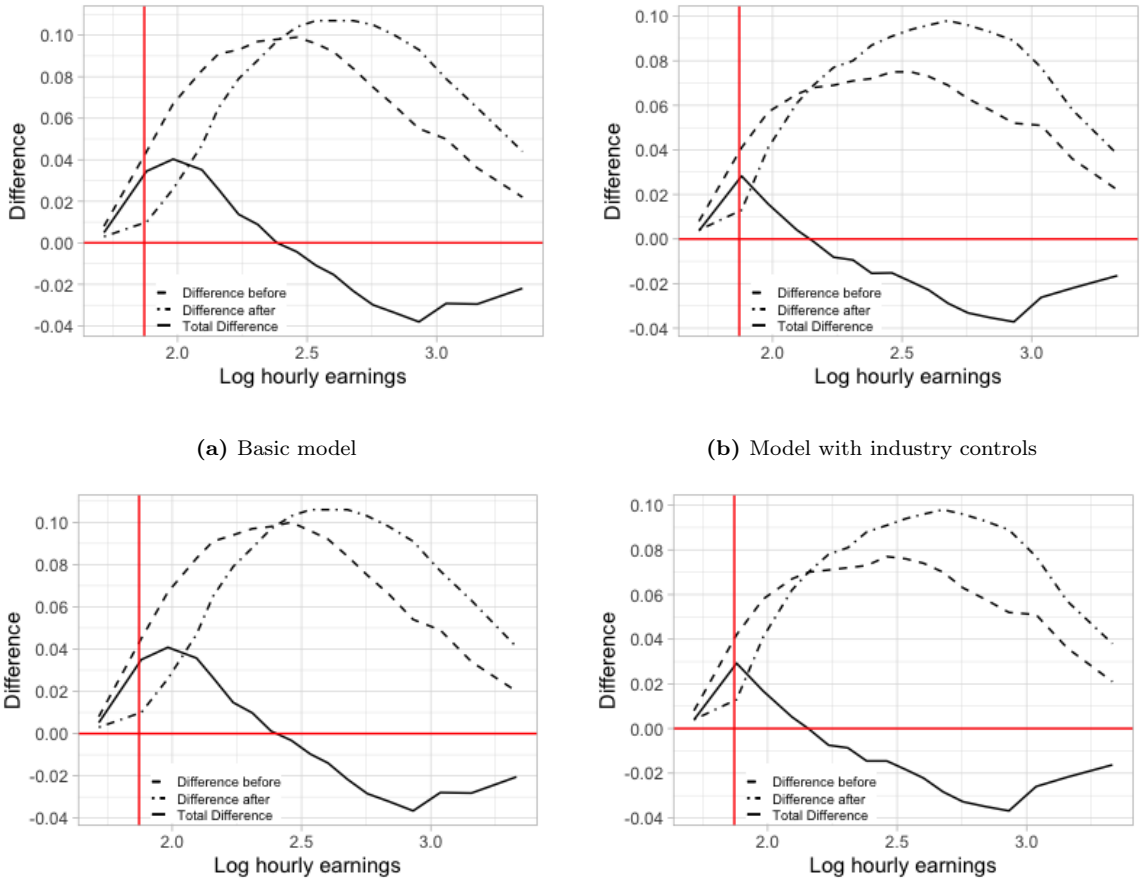
Figure 3: Estimated CDF's Before and After the Minimum Wage Increases



tual cumulative distribution of female workers in Poland before and after minimum wage increase. Following the first panel, the counterfactual wage distributions MBFB and MAFA are lower than predicted distributions FBFB and FAFA. Additionally, the second panel of the Figure 3 suggests that the counterfactual distribution MAFB lies below the counterfactual distribution FAFB. This representation suggests that the predicted wage distribution function of female before workers if they were paid as male after, is lower than for female before if they were paid as female after. Overall, the distribution graphs presented above support the main prediction of the study that men have better earnings than women and that minimum wage increases earnings.

