TALLINN UNIVERSITY OF TECHNOLOGY
School of Business and Governance
Department of Economics and Finance

Birgit Hänilane

THE IMPACT OF THE MINIMUM WAGE ON EMPLOYMENT IN ESTONIA

Master´s Thesis

Supervisor: Visiting Lecturer Simona Ferraro
Co-supervisor: Professor Tairi Rõõm

Tallinn 2017

I declare I have written the master's thesis independently.

All works and major viewpoints of the other authors, data from other sources of literature and elsewhere used for writing this paper have been referenced.

……Birgit Hänilane…….

(signature, date)

Student´s code: 153362TAAM

Student's e-mail address: birgit.hanilane@gmail.com

Supervisor Visiting Lecturer Simona Ferraro:

The thesis confirms to the requirements set for the master's thesis

……

(signature, date)

Co-supervisor Professor Tairi Rõõm:

The thesis confirms to the requirements set for the master's thesis

……

(signature, date)

Chairman of defence committee:

Permitted to defence

……

(Title, name, signature, date)

TABLE OF CONTENTS

ABSTRACT

The effects of minimum wage laws are one of the most debated topic in labour economics and in Estonia it has been particularly important since the fast increase of minimum wage. Minimum wage has risen faster than the nominal average wage in the last four years with a constant rate of 10 per cent. Also, trade unions have set the target – minimum wage representing 60 per cent of the median wage. Currently, the ratio to median is 50 per cent. Future increases in minimum wage would affect more employees in the labour market and a larger negative impact on the employment could be found. Therefore, the thesis examines the effect of the increase of the minimum wage on employment in Estonia during the years 2013 – 2016. The data source originate from the Labour Force Survey. Using Difference-in-Differences and *probit*-regression on wage groups based on the position in the wage distribution, the author supports the previous findings and shows that the minimum wage increase has significant negative impact on the employees, who are directly affected by the minimum wage change.

Keywords: minimum wage, employment, Difference-in-Differences, *probit*-regression, Estonian Labour Force Survey, competitive labour market, monopsony.

INTRODUCTION

At the international level, minimum wages have increased but there is still an empirically controversial question of the impact of the minimum wage on employment. There is no doubt about the vast literature on the topic and from the existing literature, several studies have found different results but not a common ground regarding on whether the minimum wage reduces employment (Neumark and Washer 2007; Schmitt 2013).

Although it remains the subject of many researches, a growing body of evidence in developed countries have suggested that minimum wages have little or no effect on overall employment levels (Stewart 2004a; Dickens *et al*. 2012). Moreover, the main studies regarding minimum wage have focused on the effect of incremental increases in the minimum wage on the experience in the UK (Dolton *et al.* 2012; Metcalf 2008; Stewart 2004b) and the US (Brown *et al.* 1982; Card and Krueger 1994). However, studies from developing countries and emerging economics are quite recent and they do not show a common conclusion about the adverse effect on employment (Hinnosaar and Rõõm 2003; Baek and Park 2016). Whether the effects on employment are positive or negative depend on the fact, that they have used different estimation strategies (Dolton *et al.* 2012).

The scepticism about its effect is also due to the traditional microeconomics theory between competitive market and monopsony. In a single competitive labour market with homogenous workers, any increase of the minimum wage would lead to a reduction in the employment level. Keeping same level of employment depends on the ability of firms to substitute other factors of production for the higher priced labour in response to the change in relative input prices.

In monopsonistic labour market, on the contrary, firms set the wage as they are price-makers rather than take it at which they hire workers and under the efficiency wage theory, increases in the minimum wage could increase labour productivity and, thereby also employment. When measuring minimum wage impact on employment, both of the theories are describing Estonian labour market, perfectly competitive in Harju county, as over half of the

occupied and vacant posts are there and in more rural areas monopsony, where is only one major employer.

Studying the minimum wage is important to look at the indicators describing the strictness of labour institutions such as trade union density, collective bargaining coverage and the Kaitz index also known as the minimum wage relative to the average wage or the proportion of low-wage earners. In Estonia, minimum wage is settled by the agreement between the Estonian Trade Union and the Employer's Confederation. When trade union increases the wage level, *ceteris paribus*, there is a decrease in the employment rate in competitive labour market, which intensity depends on the density of trade union.

However, the collective bargaining coverage and the membership of trade union are low in the country and there might expect that the influence on the wage negotiations is low and the pressure on raising the minimum wage, minimal. Despite of this, minimum wages have raised faster in the last four years than the average wage (Appendix 1) and the proportion of low-wage earners is almost one quarter (Eurostat 2014b). Hence, future increases in minimum wage should affect more employees.

Minimum wage policies have been introduced to support low-wage workers, fight inequality and poverty, but fees and taxes are also indexed to the minimum wage in Estonia, which will automatically increase after a rise of the minimum wage. These fees and taxes include social security contribution, health insurance for unemployed, unemployment insurance, parental benefit, the minimum sickness and care allowance and, 15 days of study leave for graduation is calculated on the basis of minimum wage as well as kindergarten fees. Given the literature and the situation in Estonia, some questions drive the author to ask:

1) Is minimum wage an effective tool for supporting the low-wage earners?
2) Does the rapid minimum wage growth of recent years have a negative impact on employment or whether there is any significant effect?
3) Does geographical unit matter?

Whether or not the minimum wage should be untied from taxes and fees is not the main goal of this thesis and the author would keep it to policy makers decision, but the main argument here is to find an answer to above research questions and provide evidences for an update study regarding the effect of minimum wage on employment by documenting the experience of

Estonia, where a minimum wage was first enforced in 1991[1]. This thesis contributes to the literature by examining the effect of the increase of minimum wage on employment after its introduction and over the period 2013 – 2016, when minimum wage increase exceeded average nominal wage growth. The minimum wage has risen every year, mostly in January, except during years 2009 – 2011 due to the economic crisis.

The dataset originate from the Estonian Labour Force Survey (LFS), which was conducted for the first time in 1995 by Statistics Estonia. The author applies a simple policy-on/policy-off Difference-in-Differences (DiD) model as suggested by Laporšek *et al.* (2015), in which the treatment group consists of workers whose wages at the time of the increase in minimum wage were below the new minimum wage, and the control groups are workers whose wages were above the new minimum wage.

In the previous study on Estonia, Hinnosaar and Rõõm (2003) used the Heckman selection model. Using different estimation approach in this thesis, gives a comparison whether the results differ.

The thesis is organised as following: the first chapter reviews the existing literature on the topic and recent new evidences of the impact on employment. Also, the theory of traditional microeconomics on competitive labour market and monopsony.

In the second section is presented an overview of Estonian labour market, about the change of minimum wage and average nominal wage during the years. Also, comparison of minimum wages and low-wage earners with other European countries.

The third chapter presents the methodology and data. The author describes two models – the *probit*-regression for estimating whether the employee has stayed active (not fired) after the minimum wage increase and Difference-in-Differences estimator for comparing differences in probability of staying employed between target group and comparison group after the minimum wage increase. In the data selection, the author describes how the target and comparison groups are composed according to the position in the wage distribution. Also, the main characteristics of these groups.

