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Effect of the minimum wage on labor market in Estonia

Master's thesis

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I have written this master's thesis independently. All viewpoints of other authors, literary sources and data from elsewhere used for writing this paper have been referenced.

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1. **Abstract**: This Study analyzed how increasing the minimum wage effects on employment and wage distribution in Estonian. The effect of the minimum wage on employment has been analyzed by comparing the probability of the workers remaining employed when the minimum wage increased in 2014 with the probability of workers at comparable wage levels remaining employed in 2010 when the minimum wage was constant. The study found a significant effect of the minimum wage on employment retention. This study also found that minimum wage has a substantial spillover effect on wage distribution until the 50th percentile. The minimum wage also helped to reduce the wage income gap between different ethnic groups as well as the gender wage gap.

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2. Introduction

A minimum wage is the lowest wage that employers may legally pay to workers. The popular prediction of standard economic theory is that increasing the minimum wage will decrease the employment of the low wage employees. Over the year's there have been diverse findings of the effect of increasing the minimum wages on employment. In the era of seventies, there were several studies of the minimum wage on employment and almost all of them found the substantial effect of the minimum wage on employment (Card & Krueger,1995). On the other hand, some later studies from the nineties found the minimum wage does not have any significant or even marginally positive effect on employment.

The first minimum wage law was enacted in 1890 in New Zealand and Australia (Neumark et al., 2007). In 1938, the United State Congress passed a federal minimum wage law to ensure the workers are receiving fair wage for their work (Neumark & Wascher, 2008). Despite much popularity from the citizens of the US, the minimum wage in the US received criticism from the economists as they pointed out potential job loss due to introducing the minimum wage. However, in the modern economy, the minimum wage has much larger visions than just insuring the fair wages which through minimum wages increasing purchasing power of the consumers.

Since the US passed the law, the minimum wage gained much popularity in Europe as well as in the rest of the world. According to the United Nations, as of year 2019, 193 countries have the minimum wage law. In Europe, out of 28 EU countries, 21 countries have a uniform national minimum wage system and the remaining seven EU country has a sectoral wage system (Schulten, 2014).

Minimum wages in Baltic states were introduced together with other market economy institutions during the earlier period of the transition from socialism to a market economy in 1991 (Masso et al., 2010). During the Soviet Union, wages were controlled administratively and the wage distribution was relatively compressed. Due to the high inequality in the society , several challenges like poverty, working poor and so on has

risen up after the dissolution of the Soviet Union. In this context that the minimum wage is seen as a part of the solution to address poverty and inequalities. At the same time, the minimum wage has also come back at the core of policy debates dues to the problem of labor shortage faced by employers in several sectors and a problem of significant migrations toward other EU countries, which contributed to the disbalance between labor supply and demand even further. This also explains why the social partners impression of the role of minimum wages in the labor market also changed over the time, including from the employers side.

The purpose of this study is to analyse the impact of the minimum wage on employment and wage distribution in Estonia. Increasing the minimum wage may not only affect the targeted groups who are earning below the minimum wage or the group that living at the poverty line, but it may also affect the wages for those with earnings above the minimum wage. Increasing minimum wage may also affect the unemployment rate. In a competitive labor market, a higher minimum wage might lead to high unemployment in the economy.

A recent study by Ferraro et al. (2018a) used Estonian Labor Force Survey (LFS) data to identify the effect of the minimum wage on Estonian labor market and it did not find any significant effect of the minimum wage on the Estonian labor market. One of the reasons for not finding any effect of the minimum wage in Estonia could be that the LFS data sample were rather too small. Therefore, our study uses Structure of Earnings Survey (SES) dataset for the year of 2010 and 2014 and Tax and Customs Office data (from TSD declarations) of 2011 and 2015 which are much larger dataset than the LFS dataset.

Estonian is a country with a high gender wage gap. A study by Ferraro et al. (2018b) found the although minimum wages reducing the gender wage gap in Estonian, there is still a significant gender wage gap in Estonia. Ferraro et al. (2018b) also found that the minimum wage effect on wage distribution varies among different groups (gender, and different age groups). It also found a substantial spill-over effect on wage distribution. For the wage analysis, we will use tax and Customs Office TSD declarations on payroll taxes data. We

will investigate the effect of the minimum wage on wage distribution among different groups (gender, age, and ethnicity)

3. Literature Review

3.1. Review of empirical studies for employment retention:

Since 1970 there have been undertaken over 30 time series studies on the effect of the minimum wage on employment in the United States. A time series meta-analysis of the minimum wage by Card & Krueger (1995) explained that sometimes authors temper the interferences they draw from a body of published studies as the existing literature has some selection bias. Doucouliagos & Stanley (2009) applied a recently developed meta-analysis method to 64 US minimum wage studies and found that minimum wage literature is contaminated by publication selection bias[1].