We start the analysis of the gender wage gap in Poland by estimating Equations (3.4) and (3.5). Following the equation (3.5), the total gender wage difference captures

Figure 4: Gender Wage Gap Decomposition and its Change over Time (Before/After)



(a) Basic model

(b) Model with industry controls

(c) Models with regional controls

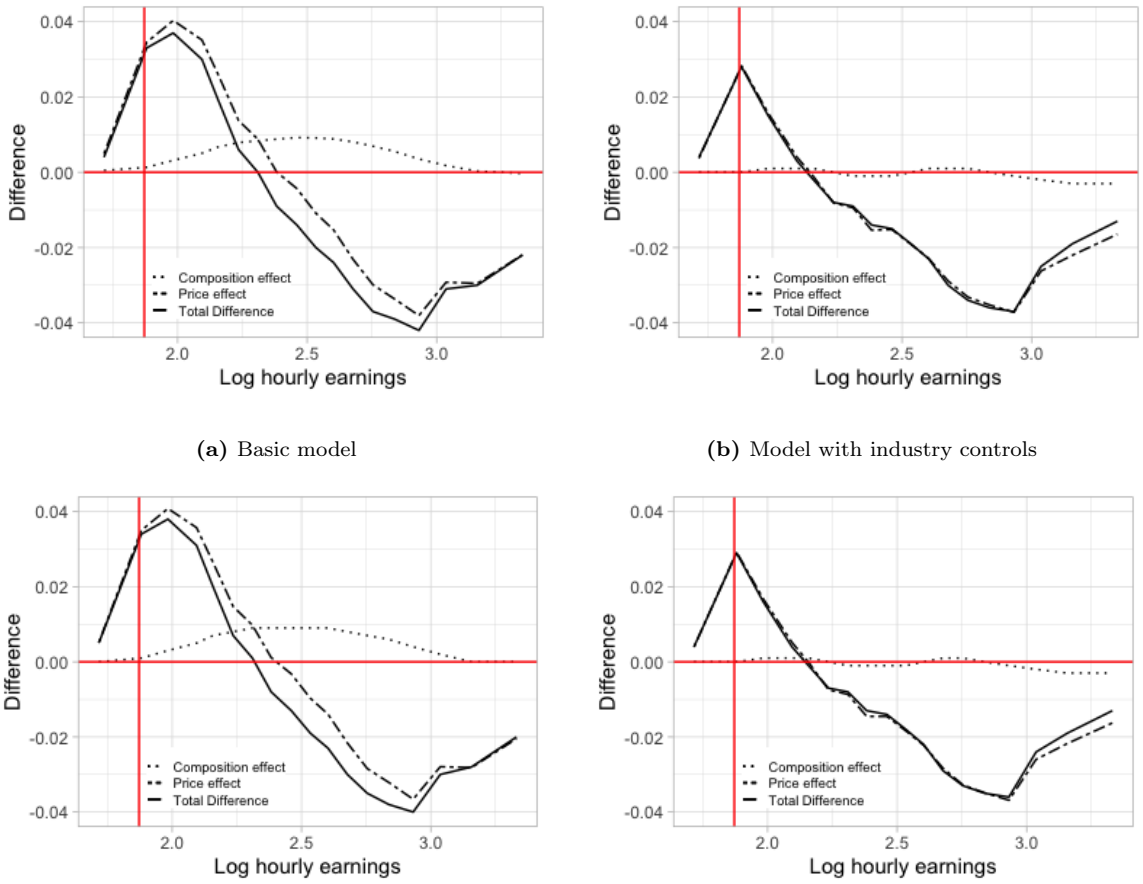
(d) (a) and (b) controls

the impact of minimum wage increase on the counterfactual wage distributions of male and female workers. Figure 4 illustrates the changes in the gender wage gap for four different models: basic model, model with NACE industry controls, model with NUTS2 regional controls and mixed model with NACE and NUTS2 controls. We can interpret the 0.01 point from each panel as 1 percentage point $(0.01 * 100)$ reduction in the male's and female's likelihood of being paid below particular level of the wage w, in other words, reduction in the gender wage gap. The results of each panel suggest up to 4 percentage points reduction in the gender wage gap at the bottom of the wage distribution. The red vertical line belongs to the logarithm of hourly minimum wage in Poland in 2008. The results of the gender wage gap decomposition suggest presence of the spillover [9] effect of minimum wage increase on the gender wage gap. The decrease in the gender wage gap

[9]The presence of spillover effect of the minimum wage was found also for Ireland (Bargain et al. (2019)) and Ukraine (Ganguli and Terrell (2009))

becomes zero around $30th$ quantile of the wage distribution in all specifications.