The fourth chapter discusses the empirical analysis and describes the econometric model. The analysis of the econometric model is mainly on binary data (fired/not fired), but the

[1] Estonia regained its independence in 1991

model includes also socio-demographic characteristics, like age, nationality, number of children below 18 years old, profession, economic activity, education, gender etc.

The fifth chapter illustrates the main results and compares the results with similar researches on that topic. Last chapter summarizes the conclusion.

The author of this thesis would like to thank her supervisors, whose professional advice and support were very helpful for completion of the thesis.

1. LITERATURE OVERVIEW

In this section, the author reviews the minimum wage literature with respect to employment effects. The results of a selection of empirical studies are tabulated in Appendix 2. The first comprehensive study on the evidence of empirical studies is found at the beginning of 1980s when Brown *et al.* (1982) claimed that the increase in the minimum wage reduces employment. This study has formed the basis for upholding the predictions of the "traditional model" also known as "consensus" estimates. It was one of a small but statistically significant negative effect of the minimum wage on teenage employment in US.

Decade later, a new study by Card and Krueger (1994) changes the scenario. Their article, related on the impact of the 1992 increase of minimum wage on employment for fast food restaurants in New Jersey, shows results that were inconsistent with conventional competitive model and showed no negative employment effects. Their findings were based on the Difference-in-Differences (DiD) approach comparing the minimum wage between New Jersey and Pennsylvania, where the minimum wage was constant. That study was debated for the last two decades with proponents claiming that there is no adverse employment effect and opponents have claimed of significant employment losses (see O'Neill, 2015 for a review on the debate).

More recent studies for the US (Allegretto *et al.* 2011, 2013; Dube *et al.* 2010) looking at the federal and state level minimum wages, do not find significant employment effects using different periods of time and methods. This was also supported by O´Neill (2015) as well as many recent evidences have come to conclusion that there has been a little if any effect on the employment of minimum wage earners, even not showing weaknesses to the labour market fluctuations. In response to other researchers Allegretto *et al.* (2017) published a newer study and used a longer panel data than previously, the results confirm that minimum wages do not have significant impact on teen employment, while it is driven by negative pre-existing trends – teen employment was usually low before the minimum wage increase.

Card and Krueger (1995) pointed out that most of the evidence on the minimum wage is previously based on the analysis of time-series data, typically aggregated employment-population rate of teenagers in particular year. Also, they presented the mostly cited conclusion by Brown *et al.* (1982), that a 10 per cent increase in the minimum wage reduces employment by 1-3 per cent. In another research by Card (1992a) he didn´t find any adverse employment effect, even not in the low paid retail trade industry and for teenagers the results were even controversially with raising employment-population rate. Card and Krueger (1995) wondered whether the time-series approach provided the best mean of estimating the employment effects of minimum wage increases. In contrast to time-series evidence, cross-section and panel studies generally were considered to provide less-definitive evidence on the impact of the minimum wage.

In the UK, Stewart (2004a, 2004b, 2002) using DiD approach finds that employment had been neither adversely affected with the introduction of the National Minimum Wage (NMW) nor with the rise in 2000 and, again in 2001 while another study by Dolton *et al.* (2012) looking at the effects of NMW on employment and inequality in the UK since 1999, find neutral effects for most of the time. They have also said that whether the effects on employment are positive or negative depend on different estimation strategies. A more recent study by Dolton *et al.* (2015) when implementing the incremental changes of new minimum wage, again did not find no effect in a year on year context. Carrying out a meta-analysis on all the empirical studies for UK, De Linde Leonard *et al.* (2014) found also no evidence of a negative employment effect overall.

Nevertheless, the negative effects of the NMW are mainly found when there is a distinction between low and high skill employees and NMW does negatively affect low-skilled employment (Neumark *et al.* 2015). They made a very interesting point on "labour-labour" substitution, that to the respond to higher minimum wage it is pushing low-skilled out from the labour market, as employers will hire more high-skilled workers. Doing this would lead to fewer jobs for low-skilled workers, although minimum wages are settled to help them (Neumark *et al.* 2015).

De Linde Leonard *et al.* (2014) point out that policy makers could have implemented minimum wage adjustment only when employment is high or expected to increase, which minimizes the employment effect. Moreover, they find that the employment effect is significantly more negative in the residential home care industry and also retail food and

suggested that UK legislators might consider sector-specific minimum wage regulations than single statutory minimum wage.

Their findings were supported by the study of Laporšek (2013) where, in his paper, the author discusses the youth unemployment in the European Union providing evidences of a significant negative effect with the NMW. In a more recent article, Laporšek *et al.* (2015) studies the impact of the dramatically increase of minimum wage in Slovenia with a consequence of doubling minimum wage earners. The Difference-in-Differences method confirms that minimum wage has negative effect on job retention of minimum wage recipients.

Another study from Central Eastern European countries (CEE) by Harasztosi *et al.* (2016) shows opposite result proving that, the increase in minimum wage in 2001 had no effect on employment in Hungary. Most firms responded to the minimum wage by raising wages instead of destroying jobs and, also the employment effect varies across industries and they suggested that a lower minimum wage set to the industries that were hit the most could lead to less of a negative employment effect overall.

In Germany, where minimum wage was introduced recently, Bossler and Gerner (2016) using DiD comparison of affected and unaffected establishments for the new statutory minimum wage introduced in 2015, shows a meaningful job loss induced by the minimum wage in the affected establishment. Affected establishment consists of workers, whose hourly wage was below the introduced statutory minimum wage. A significant negative employment effect was also found by Bazen and Martin (1991) in France. French labour market inflexibleness is blamed for the high unemployment, as 90 per cent of the work force in France is covered by collective bargaining (Bazen & Cardebat 2001). A more recent study by Aeberhardt *et al.* (2015) measuring spillover effects over the period 2003-2005, when changes in the minimum wage level occurred in the French labour market[2], proves that this increase has spread over a large part of the wage distribution and they concluded that minimum wage is "either driving out low productivity workers from the labour market, or attracting previously unemployed individuals for whom the minimum wage did not meet their reservation wage."

The effect of minimum wage on employment has very little studied in Estonia. A recent study on the topic is by Hinnosaar and Rõõm (2003) using Estonian LFS microdata during the period of 1995-2000. Their research use the Heckman selection model and *probit*-regression and their findings show that 10 per cent increase of the minimum wage affected by 0.43 – 0.66

[2] The minimum wage was first legislated in 1950

per cent the reduction in employment, which was significant only in the group of employees who were directly affected by that change. Those employees whose salary were below minimum wage and in a higher salary group the result was insignificant. They also pointed out that, given the proportion of minimum wage relative to average wage has increased over years, a greater negative impact could be detected. As data source, they have used Estonian Labour Force Survey, where the employee´s themselves report their net wages and working time and therefore wrong subscriptions could occur, which could be one explanation why they are paid less than the legal minimum wage. Other reason for that could be due to the shadow economy, as for Estonia the shadow economy in relation to GDP is estimated to be almost 30 per cent (Schneider *et al.* 2013).

A more recent study by Ferraro *et al.* (2016) study the spillover effects of the increase of the minimum wage on wages distribution for a large temporal range 2001-2014. Results of that study show that the effects are most substantial up to the 20th percentile, female are more affected and wage-earners over 45 years old. It is interesting that the effect decreases sharply until to the median and upper part of the wage distribution the increase in minimum wage does not have significant impact.