Another meta-analysis (De Linde Leonard et al., 2014) which combined 16 UK studies found no adverse effect of minimum wage on employment except for the residential home care industry in the UK where it was found a small adverse effect of minimum wage on employment. The finding is consistent with an earlier meta-analysis on US minimum wage effects (Doucouliagos & Stanley, 2009). Similarly, another meta-analysis 55 empirical studies from 15 industrial countries found that the effect of the minimum wage on employment is heterogeneous between countries (Boockmann, 2010). The study used benefit replacement ratio, employment protection, and the collective bargaining system as institutional variables in his model to capture the estimated employment effects of the minimum wage in reasonable ways.

There is also some evidence that the burden of increasing the minimum wage might be passed on to the consumer. The study conducted by Card & Krueger (1993) is based on a

[1] Publication selection bias is a type of bias that occurs in published academic research. It occurs when the outcome of an experiment or research study influences the decision whether to publish or otherwise distribute it.

primary data set in New Jersey and Eastern Pennsylvania restaurants. Overall 410 restaurants were interviewed over the phones. By using a difference in difference methodology, the study found that increasing the minimum wage for employees in fast food restaurants in New Jersey did not reduce the employment in the state. At the same time, the price of the fast foods increased in New Jersey more than in the Pennsylvania which suggested that the burden of increasing minimum was passed to the consumer. The study indicated that there could be some discouragement of opening up new restaurants due to increasing minimum wages.

Another important aspect of the minimum wage effects is that the effects could be different for formal and informal labor markets. When the sector is not subject to government regulation and mostly dominated by small enterprises with few workers, then the sector is called informal an sector (Pradhan & van Soest, 1995). Kahmis (2013). The research was based on the data from Argentine national household surveys, the Permanent Household Survey (EPH) for the year 1993 and the Continuous Permanent Household survey (EPH-C) for the year 2004. The study investigated in Argentina whether the change in the minimum wage had a higher impact on the informal labor market than on the formal labor market. The difference in difference estimation showed a significant positive impact on both formal and informal sectors, but the effect was found to be larger in the informal sector as compared to the formal sector.

While the minimum wage has a positive effect on different sectors, it has dubious effct on rate of receiving the unemployment benefit. The study by Schmitz (2017) was conducted using monthly time series data of four labor market outcomes (Regular Employment, Marginal Employment[2], Able to Work and Not-working) which were provided by the Federal Employment Agency for the years 2012 to 2015. Based on county-level administrative data, this study used the difference-in-differences technique, exploiting regional variation of the minimum wage. The study found that since introducing the

[2] Regular employment refers to jobs subject to social security contributions, i.e. with an average monthly income of more than 450 €. Jobs below or just paying 450 € are exempt from these contributions and constitute marginal employment.

minimum wage there had been a large reduction in marginal employment in Germany. It also found that since implementing the minimum wage, a significant number of workers withdraw themselves from receiving social welfare benefits. Although for former West Germany, there was no proof that reduction of the growth rate of receiving unemployment benefit while working triggered by the minimum wage. At the same time, in former East Germany there was found evidence of receiving welfare while working decreased due to the implementation of the minimum wage.

Next, minimum wages may also have important effects in the context of international labour migration. The study by Masso et al. (2010) discussed three related case studies in this research. The first case study discovered setting up minimum wage could be one of the main factors for all three Baltic countries to control the labor migration in the future. The second case study discussed that combination of national minimum wage and collectively agreed minimum wage could limit the outward labor migration in the health care sector. Finally, the third case study suggested that greater differentiation of wage floor would be needed to avoid more migration from these the three Baltic countries.

Minimum wages may affect both employment and labour force participation (by making working relatively more beneficial as compared to staying out of the labour force), and the previous studies undertaken in the Baltic States have looked at both of these effects. Hazans (2007) study was based on Labor Force Surveys (LFS) of Estonia from 1989–2003, Latvia from 1996–2003, Lithuania from 1997–2003, and a Population Census data of 1989 for Latvia and Lithuania. The study used an equal correlation population-averaged probit model and the principal finding of this study was that increasing real minimum after tax wage has a significant positive effect on labor participation and reduces discouragement of participation in the labor force for all three countries. In the case of Estonia, there was found a positive effect on minimum after tax wage increase labor participation for teenagers of both genders but only for young males. (Hinnosaar & Rõõm (2003) used an Estonian Labor Force Survey (LFS) data and difference in difference methodology derived from a study conducted by Neumark et al. (2004). They found that increasing the minimum wage had a negative effect on employment. Later on, a study

conducted by Ferraro et al. (2018a) used Estonian LFS data from 2001 to 2014 and similar difference in different methodology as Hinnosaar & Rõõm (2003). Differently from Hinnosaar & Rõõm (2003) the study did not find any significant effects on employment retention due to the increasing minimum wage in Estonia.

3.2.Review of empirical studies for wage distribution

Over the years, there has been a growing interest in wage distribution and inequality in the academic literature. A meta-analysis by Dominicis et al. (2006), which consists of 22 studies from all around the world found that the negative effect of the uneven wage distribution is higher in developing countries. Lee (1999) developed a methodology to estimates the minimum wage effect at different percentiles of the wage distribution for US economy in the 1980s. The method used the minimum wage relative to the median wage across the different states (New Jersey, Michigan, Maryland, South Dakota, Mississippi, and Arkansas) and found that due to the declining minimum wage, wage inequality increased in the US economy in the 1980s.