Figure 5: Gender Wage Gap Decomposition and its Change over Time (Double Decomposition)



(a) Basic model

(b) Model with industry controls

(c) Models with regional controls

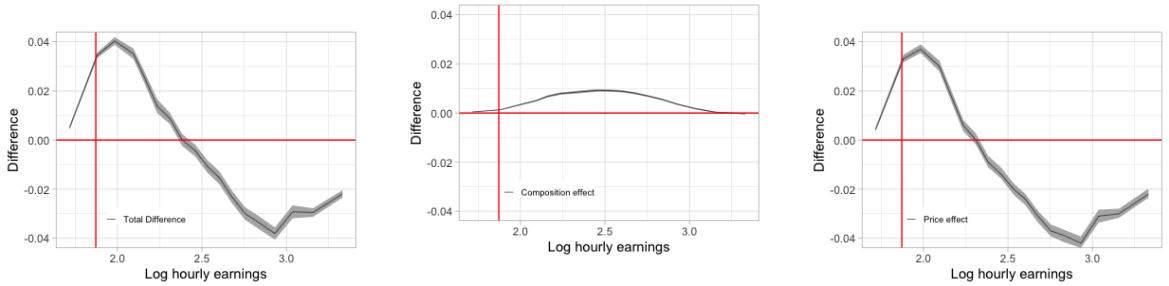
(d) (a) and (b) controls

Further, we use an equation (3.6) to present the effect of minimum wage increase on gender wage gap. According to equation (3.6) the difference is decomposed into two components: price effect and composition effect. Similarly to Figure 4, the authors presents the results of four distinct decomposition (basic model, model with NACE industry controls, model with NUTS2 regional controls and mixed model with NACE and NUTS2 controls). Each panel of the Figure 5 shows the estimates of composition effect, price effect and total difference for those models. The results of the decomposition suggest that decrease in the gender wage gap is mostly driven by the price effect in all specifications, with very small composition effect. Moreover, the employment effect is almost zero in the specifications with industry controls.

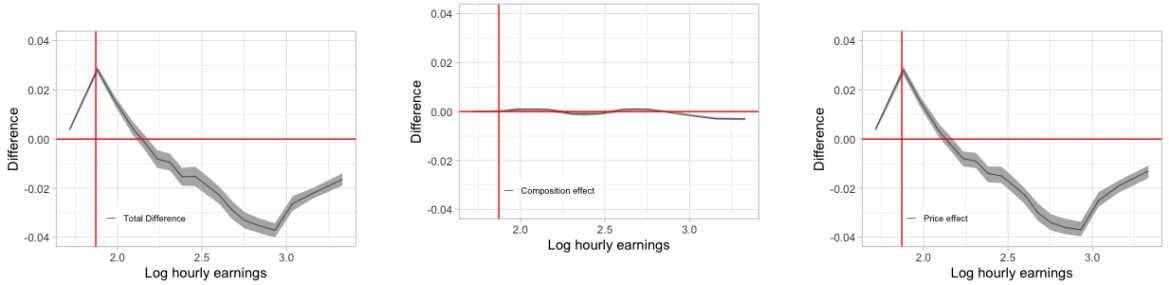
The Figure 6 depicts the previous decomposition's together with the 95% confidence intervals. The decrease in the gender wage gap is highly statistically significant at the

bottom of the wage distribution, especially at the bottom, where the impact of minimum wage is the strongest.

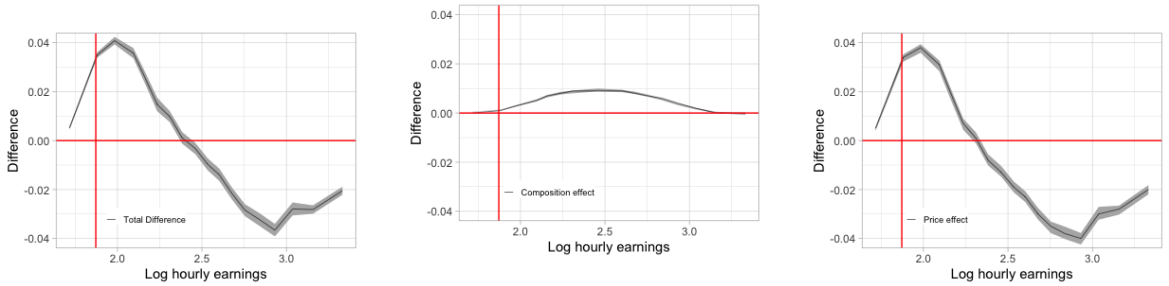
Figure 6: Gender Wage Gap Decomposition and its Change over Time (95% Bootstrapped Confidence Intervals)