Taking advantage of a large increase in the minimum wage that occurred in Russia, when the minimum wage was increased from 1100 to 2300 Rubles in 2007, Muravyev *et al.* (2016) found some evidence of adverse effects. They prove that when using different methods, the results are consistent with the previous study of Muravyev *et al.* (2013) when they used region panel data approach.

In developing countries as South-Korea[3], applying a DiD framework to the plant-level panel data to reveal the causal effect of the newly introduced minimum wage, Baek and Park (2016) find that the minimum wage introduction did not have any discernible adverse effect on plant level employment.

Regarding the models for evaluating employment effects of minimum wage, the theory presents two main models: the neoclassical model and the well-known exception of monopsony. Edagbami (2006) presents a wide literature review describing the traditional model, which "…focuses on a single competitive labour market with homogenous workers and a complete coverage of the minimum wage", where "…equilibrium levels of employment are set by the forces of demand and supply" (Figure 1). "After the imposition of a binding minimum

[3] The minimum wage was first enforced in 1988

wage, employers reduce the quantity of labour demanded" (Edagbami 2006) and how the hike in the minimum wage reduces employment "…depends on the ability of firms to substitute other factors of production for the higher priced labour in response to the change in relative input prices. Apart from the disemployment effects, an additional set of workers would be attracted into the labour force by the higher minimum wage, thus increasing the queue for the already reduced number of jobs" (Edagbami 2006).

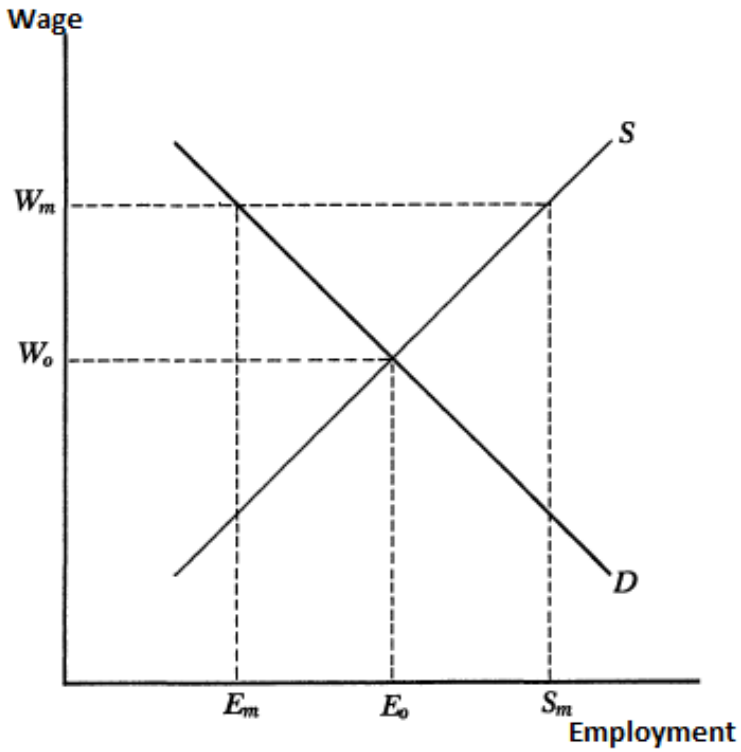

Figure 1. Minimum wage in the competitive labour market

Source: Brown *et al.* (1982)

Notes: Initial employment E_0 is determined by supply and demand, once the minimum wage is W_m introduced, employment falls to E_m. S_m represents the number of those persons willing to work at W_m.

Dickens *et al.* (1999) argue that labour market search models provide some support for constructing theoretical models of the labour market where employers have some monopsony power. They think of the source of the monopsony power as labour market frictions (whether the frictions are search related or related to transitioning from one job to another) and under the efficiency wage theory, increases in the minimum wage could increase labour productivity and thereby also employment (Figure 2). Although these conclusions describe partial equilibrium

model, but while minimum wage does not affect only one employer, there should be also other form of imperfect competition considered – such as general equilibrium of oligopsony (Manning 2003).

A minimum wage in a monopsony market does to increase employment within some relevant range of wages and we can see it as an exception to the conclusion of negative effects of the minimum wage. "A monopsonist is a firm whose large size relative to the size of the labour market permits it to set rather than take the wage at which it hires workers. In order to attract additional labour, the monopsonist has to raise wages; but if it lowers the wage rate, it will not lose all of its work force" (Edagbami 2006)[4].

[4] For a full description on labour market theory see also Benjamin, D., M. Gunderson, W. C. Riddell. (2002). Labour Market Economics, fifth edition, McGraw-Hill Ryerson, Toronto.

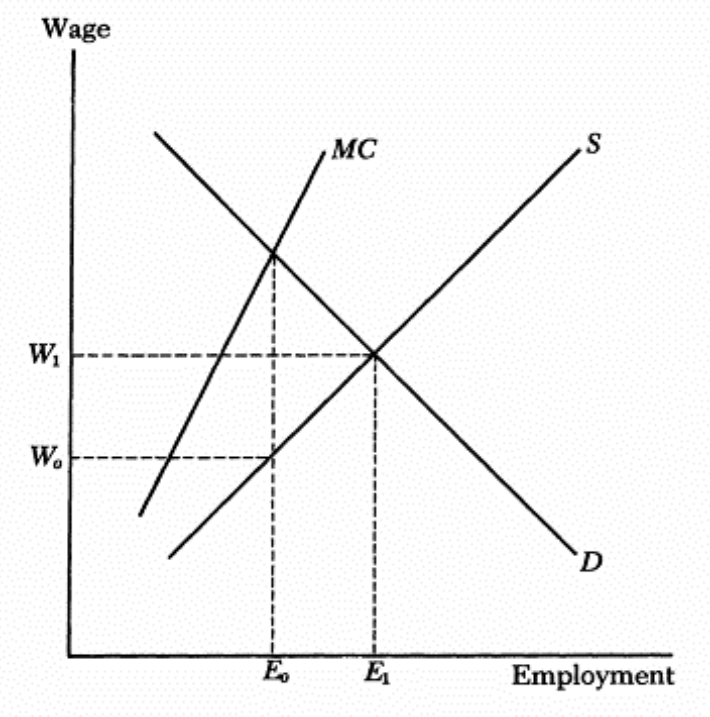

Figure 2. Minimum wage under monopsony

Source: Brown *et al.* (1982)

Notes: A minimum wage between the original monopsony wage W_0 and the competitive wage W_1 will increase employment, choosing $W_m = W_1$ brings employment to its competitive level E_1, further increases in minimum wage would reduce employment under E_1.

2. BACKGROUND OF ESTONIA

In the pre-election time, there were proposed several ambitious promises by the political parties. In 2006, the Reform Party promised that Estonia will be in 15 years one of the 5 richest countries, following to Switzerland, Norway, Luxembourg and Denmark. When looking to the latest data on economic growth, compared to the last year in 2016, the growth of GDP was 1.6 per cent (Statistics Estonia 2017), then the promise by the Reform Party seems to be ever impossible. Nobody could also see the import restrictions on EU food products by Russia. Also, there is no significant growth to see in the near future, rather more discreet ca. 3 per cent growth is projected for the next coming years (Ministry of Finance 2017).