Another meta-analysis which consists of 98 peer-reviewed journals from all around the world found that the gender pay gap exists in the workforce (Bishu & Alkardy, 2017). Arulampalam et al. (2007) found that women were paid less than men in EU countries. The size of the wage gap varies substantially across the countries as well as across sectors in EU countries. The study found that countries with less unionization and more centralised minimum wage tend to have lower wage gap than countries with high unionisation and sector level collective agreements wage distribution in EU countries. Majchrowska & Strawinski (2017) found that increasing the minimum wage decreased gender wage gap among young workers in Poland and for middle-aged workers effect of the increasing the minimum wage is insignificat.

In recent years, due to the better education of the women, training, and more work attachment wage gap between genders have fallen down substantially in the world. From the 1960s to the 1990s, wage differentials between gender worldwide have declined

substantially from around 65% to only 30% (Weichselbaumer & Winter-Ebmer, 2005). Van et al. (2018) estimate decomposing real wage changes in the US by using microdata from the Annual Social and Economic Supplement (ASEC) of the Current Population Survey (CPS). The study found that employees with completing high school and obtaining college degree get higher wages relative to those who do not complete high school. The decompositions found that for male the lack of education and skills shortage employee causes the lower wages. However, with the increasing level of the education of employees, the composition effects become positive and somewhat offset the negative structural effects. On the other hand, for females, wages are increased consistently.

The effects of minimum wages are expected to be different at different parts of the wage distribution. Neumark et al. (2007) discovered that low wage workers are most strongly affected by increasing minimum wage, while higher wage workers are hardly affected by increasing minimum wage. Due to the reducing work hours and employment, increasing the minimum wage have net adverse consequences for the low wage workers. On the other hand, increasing minimum wage decreased 38.2% number of impoverished people, a 39.4% of reduction in the intensity of poverty and 40.6% decrease in the severity of poverty in Brazil Brito & Kerstenetzky (2019). It also found that minimum wage is more effective in the poorest regions of Brazil.

Caliendo et al.(2018) found that in Germany after implementing the minimum wage, during the first two years, hourly wages of lower income people significantly increased. Mostly less educated, partially employed, women and people with a migration background benefited in those first two years of minimum wage implementation. Although minimum wage increased income of above-mentioned groups, it did not have a significant positive effect on the livelihood of affected persons which actually failed to reduce the poverty and inequality in German society.

Masso et al. (2103) found that during the Soviet time income inequality was lower in the Baltic state due to the low returns to education. But during the first year of the transition, the income inequality increased in all Baltic states due to the market economy and

increasing return to higher education. It also found that tx system in Baltics state also created income inequality due to the higher share of indirect taxes, relatively low taxes on capital and relatively high taxes on labor.

Coming to the country of our study, Estonia, it can be said based on previous investigations that Estonia is a country with relatively high-income inequality in its economy. But over the years, the wage gap between the public sector and private sector decreased significantly (Leping, 2006). This concludes that over the years, public sector wage increased more than the private sector wage. Besides that, Several studies have found that Estonia has a very high gender pay gap, up to 30%, most of which is unexplained (Anspal, 2015). This concludes that the unexplained wage gap is highest for the craft worker and lowest for the professional.

A study conducted by Ferraro et al. (2018)found that minimum wage has greater importance for women than men. It found that by implementing a minimum wage in Estonia decreases the wage inequality across Estonia. The study employed a methodology by Lee (1999) to estimate the effect of the minimum wage on different percentiles of the income distribution. The study only considered the full-time employees, it excludes all employees who work part-time and whose main employment status is self-employment, or current residence is abroad.

4. Data

The study was conducted using the Structure of Earning Survey data (SES) for 2010 and 2014. We also used the Estonian Tax and Customs Office data from TSD declarations on paid social taxes (payroll taxes) of 2011 and 2015. To find the minimum wage effect on the employment, we merged SES data of 2010 with Estonian Tax and Customs Office (TSD) wages data of 2011 and SES data of 2014 with Estonian Tax and Customs Office wage data of 2015. In 2010-2011. In order to analyse the employment retention, we used years 2010-2011 years as control years as during those years minimum wage did not

increase and 2014-2015 used as treatment years when the minimum wage increased relative to what it was in the years of 2010-2011.

Structure of Earnings Survey (SES) data is currently carried out in Estonian in every four years by Statistics Estonia (earlier it was undertaken even more frequently). The survey was in 2014 conducted on 122,122 employees and the age range of employees was from 15 to 91 years. The SES included hourly earnings data of the month of October for 2010 and 2014. The data set included various demographic and labour market variables like sex, age, occupation (by 4-digit ISCO codes), citizenship, whether an employee is with full time or part-time contract, both public and private ownership of the establishment, size of the establishment, industry, region of establishment, and length of service in the enterprise. As we only considered the full-time employees, we excluded all the part-time employees from our data set to avoid the possible measurement issues of working time. SES data on earnings also do not include irregular bonuses and allowances.