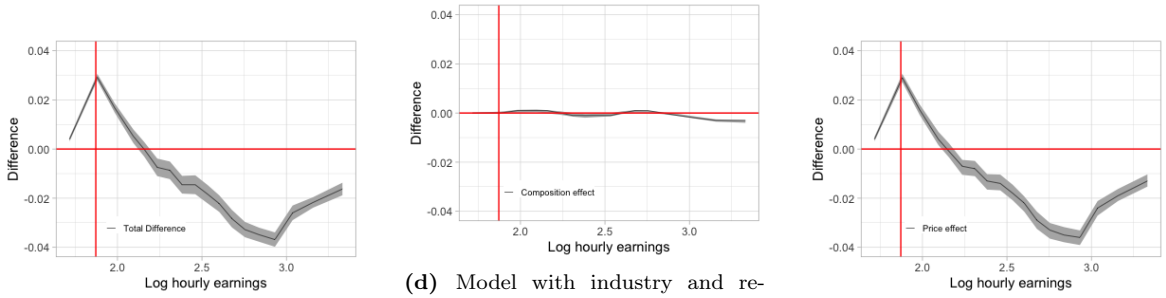
(a) Basic model



(b) Model with industry controls



(c) Model with regional controls



(d) Model with industry and regional controls

6. Conclusion

The binding minimum wage legislation is a particularly important tool for dealing with the gender gap in pay problem. This study contributes to the debates on the economic impact of minimum wage legislation on the gender wage gap. Exploiting a methodology suggested by Bargain et al. (2019), the study presents an evidence of significant reduction of the gender wage gap at the bottom of the wage distribution. The results of our study suggest up to 4 percentage points reduction in the gender wage gap at the bottom of the wage distribution where the minimum wage has the strongest.

These findings provide the insight for future research. First, it would have been useful to check whether there is a selection on employment problem in our model. The following issue will be particularly hard to check as Structure of Earnings Survey does not record the information on unemployed workers. Therefore the authors consider estimation of the selection parameters from the Labor Force Survey and apply them to our dataset. Second, the researchers might consider estimation of the selection model in the distributional regression context.

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Appendix

Table 3

Industry-Level Proportions of Minimum Wage Workers in Structure of Wages and Salaries (SWS) by Occupations in Poland

	2004	2006	2008	2010
Agriculture, forestry and fishing	0.162	0.278	0.244	0.173
Fishing	0.088	0.243	0.338	
Mining and quarrying	0.075	0.169	0.149	0.138
Manufacturing	0.189	0.299	0.231	0.183
Electricity, gas and water supply	0.032	0.072	0.045	0.057
Construction	0.139	0.278	0.216	0.201
Wholesale and retail trade	0.289	0.434	0.329	0.262
Hotels and restaurants	0.259	0.456	0.414	0.375
Transport, storage and communications	0.091	0.297	0.194	0.140
Financial intermediation	0.016	0.035	0.039	0.027
Real estate, renting and business activities	0.225	0.377	0.322	0.309
Public administration and social security	0.022	0.086	0.065	0.029
Education	0.082	0.179	0.192	0.152
Health and social work	0.140	0.205	0.150	0.083
Other activities	0.126	0.253	0.268	0.184

Note: This table summarizes information about proportions of minimum wage workers at each NACE, one digit industry in the years 2004, 2006, 2008 and 2010. The minimum wage worker is defined as worker with $W_{t-2} < MW_t$.

Table 4

NUTS2 Classification of Minimum Wage Workers in Structure of Wages and Salaries (SWS) by Occupations in Poland

	2004	2006	2008	2010
Dolnoslaskie	0.171	0.275	0.221	0.152
Kujawsko - Pomorskie	0.183	0.294	0.244	0.225
Lubelskie	0.163	0.280	0.247	0.201
Lubuskie	0.158	0.283	0.251	0.168
Lodzkie	0.177	0.299	0.242	0.187
Malopolskie	0.132	0.252	0.216	0.161
Mazowieckie	0.100	0.181	0.129	0.107
Opolskie	0.134	0.260	0.225	0.169
Podkarpackie	0.177	0.297	0.281	0.188
Podlaskie	0.163	0.318	0.251	0.179
Pomorskie	0.135	0.229	0.198	0.158
Slaskie	0.141	0.247	0.209	0.162
Swietokrzyskie	0.161	0.262	0.231	0.173
Warminsko - Mazurskie	0.179	0.278	0.254	0.200
Wielkopolskie	0.152	0.271	0.220	0.187
Zachodniopomorskie	0.119	0.262	0.200	0.147

Note: This table summarizes information about proportions of minimum wage workers at each NUTS2 regional level in the years 2004, 2006, 2008 and 2010. The minimum wage worker is defined as worker with $W_{t-2} < MW_t$.

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