Looking at the promise by the Centre Party in the 2015 elections, minimum wage should reach 1000 euros. Based on author´s own calculations, when minimum wage increases faster than the average nominal wage, if minimum wage will continue to rise 10 per cent as it has been in the last four years and using the spring economic forecast by Ministry of Finance for average nominal wage projections until 2021 and if the average nominal wage growth will stay at 5 per cent level until 2025, then the time could arrive after 8 years, when the average nominal wage is approaching to 2000 euros (Table 1).

Table 1. Minimum and average nominal wage projections

	2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Minimum wage, euros	470	517	569	626	688	757	833	916	1007
Nominal average wage, euros	1214	1274	1343	1414	1486	1561	1639	1721	1807
Nominal wage growth, %	5.9	5.0	5.4	5.3	5.1	5.0	5.0	5.0	5.0

Source: For nominal wage projections is used the Ministry of Finance projections from 2017 – 2021
Notes: Author´s own calculations.

The negotiation of the minimum wage is annually and made between the Estonian Trade Union Confederation and Employer's Confederation. If there is no agreement, then the minimum wage is determined by the government. According to the agreement in 2016, the minimum wage in 2016 was 430 euros per month and 2.54 euros per hour while in 2017 is 470 euros per month and 2.78 per hour (Estonian Trade Union Confederation). European Trade Union Confederations have set the target, that minimum wage will represent 60 per cent of the median wage, currently it is 50 per cent (author´s own calculations).

Studying the minimum wage, it is also important to look at indicators that describe the strictness of labour institutions, such as trade union density, collective bargaining coverage and the Kaitz index or the proportion of low-wage earners. When trade unions increase the wage level, *ceteris paribus*, it might decrease the employment rate in competitive labour market and the impact is greater when more employees belong to the trade union. In Estonia, however, a small part of the employees belong to the trade union and based on Organization for Economic-Cooperation and Development (OECD) studies, trade union density is 6 per cent (OECD 2013) and the collective bargaining coverage is low. It might be expected that the influence of the trade union on the wage negotiations is low and the pressure on raising the minimum wage is minimal.

Despite this, minimum wages do amount for ca. 40 per cent of the average nominal wage, but in the last four years, minimum wage has grown faster than the average nominal wage (Figure 3). Although the minimum wage has risen rapidly, we should expect, according to the theory in competitive labour market, a decrease in the employment rate. Nevertheless, the employment rate has exceeded the rate before the crisis (Appendix 1). Might monopsonistic power be in the labour market responsible for the absence of a negative employment effect?

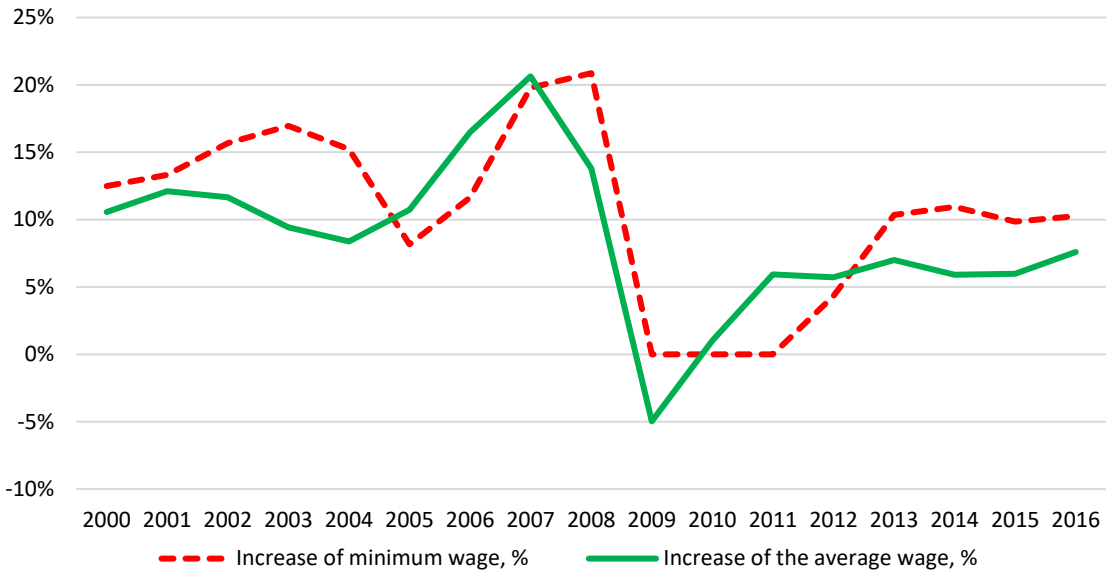

Figure 3. Increase of minimum and nominal average wage

Source: Statistics Estonia (2016a)/author´s own calculations

Notes: Minimum wage growth is calculated based of the annual minimum wage.

According to the author´s own calculation when using Estonian Labour Force Survey (LFS), the share of minimum wage earners is 5.5 per cent. While sectors are highly concentrated in Estonia, then the share of minimum wage earners varies among them and being the highest in accommodation and food service activities (11.0 per cent), which is expected as in that sector the nominal wage is one of the lowest (Table 2). Agriculture, forestry and fishing is also expected to have more minimum wage earners, but according to the Estonian LFS the share is 3.6 per cent. The lowest share of them is in financial and insurance activities and in information and communication, which are also sectors with high pay. So, for different sectors, different impact on employment might be expected.

Table 2. Average monthly gross wages in economic activities 2016, euros

	Average monthly gross wages (salaries), euros
Average of economic activities	1146
Agriculture, forestry and fishing	1060
Mining and quarrying	1361
Manufacturing	1107
Electricity, gas, steam and air conditioning supply	1597
Water supply; sewerage, waste management and remediation activities	1146
Construction	1112
Wholesale and retail trade; Repair of motor vehicles and motorcycles	1028
Transportation and storage	1129
Accommodation and food service activities	756
Information and communication	1900
Financial and insurance activities	1856
Real estate activities	951
Professional, scientific and technical activities	1321
Administrative and support service activities	1058
Public administration and defence; compulsory social security	1364
Education	1006
Human health and social work activities	1209
Arts, entertainment and recreation	901
Other service activities	617

Source: Statistics Estonia (2016a)

Despite the rapid growth of minimum wage, compared to the European Union countries, the minimum wage in Estonia is still low (Table 3) and it might affect a very small proportion of the labour force. Looking at the proportion of low-wage earners, Estonia is at the top of the ranking with 23 per cent of all employees who earn two thirds or less of the national median gross hourly earnings (Figure 4), which was 4.91 euros in 2014 (Eurostat 2014b). The minimum wage growth, however, might not only affect a substantial part of the employees at the bottom of the wage distribution. The study by Ferraro et al. (2016) showed that the effects are most substantial up to the 20th percentile and the impact is significant until the wage approaches to median wage.