On the other hand, Estonian Tax and Customs Office wage data (from TSD declarations) includes a monthly payroll tax payments of individuals (disaggregated by employers) for 2011 and 2015. We get the monthly TSD data for 2011 and 2015 from October of each year which makes possible to calculate the gross wages and hence also the employment status of an individual one year after the SES survey.

The TSD and Structure of Earnings Survey datasets were merged in case of the year 2014 data by using the anonymized personal identity numbers. For the SES 2010 wave, the maching was complicated by the fact that the anonymized personal identity number was not there differently from the SES 2014 wave. Thus, for the year 2010, the SES and TSD data were matched using the employees' gender, company of work and age (i.e. only the individuals were matched where such variables combinations resulted in unique observations). Due to that, while for the year 2014 nearly all the observations of the SES data were matched with the TSD data, for the year 2010 just ca 13,000 observations (individuals) were matched (i.e. for the rest of the individuals it was not possible to establish a unique link between the SES and TSD datasets). Despite that, our final dataset

used for the analysis was quite large and significantly larger than in the study of Ferraro et al. (2018a).

Structure of Earnings Survey data is essentially a repeated cross-sectional data. In order to assess whether the minimum wage changes in a particular year had any effect on the changing of the employment status over the succeeding year (i.e. whether minimum wage increase in 2014 may have caused an individual employed in 2014 to become unemployed in 2015) the Structure of Earnings Survey data was matched with the Estonian Tax and Customs Office Data.

For wage distribution analysis, we use cell level data. We constructed cells by the year, sector, and NUTS3 level region (Northern Estonia, Western Estonia, Central Estonia, North Eastern Estonia, Southern Estonia). The wage data used in the analysis was taken from the Estonian Tax and Customs Office TSD declarations on payroll taxes (whereas the SES data covers only a few years). Sector and region of working were linked to the TSD data from the Estonian Commercial registry firm-level data. The unemployment rate and economic growth were used as additional explanatory variables in the wage analysis model which were taken from the Statistics Estonia. There are 18 groups created for cell level data and by following Ferraro et al. (2018b), if the cell has less than 20 observations then we exclude it from the analysis.

Table 1: Descriptive statistics of gender and education.

Group Variable	Mean wage (2010)	Mean wage (2014)	Higher education (2010)	Higher education (2014)
Male	970.60	1215.96	0.33	0.31
Female	715.43	855.93	0.44	0.43
Total	822.10	1035.95	0.39	0.37

Table 1 shows that the mean wage for male 2014 is significantly higher (1215.96 Euro) than the 2010 mean wage for male (970.60). Similarly, the mean wage for female 2014

(855.93 Euro) is also higher than the mean wage for 2010 (855.93). This significant increase in mean wage comes probably from the general economic growth rather than from the minimum wage increase as the minimum wage only increased 10% for each 2013 and 2014, when there was no increase in the minimum wage for 2011 and only a slight increase for 2012 (Ferraro et al., 2018). Table 1 also shows that the mean wage for male is higher than the female mean wage for both 2010 and 2014, which supports our claim in literature review about the existence of gender wage gap in Estonia.

Despite the fact that over the years there is an overall improvement in the education level for both gender in Estonian, yet mean higher education level for men (31%) is still significantly lower than women (43%) which again supports the gender wage gap in Estonia that even though more women have higher education than men, still they are getting paid lesser than the men.

Table 2: Shares of different occupations.

	Year	
Group Variable	**2010**	**2014**
Armed Forces	0.005	0.004
Managers	0.173	0.158
Professionals	0.132	0.122
Technicians and ass. Professionals	0.139	0.150
Clerical support workers	0.028	0.040
Service and sales workers	0.063	0.061
Skilled agricultural workers	0.007	0.009
Craft and related trade workers	0.207	0.219
Plant and machine operators	0.168	0.144
Elementary occupations	0.076	0.090

In table 2, we divided all the employees into nine occupation groups. It shows that "Crafts and related trade workers" group has the highest number of employees (20.7% for 2010

and 21.9% for 2014) while "Armed forces" group has lowest number of employees (0.5 % for 2010 and 0.4% in 2014).

5. Methodology

5.1. Employment Effects

We seek to identify the effect of the increases in minimum wage on employment using a standard difference-in-differences methodology comparing employment retention across the wage distribution in 2014-2015, with retention at comparable wage levels when the minimum wage did not increase in 2010–2011.

The difference-in-differences methodology we use draws on Neumark et al. (2004). All working individuals are divided into groups by their wage before the minimum wage was raised and then we test whether the probability of employment retention for individuals in the different wage groups was different in the years 2014-2015 when the minimum wage was increased from what it was in the years 2010–2011 when there were no changes. The null hypothesis is that raising the minimum wage does not lower the probability of individuals in the treatment period remaining employed. Note that the comparison of employment retention can be carried out for employees in groups directly affected and for workers in groups indirectly affected through the spill-over and substitution effects.