Table 3. Minimum wages in EU, euros

	2016	**2015**
Luxembourg	1 923	1 923
Ireland	1 546	1 462
Netherlands	1 525	1 502
United Kingdom	1 512	1 379
Belgium	1 502	1 502
France	1 467	1 458
Germany	1 440	1 440
Slovenia	791	791
Spain	764	757
Malta	728	720
Greece	684	684
Portugal	618	589
Poland	434	410
Estonia	**430**	**390**
Croatia	408	396
Slovakia	405	380
Latvia	370	360
Czech Republic	366	332
Hungary	351	333
Lithuania	350	300
Romania	232	218
Bulgaria	215	184

Source: Eurostat (2016)
Notes: Denmark, Italy, Cyprus, Austria, Finland and Sweden have not introduced minimum wage. The most recent country Germany established minimum wage in 2015.

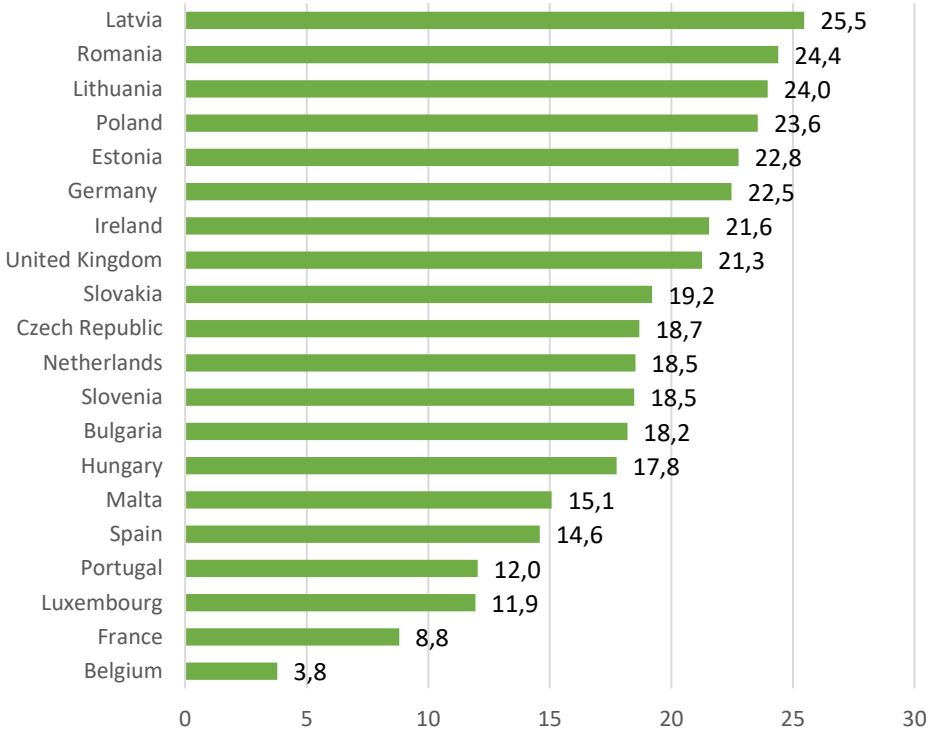

Figure 4. Low-wage earners as a proportion of all employees in 2014, countries who have introduced minimum wage

Source: Eurostat (2014b)

A number of fees and taxes are also indexed to the minimum wage in Estonia, which automatically increase after a rise of minimum wage. Based on the Estonian laws such as the Social Tax Act § 2, Health Insurance Act § 55, Unemployment Insurance Act § 9, Parental Benefit Act § 3, Adult Education Act § 13, these include:

- The monthly rate of the social tax shall not be less than the previous calendar year minimum wage,
- unemployment insurance benefit, which equals to 50 per cent of the previous calendar year minimum wage,
- parental benefit, which is 100 per cent of the previous calendar year minimum wage,
- the minimum sickness or care benefit is calculated on the basis of current minimum wage,
- 15 days of study leave for graduation is calculated on the basis of minimum wage,
- Kindergarten fees are linked to the minimum wage.

The thesis does not solve the issue of whether minimum wage should be untied from these taxes and fees, but the author will dry to find support whether the fast minimum wage increase has any impact on employment. Also, whether it impacts only those employees, who belong to the bottom end in the wage distribution or also those, whose wages are higher from minimum wage. And whether geographical unit matters, knowing that Estonian labour market is highly competitive in Harju county, as over half of the occupied and vacant posts are there (Statistics Estonia 2016b), then employment should decrease after the introduction of the new minimum wage. All other counties, separately, have less than 10 per cent of total occupied posts, except of Tartu county. Hence, the rise of minimum wage might have different impact on regions outside of Harju county (included Tallinn).

3. METHODOLOGY AND DATA

3.1. Difference-in-Differences method in policy evaluation

The study conducted by the European Central Bank (Bodnar *et al.* 2017) shows that in Estonia, there are around 4.9 – 5.8[5] per cent of minimum wage earners employed by firms, who have been directly affected by the increase of minimum wage. Therefore, it is important to measure whether the minimum wage increase has a negative or positive effect on employment of low-wage earners. Statistics Estonia, in its recent press release on labor market[6] shows that, additional 8,300 people have entered to the labor market within a year, which in one case might, also be the result of the policy changes, such as "Work Ability Reform" introduced by the Ministry of Social Affairs in January of 2016. The reform contributes in the recruitment of people with reduced working capacity. Or, another hypothesis is that, the raise is due to the minimum wage increase and, in the monopsony case it is known that employment also increases as more people are willing to work at the new minimum wage level.

Since 2013, minimum wage has grown faster than the average wage four years in succession with a constant rate (Appendix 1), therefore the author analyses the effect of an increase in Estonia´s minimum wage from January 2013 until December 2016 using Estonian LFS which covers working age population. While some of them are directly affected by the increase of minimum wage, the estimated impact is measured by using Difference-in-Differences (DiD) method, which is based on "before-and-after" of the policy change as well as "treatment-and-control" comparisons, in which the treatment group is comprised of workers whose wages at the time of the increase in minimum wage were below the new minimum wage,

[5] According to the Wage Dynamics Network (WDN) data, the average share of minimum-wage earners employed by firms was 4.9 per cent and to the national statistics 5.8 per cent.
[6] Source: Statistics Estonia. (2017b). No major changes in the labour market. http://www.stat.ee/news-release-2017-019

and the control groups are comprised of workers whose wages were above the new minimum wage. The study follows Laporšek *et al.* (2015).

Difference-in-Differences method is most known by the work of Card and Krueger (1994), but several other recent studies have also used it in measuring the impact of the policy change (Appendix 2). The underlying assumption of the model is that the outcomes for treatment and control groups without the policy change, would have equal trends. Inversely the estimated treatment effect would be invalid or biased (Gertler *et al.* 2016).

A graphical representation of the DiD estimator is illustrated in Figure 5, where before-and-after outcome variables for the treatment group are A and B, and for the comparison group are C and D. The DiD impact is the difference between the difference in outcomes for the treatment group (B-A) and the difference for the comparison group (D-C) (Gertler *et al.* 2016), which shows the effect of the policy change on the treated group.

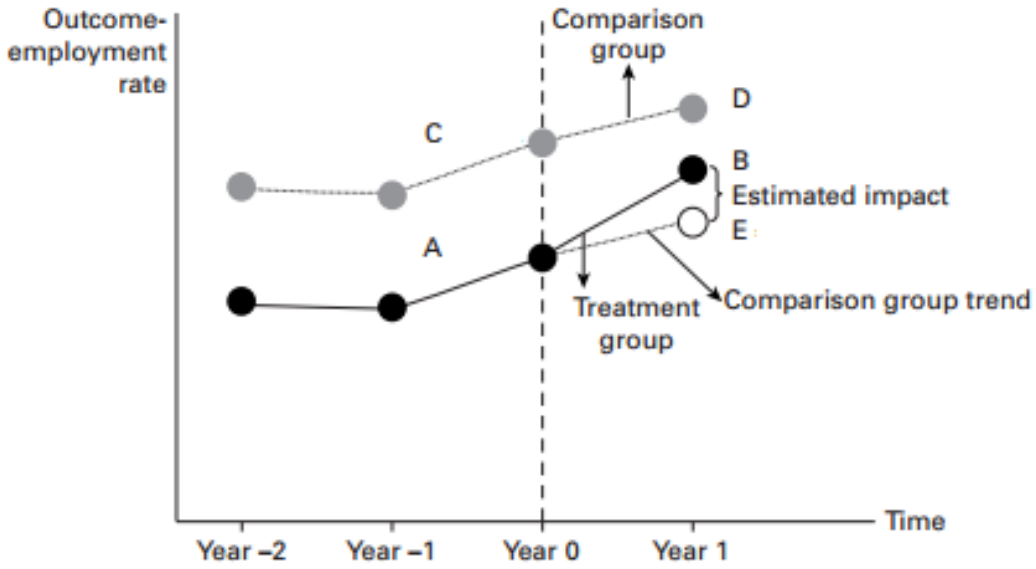

Figure 5. The Difference-in-Differences Method

Source: Gertler *et al*. (2016)

Notes: DiD impact = (B-A) – (D-C).

DiD estimator is typically applied as an interaction term between time and treatment group dummy variables in a regression model, which is expressed in the following form:

$$Y_{i,t} = \beta_0 + \beta_1 Treat_i + \beta_2 Post_t + \beta_3 (Treat_i \cdot Post_t) + \varepsilon_{i,t} \quad (1)$$

where

$Y_{i,t}$ – is the observed outcome in group *i* and period *t*,
$Treat_i$ – is the dummy variable, which is set to 1 if it is the treatment group,
$Post_t$ – is the dummy variable, which is set to 1 for the post treatment period,
β_3 – is the differences between means of the two groups,
$\varepsilon_{i,t}$ – is an error term.

Effects on employment

In this thesis, the estimation is based on the treatment and control groups comparison, which are formed similarly to Neumark *et al.* (2004) and to Laporšek *et al.* (2015) and based on the position of workers in the wage distribution before the introduction of the new minimum wage. These workers belong to the fourth quarter of the year (Table 4). An Estonian study by Hinnosaar and Rõõm (2003) used the working paper from Neumark *et al.* (2000). The fourth quarter is considered as period before the minimum wage increase while the third quarter is used as control period, to estimate whether the employee has maintained the job. The target group consists of workers who are directly affected by the change of minimum wage and they have wages between the old and the new minimum wage (Group 2) at the time of the introduction of the new minimum wage. The control groups consist of workers respectively below the old minimum wage (Group 1) and between the new minimum wage and times the level of 1.4 – 3.6 with the new minimum wage (Group 3 – 8).

Thus, obtained coefficients 1.4, 1.8, 2.2, 2.5 and 3.6 are found, when ranking the net wages in the 4th quarter of 2012 (before the minimum wage increase) from smallest to largest and dividing them into 8 equal groups so that each group has similar size of employees and the last net wage in each group is divided by the last net wage of the first group.

Table 4. Definition of target and control groups

Group 1	$wage_{it} < mw_t$
Group 2 = target group	$mw_t < wage_{it} < mw_{t+1}$
Group 3	$mw_{t+1} < wage_{it} < mw_{t+1}*1.4$
Group 4	$mw_{t+1}*1.4 < wage_{it} < mw_{t+1}*1.8$
Group 5	$mw_{t+1}*1.8 < wage_{it} < mw_{t+1}*2.2$
Group 6	$mw_{t+1}*2.2 < wage_{it} < mw_{t+1}*2.5$
Group 7	$mw_{t+1}*2.5 < wage_{it} < mw_{t+1}*3.6$
Group 8	$mw_{t+1}*3.6 < wage_{it}$

Notes: $wage_{it}$ is the net wage of individual *i* in time *t*, mw_t is the net minimum wage before the minimum wage increase and mw_{t+1} is the net minimum wage after the minimum wage increase.

As in Laporšek *et al.* (2015), the dummy variable $D \in \{0,1\}$ equals to 1 if the worker receives treatment and 0 otherwise. The treatment is received when they are directly affected by the minimum wage increase. The treated outcome is Y(1) and non-treated outcome is Y(0) while Y_t are the outcomes before the minimum wage increase and Y_{t+1} after minimum wage increase. Thus, Difference-in-Differences estimator θ_{DID} would equal to the following form:

$$\theta_{DID} = (E[Y_{t+1}(1)|D = 1] - E[Y_t\,(0)|D = 1]) - (E[Y_{t+1}(0)|D = 0] - E[Y_t(0)|D = 0]) \quad (2)$$

To provide an unbiased DiD estimator of the average treatment effect in panel data, then there must hold two assumptions (Laporšek *et al.* 2015):

1) The underlying assumption of the model is that the outcomes for treatment and control groups without the policy change would have equal time trends.
2) The minimum wage increase must have affected treatment group in the same way as the rise would have impacted the control group.

Under these two conditions the unbiased estimate of the average treatment effect θ_{DID} is found to the following from:

$$\theta_{DID} = E[Y_{t+1}\,(1) - Y_{t+1}\,(0)] \quad (3)$$

Since the Estonian LFS is with rotating panel data, all individuals involved are interviewed 4 times in 2 consecutive quarters and again after 2 quarters. This gives the opportunity to measure periods when the minimum wage did not change (for example the 4th quarter of 2012) and periods when it increased (for example the 3rd quarter of 2013). The *probit*-regression analysis is used, for measuring the probability of staying employed one year after the minimum wage increase, in other words, measuring the probability that the person after the increase of minimum wage in 2013 does not lose her/his job, considering that the she/he worked before and received a salary.

The sample covers 4 years and includes 2 time periods for each year. The model is estimated to the following equation:

$$\Pr[Y_{it+1} = 1|x] = \propto_0 + x_{it}\delta + \beta_1 D_t group_1 + \beta_2 D_t group_2 + \beta_3 D_t group_3 + \beta_4 D_t group_4 + \beta_5 D_t group_5 + \beta_6 D_t group_6 + \beta_8 D_t group_8 + D_t + \varphi_1 group_1 + \varphi_2 group_2 + \varphi_3 group_3 + \varphi_4 group_4 + \varphi_5 group_5 + \varphi_6 group_6 + \varphi_8 group_8 + \varepsilon_{it} \quad (4)$$

where the dependent variable (Y_{it}) is a dummy variable, which is set to 1 when the person *i* is still employed (not fired) at time $t + 1$ and 0 if her/his employment status has changed to unemployed (fired) or not active without been paid. The variable $\beta_j D_{t+1} group_j$ equals to 1 for the group definition indicated in Table 4 and 0 otherwise ($Group_j$_d). Group dummies are multiplied with the time dummies, to look whether the individual who was employed and received a salary in the fourth quarter, period before the increase *t*, in the $Group_j$ is not fired at the third quarter, after the introduction of the increase in the minimum wage. Group2 (target group) could be the most vulnerable, as their wages are needed to be raised. The Group7 is a reference group and left out from the equation to avoid perfect multicollinearity. This reference group is expected to be one where employees are least affected by minimum wage increase due to the high salary. The variable x_{it} is a vector of control variables for individual *i* in time *t* and includes gender (Gender), age (Age), age squared (Agesquare), education (High_education and Low_education), nationality (Nationality), language (Language), children (Child_18_nr), sector (Industrial, Services, Wholesale, Public), occupation (Occ1-Occ8) and region (region1-region4) (Appendix 3). Variable D_t detects the time varying effects and ε_{it} is the stochastic error. Variable β_j is the coefficient estimates for the interactive variables of the group dummies.