The baseline estimations are run for a cross-sectional model with the observations for all individuals pooled across the reference year 2010-2011 when the minimum wage did not increase, and the treatment year 2014-2015, when minimum wage raised. The time index *t* denotes the second year of the matched Structure of Earning Survey dataset (SES) data (i.e. 2011 or 2015) and *t-1* denotes the first year of the matched Structure of Estonia Survey (SES) data (i.e. 2010 or 2014). The index *i* depicts the individuals included in the sample, which are those in full-time employment with non-missing wage data in year *t-1*.

Following Ferraro et al. (2018a), SES data represent the gross monthly income in year *t-1* for all individuals in the sample. To differentiate the different wage groups among all employees, we divided SES data into eight wage groups and labelled them with Group1 to Group8. Depending on an individual's income, every individual is placed into a particular group in the year of *t-1*. For the treatment year 2014, individuals are placed in group2 if the wage is higher than minimum wage in year t-1 but is lower than the minimum wage in year t. This shows that individuals who belong to Group2 are directly affected or treated by the increase in the minimum wage from year t-1 to year t. Group1 consists of individuals whose wage income is already lower than the minimum wage in year *t−1*[3]. Group3 contains individuals who had wage income in year *t−1* and who received wage income in year t above the new minimum wage but below 1.4 times the new minimum wage. Group4 consists of individuals with wage income in year *t−1* and with income in period t that is more than 1.4 times the new minimum wage but less than 1.8 times the new minimum wage. Group5 consists of individuals with wage income in year *t−1* and with income in period t that is more than 1.8 times the new minimum wage but less than 2.2 times the new minimum wage. Group6 consists of individuals with wage income in year *t−1* and with income in period t that is more than 1.2 times the new minimum wage but less than 2.5 times the new minimum wage. Group7 consists of individuals with wage income in year *t−1* and with income in period t that is more than 2.5 times the new minimum wage but less than 3.6 times the new minimum wage. Group8 consists of individuals with wage income in year *t−1* and with income in period t that is more than 3.6 times the new minimum wage. We followed the same method of doing groups as Ferraro et al. (2018a). These wage groups are somewhat arbitrary, but Ferraro et al. (2018a) tried other possibilities and that did not change the results.

We use a difference-in-difference approach with a dummy variable for the treatment period to estimate the effect of rises in the minimum wage on the probability of individuals in different wage groups retaining employment. As there is no increase in the minimum wage from 2010 to 2013 in Estonia, due to the data availability from SES for the year

[3] That particular wage groups may look somewhat strange (people earning less than the minimum wage), but it was there also in the earlier studies (Ferraro et al 2018a, Hinnosaar ja Rõõm 2003).

2010 we considered the year 2010 as a control variable. On the other hand, due to data availability and an increase in the minimum wage in 2014, we considered 2014 as a treatment variable. The dummy variable Treat takes the value 1 for the treatment year t=2014 and 0 for the reference years t = 2010. The employment indicator L_{it} takes the value 1 if the individual i is full-time employed in year t and 0 if the individual is not full-time employed. The term Pr (L_{it}= 1|Group n_{it-1}) is then the probability of individual i retaining full-time employment in year t given that the individual was employed and belonged to wage group Group n_{it-1} in year t − 1. The employment probability is estimated using the following specification:

$$Pr\ (L_{it}= 1|\text{Group } n_{it-1}) = \alpha+\sum \beta_n \text{ Group } n_{it-1}+\sum \gamma_n \text{ Group } n_{it-1} \times \text{Treat}_t + \tau_t +\delta X_{it-1} +\varepsilon_{it} \quad (1)$$

The β-coefficients of the group dummies Group n_{it-1} capture the overall differences in employment retention across the wage groups, while the γ-coefficients of the interaction terms Group $n_{it-1} \times \text{Treat}_t$ capture the additional effects of the treatment period. The term α is a constant. Group7 is omitted so that the β_n and $\sum \gamma_n$ coefficients must be interpreted as the additional effect relative to that of Group7. We choose group7 as an omitted group as the changes in the minimum wage are improbable to influence the employment retention so high in the wage distribution. Group8 was not chosen as an omitted group as they have the highest wages among all the groups and because of that they employment retention without for the group8 does not depend on the minimum wage.

The control variables include the year dummies τ_t which are meant to absorb business cycle effects that impact the employment probabilities of the eight wage groups in equal proportion. The rest of the control variables are collected in the vector X_{it-1} and are specific to the individual for year *t-1*. The controls are for the region of residences (Northern Region, Central region, North-Eastern region, Western region, and South region), gender, ethnicity, age, education level, sector of activity and occupation. The vector of coefficients of the control variables X_{it-1} is labelled δ. Finally, $\varepsilon_{it}$is the error

term. The employment indicator L_{it}takes the values 0 and 1 so the model is estimated using Probit and we report the marginal effects evaluated at the means of the explanatory variables.

5.2. Wage effects

On the other hand, following a recent study by Ferraro et al. (2018b), to analyse the effect of the minimum wage on wage distribution in Estonia, we will use a methodology that was developed by Lee(1999) to estimate the effect of the minimum wage on different percentiles of the income distribution. The main idea of using Lee (1999) is that the effect of the minimum wage varies based on the position of the individual in the wage distribution. If the wages are relatively low in the labor market relative to the minimum wage, a large share of employees will be affected by the minimum wage which implies that minimum wage will have a larger effect on the wage distribution. On the other hand, if the wage is high in the labor market, a small number of employees will be affected by the minimum wage which implies that minimum wage will have a smaller effect on the wage distribution.

By following Lee (1999), we define the labor market or cell by the year, sector, and region. Lee(1999) assumes that there is no worker mobility between sector and region. There is a challenge of using this methodology in Estonia as for instance during the Great Recession, regional mobility in the labor market increased in Estonian, but sectoral mobility decreased (Meriküll, 2011). Still, due to the low level of the regional mobility in the Estonian labor market (Meriküll 2016; OECD 2010), Estonian labor market allows us to use the sectoral distribution as an additional margin of identification when estimating the effect of the minimum wage.

By following Ferraro et al. (2018b), we assume that the p^{th} percentile of the log wage in a cell is denoted W_{ij}^{p} and the 60$^{\text{th}}$ percentile of log wage in a cell is W_{ijt}^{60}. The effect of the minimum wages on the wage distribution is estimated by using the following specification:

$$W_{ijt}^{p} - W_{ijt}^{60} = \beta_1 (W_t - W_{ijt}^{60}) + \beta_2 (W_t - W_{ijt}^{60}))^2 + \text{controls} + \varepsilon_{it} \quad (2)$$

In the equation (2) β_1 and β_2 are the estimated coefficient and ε_{it} is an error term. Subscript *i* indicate the region, *j* indicates the sector, and *t* indicates the time. In equation 2, we used the year fixed effect that control for other changes on the wage distribution from year to year which are not related to the minimum wages will be absorbed by the fixed year effect. The regional unemployment rate, regional economic growth, sectors, and occupation are used as control variables in the equation. Equation (2) can be estimated for any percentile *p*, but here we assume that W_{ijt}^{60} as an observed wage percentile. By following Lee(1999), the marginal effect above $P > 60$ is negligible. This provides a test of the assumption that the W_{ijt}^{60} is a centrality measure that is not affected by the minimum wage. We will generally compute the marginal effects for percentiles above the W_{ijt}^{60} and examine whether the effects are insignificant in statistical and economic terms.

6. Empirical results

6.1. Employment analysis

Table 3 shows the results when equation (1) is estimated with Probit using different sets of control variables. The marginal effects presented are relative to the omitted variable, the Group7 dummy, and the interaction of the Group7 dummy and the treatment dummy for the years 2014-2015.

Table 3: Marginal effect of Probit estimations.

Variables	Coefficient	t-value	Standard Error
Age squared	0.000	(5.99)***	(0.000)***
Armed Forces	-0.001	(-1.01)	(0.001)
Managers	-0.018	(-1.78)*	(0.010)*
Professionals	-0.000	(-0.05)	(0.009)
Technicians and ass. Professionals	-0.006	(-0.79)	(0.008)
Service and sales workers	-0.007	(-1.32)	(0.005)
Skilled agricultural workers	-0.008	(-1.10)	(0.007)
Craft and related trade workers	-0.009	(-2.56)**	(0.003)**
Plant and maschine operators	-0.009	(-3.05)***	(0.003)***
Elementary occupations	0.000	(.)	(.)
Central Estonia Region	-0.001	(-0.35)	(0.003)
North-Eastern Estonia Region	-0.012	(-3.23)***	(0.004)***
South Estonia Region	-0.000	(-0.15)	(0.002)
Male	-0.007	(-5.70)***	(0.001)***
Tertiary education	-0.002	(-0.69)	(0.003)
Secondary education	0.005	(2.28)**	(0.002)**
Estonian	-0.003	(-2.29)**	(0.001)**
Group1	-0.005	(-0.74)	(0.007)
Group2	0.041	(5.11)***	(0.008)***
Group3	0.032	(4.27)***	(0.007)***
Group4	0.038	(5.90)***	(0.007)***
Group5	0.031	(4.69)***	(0.007)***
Group6	0.024	(3.62)***	(0.007)***
Group7	0.070	(14.26)***	(0.005)***

Variables	Coefficient	t-value	Standard Error
Group1_treat	0.035	(5.37)***	(0.006)***
Group2_treat	-0.018	(-0.82)	(0.022)
Group3_treat	0.019	(2.48)**	(0.008)**
Group4_treat	0.019	(2.72)***	(0.007)***
Group5_treat	0.032	(4.56)***	(0.007)***
Group6_treat	0.043	(6.02)***	(0.007)***
Group7_treat	0.000	(0.08)	(0.005)
Group8_treat	0.050	(13.48)***	(0.004)***
Constant	0.918	(75.52)***	(0.012)***
Number of Observations	102389		
Pseudo R-Squared	0.013		

Notes: Marginal effect of Probit estimations with employment dummy as a dependent variable. Cells show the marginal effects evaluated at the means of all explanatory variables. Standard errors are shown in brackets below. Superscripts ***, ** and * denote statistical significance at the 1%, 5% and 10% levels respectively. The control variables are year dummies, region of residence, gender, ethnicity, age, education level, sector of activity and occupation are used as control variables.