Other studies have suggested that the impact of minimum wage increase on employment should be measured for regions separately (Card 1992b; Stewart 2002) or by sector-specific (Harasztosi *et al.* 2016; De Linde Leonard *et al.* 2014), while the federal minimum wage policy imposes a higher relative wage floor in regions with lower average wages and the extent of the impact on workers varies across states (Card 1992b). Although the national minimum wage is the same for all counties, there is a considerable regional variation in wages across Estonia.

The average wages vary from 1208 euros in Tallinn to around 802 - 874 euros in South of Estonia where wages are ca. 1.5 times smaller compared to the capital area[7]. In areas with low-wage workers, if firms want to be competitive with others that are settled in Tallinn, they have to increase wages. The author points out that it is important to show that the minimum wage has a different impact on the wage distribution across areas, which leads to presume differences in employment growth (Stewart 2002). The impact is estimated similarly to the equation (4), expect for the difference in region 1 – Northern Estonia that is the reference group and it is excluded from the model.

The counties are grouped into regions based on the Statistical Classification of Regional Units of Estonia (NUTS3):

- Region 1 is Northern Estonia: Tallinn and Harju county;
- Region 2 is Central Estonia: Järva, Lääne-Viru and Rapla counties;
- Region 3 is North-Eastern Estonia: Ida-Viru county;
- Region 4 is Western Estonia: Hiiu, Lääne, Pärnu and Saare counties;
- Region 5 is Southern Estonia: Jõgeva, Põlva, Tartu, Valga, Viljandi and Võru counties.

While the gender pay gap in Estonia is the highest in Europe, women might also be in the first high-risk group, who are more likely to be low paid (in Estonia women earn over 1/4 less per hour than a man[8]). Also, wages vary remarkable between occupations in Estonia, being the highest for managers 1541 euros and the lowest for elementary occupations 651 euros[9].

[7] Statistics Estonia. (2016a). Average monthly gross and net wages (salaries) by county – annual data.
[8] Eurostat. (2015). Gender pay gap in unadjusted form by NACE Rev. 2 activity - structure of earnings survey – annual data.
[9] Statistics Estonia. (2014). Gross monthly earnings and deciles of full-time employees by sex and major group of occupation – annual data.

Therefore, despite of distinction between regions, the thesis tries also to find support, whether the minimum wage increase has different impact on gender and major occupations.

3.2. Estonian Labour Force Survey data

The Estonian LFS by Statistics Estonia is used to estimate the impact of the rapid growth of minimum wage on employment during 2013 – 2016. The survey gives an overview of Estonian residents on employment, unemployment, working conditions and changes in the labour market conditions. It is a quarterly sample survey, where data are collected directly from population. The survey is partly panel data, since all individuals are interviewed four times: two consecutive quarters and after one year in the same quarters. In each year, ¼ of the sample is renewed and ¾ of the individuals have already been interviewed. It has advantages over other data source, because it covers the whole working-age population, who are in the reference week and are 15-74 years old. Since 2007, the average sample of the survey has been 12,000. The Estonian LFS is conducted since 1995 (Statistics Estonia 2012).

For the thesis, only full-time wage-earners are considered and are excluded other professional status such as: freelancers, entrepreneurs, professionals as self-employed. From the sample are also excluded part-time workers as minimum wage is only settled for workers who have full-time contract. The author also keeps workers, who have a salary below the minimum wage, although minimum wage is set to be mandatory. For the analysis, the author keeps from the dataset information related to last monthly net salary of wage earners, occupation status, economic activity, economic sector, county, yearly weight, employment status (occupied, unemployed, not active), flows (from employed to unemployed, employed-employed, employed-not active etc. compared to the situation in the last year), employee´s identification number, age, nationality, language, education, the number of children less than 18 years old.

Workers in the Estonian LFS are aggregated into groups according to the position in the wage distribution at the time of the introduction of the new minimum wage (Table 4). From the calculations, the bottom end and the top of the wage distribution were dropped (top 1 per cent and bottom 1 per cent of weighted wage). The most vulnerable group, which is directly affected by the minimum wage change is group 2 (target group), where the net wage is between the old and the new minimum wage. Based on author´s own calculations, the share of minimum wage

earners, target group is divided by the total sample, is 6 per cent, which is very close to the number published by the European Central Bank (Bodnar *et al.* 2017). Other studies have shown that the most vulnerable groups to the changes of minimum wage are sectors with the high proportion of low-wage earners, like young workers, with low education, in industrial activities (Laporšek *et al.* 2015).

As shown in Table 5, the share of those groups, who are most affected by the minimum wage increase (women, age ≤30, lower than secondary education, elementary occupations), decreases proportionally along the wage distribution. Minimum wage earners are gathered more to outside of Northern Estonia (region>1), as 76 per cent are represented in group 2 (target group). The highest share of elementary occupations or simple workers (ISCO code 9) is also in group 2. Inversely the highest share of managers (ISCO code 1) is in group 8. Also, workers with low-education with primary education are present in group 1 and 2 and high-education with tertiary education in group 8. Women are present more in the lower tail of the wage distribution than in the upper part (72 per cent of the target group are women).

Table 5. The proportion of vulnerable groups of the corresponding group, per cent

	Total	Women	Age ≤30	Age >50	Low-educat	High-educat	Region >1	Simple workers	Managers
	100	52	12	42	13	26	60	9	8
Group1	4	73	13	50	19	11	65	31	3
Group2 = target	6	72	14	53	17	10	76	32	3
Group3	19	67	14	48	19	11	71	15	5
Group4	20	58	16	43	14	22	64	9	4
Group5	16	52	12	40	11	29	56	4	5
Group6	11	43	10	40	9	33	55	4	8
Group7	16	36	9	34	9	39	53	3	13
Group8	9	26	8	31	10	47	47	2	19

Source: Estonian LFS

Notes: Author´s own calculations. Total sample for the period 2012-2016 is 96,852 observations. The number of observations for those, who are working full-time and wage-earners and whose wages are observed is 35,693.

To estimate the wage distribution changes to minimum wage increase, the author also uses a non-parametric method: the Kernel density. Figure 6 shows the Kernel estimations of the wage distribution at the third quarter of 2013 and 2016. The third quarter is used as control period to estimate whether the employee is still in the labour market after the minimum wage increase. The figure shows in 2016 a shift in Kernel wage density in the rightward direction compared to 2013 and a small spike of the maximum point. As the density is the highest near to the minimum wage level, the future increase on minimum wage could impact a remarkable part of the labour force.