In Probit estimation, we considered group7 as an omitted group that we already mentioned in our methodology. Other than group2, all wage groups have positive treatment effects which explain that employment retention increases consistently with the increasing minimum wage in Estonia. One of the possible reasons could be that higher income makes employees to be more productive and dedicated to their works to retain the job. But a recent study by Ferraro et al. (2018a) did not find any significant effect of minimum wage on employment retention in Estonia. One of the reasons may be that we have a larger data set than the Ferraro et al. (2018) did. Table3 also shows that employee with high income have a higher probability of retaining job than employees with lower income. For example, treatment Group8 (people earning minimum wage and 3.6 times higher than minimum wage) has a very high probability of retaining his job than Group3 (people earning minimum wage and 1.36 times higher than minimum wage). The estimated treatment effect for Group2 and Group7 are statistically insignificant although Group2 has a negative effect on employment. On the other hand, Group7 has zero effect on employment.

6.2.Wage Analysis

Table 4 shows the results when equation (2) is estimated with year fixed effect using different sets of control variables. For each of the percentile estimations, the dependent variable is the difference between the log wage of the percentiles and the 60th percentile, while the explanatory variables are the difference between the log minimum wage and the 60th percentile wage in linear and squared forms in addition to control variables. We also used occupations dummy, regions dummy, unemployment rate, and GDP growth as additional control variables.

Table 4: Marginal effects estimation for percentiles of log wages.

Percentiles	**(Minimum Wage_p60)**	**(Minimum Wage_p60)²**	**R²**
p5-p60	0.734***	0.000***	0.830
	(-0.008)	(0.000)	
p10-p60	0.650***	0.000***	0.826
	(-0.007)	(0.000)	
p15-p60	0.589***	0.000***	0.817
	(-0.007)	(0.000)	
p20-p60	0.514***	0.000***	0.805
	(-0.007)	(0.000)	
p25-p60	0.442***	0.000***	0.793
	(-0.007)	(0.000)	
p30-p60	0.368***	0.000***	0.780
	(-0.006)	(0.000)	
p40-p60	0.229***	0.000***	0.755
	(-0.006)	(0.000)	
p70-p60	-0.144***	0.000***	0.239
	(-0.006)	(0.000)	
p80-p60	-0.355***	0.000***	0.318
	(-0.012)	(0.000)	
p90-p60	-0.717***	0.000***	0.313
	(-0.024)	(0.000)	
Number of observations	4722.000		

Note: Each row reports the results of a separate OLS regression of equation (2) with the dependent variable being the difference between the percentile indicated in the first column and the p60. Year fixed effects are included as the control variable. Standard errors are shown in brackets. The number of observations is 4722 in all cases. Superscripts ***, ** and * denote that the effect is statistically significant at the 1, 5 and 10 per cent levels, respectively.

For the wage distribution analysis, we applied OLS regression analysis with year fixed effects included as the control variable. Table 4 shows that the estimated coefficient of independent variables become smaller as the dependent variable (the difference between the *pth* percentile and the 60^{th} percentile) increases . At 5th percentile minimum wage increase one percent leads to wage increase by 0.7 percent. The effect of the minimum wage is statistically significant and positive until 40th percentile, but the effect of the minimum wage decreases relatively as the wage percentiles increase. Above 60^{th} Percentile, the effect of the minimum wage is negative and significant. As Lee (1999) methodology assumed that minimum wage does not have any effect at the centrality measure (at 60^{th} percentile) , therefore the marginal effect above 60^{th} percentile can be considered as negligible.

Table 5: Marginal effect estimation for log wages; gender, age, and ethnic groups.

Percentiles	**Men**	**Women**	**Age 45 or less**	**Age above 45**	**Estonian**	**Non-Estonian**
p5-p60	0.736***	0.837***	0.925***	0.718***	0.731***	0.831***
	(-0.009)	(-0.014)	(-0.014)	(-0.009)	(-0.009)	(-0.01)
p10-p60	0.653***	0.704***	0.818***	0.637***	0.648***	0.772***
	(-0.009)	(-0.013)	(-0.012)	(-0.008)	(-0.008)	(-0.01)
p15-p60	0.583***	0.625***	0.748***	0.583***	0.583***	0.714***
	(-0.008)	(-0.012)	(-0.012)	(-0.008)	(-0.008)	(-0.01)
p20-p60	0.516***	0.561***	0.671***	0.520***	0.519***	0.659***
	(-0.008)	(-0.012)	(-0.011)	(-0.007)	(-0.008)	(-0.009)
p25-p60	0.440***	0.499***	0.590***	0.453***	0.447***	0.593***
	(-0.008)	(-0.011)	(-0.011)	(-0.007)	(-0.008)	(-0.009)
p30-p60	0.362***	0.428***	0.497***	0.389***	0.380***	0.525***
	(-0.008)	(-0.011)	(-0.01)	(-0.007)	(-0.007)	(-0.009)
p40-p60	0.229***	0.229***	0.229***	0.229***	0.229***	0.229***
	(-0.006)	(-0.006)	(-0.006)	(-0.006)	(-0.006)	(-0.006)
p70-p60	-0.120***	-0.113***	-0.169***	-0.175***	-0.143***	-0.137***
	(-0.013)	(-0.011)	(-0.012)	(-0.007)	(-0.007)	(-0.01)
p80-p60	-0.347***	-0.291***	-0.391***	-0.441***	-0.351***	-0.312***
	(-0.019)	(-0.018)	(-0.02)	(-0.015)	(-0.012)	(-0.015)
p90-p60	-0.722***	-0.593***	-0.793***	-0.811***	-0.762***	-0.577***
	(-0.031)	(-0.034)	(-0.038)	(-0.029)	(-0.026)	(-0.026)
No. of observations	4641	4573	4609	4619	4641	4466

Note: Each row reports the results of a separate OLS regression with the dependent variable being the difference between the percentile indicated in the first column and the median. Year fixed effects are included as a control variable. Standard error shown in brackets. Superscripts ***, ** and * denote that the effect is statistically significant at the 1, 5 and 10 per cent levels, respectively.

The estimation of equation 2 shows that wage distribution and the spill-over effects vary across different percentiles for men and women. Until 10thpercentile, the spill-over effects from the minimum wage for women are larger than the men and it shows that minimum wage helps to reduce the gender pay gap in Estonia. A recent study by Ferraro et al. (2018b) found a similar result that due to the minimum wage gender pay gap reduced in Estonian.

Similarly, the wage distribution and spill-over effects also vary over different age groups. Table 5 shows that the minimum wage also reduces the wage gap among different age groups. It also shows that minimum wage affects the lower part of the wage distribution to a greater extent for younger people than for older people. Our finding for different age groups is opposite than the Ferraro et al. (2018) as they found that minimum wages have greater wage distribution effects on older aged people than younger aged people.

Table 5 also shows that the minimum wage has greater effect on non-Estonian ethnic groups than Estonian. In lower percentiles wage, the minimum wage effect is larger for non-Estonian ethnic groups. But as the percentiles increase, the effect of the minimum wage reduced between Estonian and non-Estonian.

7. Conclusion

The paper investigates the effect of the minimum wage in labor market and the wage distribution in Estonia. Structure of Earning Survey dataset (SES) for 2010 and 2014and the Estonian Tax and Customs Office data (from TSD declarations) of 2011 and 2015 are used in this study. Difference in difference methodology is used to compare the employment retention across the wage distribution in 2014, with retention at comparable wage levels when the minimum wage was constant in 2010–2011. A methodology developed by Lee (1999) is used for analysing the wage distribution among different groups in Estonia. The wage data used in the wage analysis was taken from the Estonian

Tax and Customs Office TSD declarations on payroll taxes.For wage distribution analysis, we used cell level data. We constructed cells by the year, sector, and NUTS3 level region.

Marginal Probit estimation shows that the minimum wage does not have any effect on employment retention when people earn 1.104 times higher wages than the minimum wage. On the other hand, in the case of Estonia, when people earning gets higher and higher from minimum wage, the effect of the minimum wage on employment retention also gets higher. For example, when employees earn 3.58 times higher wages than the minimum wage, retaining employment is higher than when employees earn 2.58 times higher wages the minimum wage. Which also shows that employment retention increases consistently with the increase of the minimum wage in Estonia. A recent study by Ferraro et al. (2018) did not find any significant effect of minimum wage on employment retention. One of the reasons may be that the size of the LFS data used by Ferraro et al. (2018a) was smaller than the size of our data.

Wage distribution analysis found a considerable spillover effect across the different percentile among different groups. It was found that wage income and the spillover effect for women is larger than the men until 10^{th} percentiles which is consistent findings with previous studies by Ferraro et al. (2018b) and Anspal (2015).

Similarly wage distribution analysis also found a considerable spillover effect in different age groups as well for in different ethnic groups in Estonia. It was found that younger aged group has higher spillover effect on their wage income than those above 45. It was also found that wage distribution and the spillover effects are higher for non-Estonian ethnic group which implies that minimum wage plays a larger role in wage income of non-Estonian ethnic group.

We also found that the minimum wage is more effective on lower wage group. This is due to the Estonian flat income tax, which means marginal tax rate same for both lower income group as well as higher income group.

Minimum wage changes in advance in Estonia which creates a larger spill-over effect in the wage distribution. For example, minimum wages for 2019 is 540 euro which wad decide d in 2018 but took place from January 2019.

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