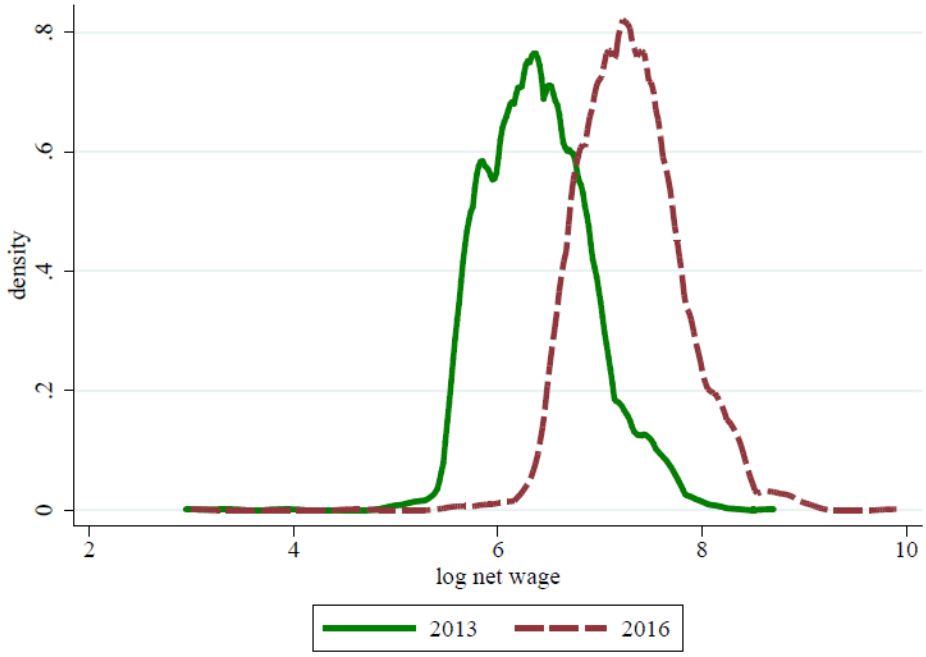

Figure 6. Kernel density for net wage in 2013 and 2016
Source: Estonian LFS
Notes: Author´s own calculations.

To estimate the minimum wage effect on employment, one of the minimum wage variables is the Kaitz index – minimum wage relative to the average wage. Since 2000, the ratio of minimum wage to average wage has increased from 36 per cent in 2000 to 42 per cent in 2016 and the ratio of minimum wage to median wage has increased from 44 per cent in 2000 to 50 per cent in 2016 (Figure 7). As the European Trade Unions have set the target that minimum wage would represent 60 per cent of the median wage, the minimum wage will continue to increase. Only during the crisis, minimum wage has not changed, but since 2013 it

has increased faster than the average wage (Appendix 1). Therefore, it is important to measure which impact has the rapid growth since 2013 on employment or if there is any effect.

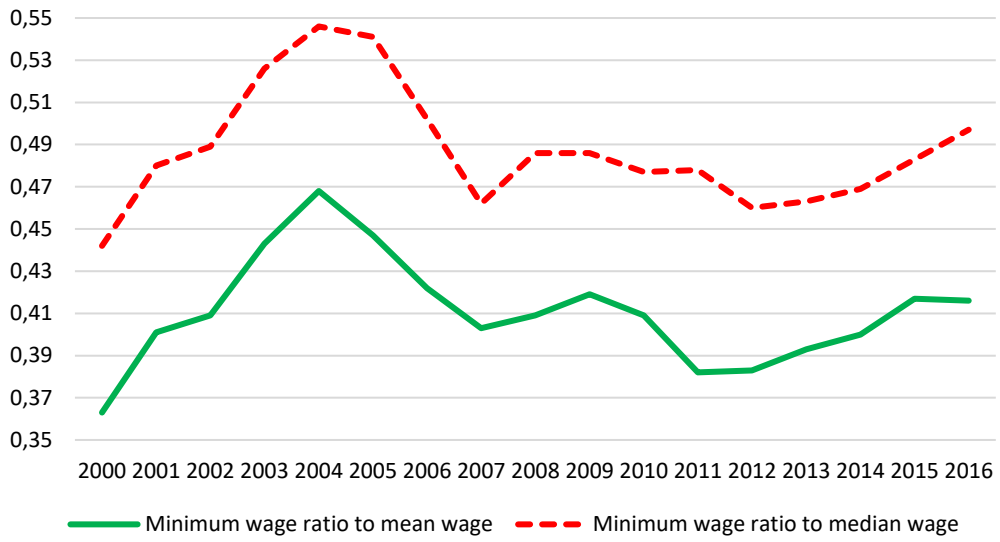

Figure 7. Minimum wage ratios

Source: Estonian LFS

Notes: Author´s own calculations.

The Kaitz index (minimum wage to average nominal wage) varies remarkable across regions and time (Figure 8). Although the overall Kaitz index has increased since 2012, then in Northern Estonia (region 1) it has stayed quite stable in the recent years. As Region 2, 4 and 5 have had similar time trends, then region 3 differs from other regions with a relatively high Kaitz index. Therefore, because of the high Kaitz index, it might expect that the proportion of low-wage earners, who would be the most affected by the minimum wage increase, is the highest in Region 3.

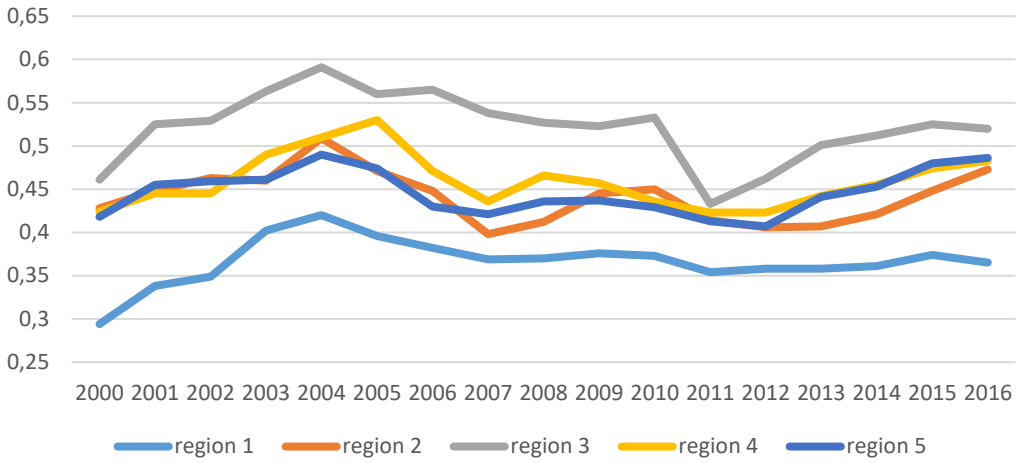

Figure 8. Kaitz index – minimum wage to nominal mean wage
Source: Estonian LFS
Notes: Author´s own calculations. NUTS3 classification: region 1 – Northern Estonia, 2 – Central Estonia, 3 – North-eastern Estonia, 4 – Western Estonia, 5 – Southern Estonia.

As minimum wage has increased faster than the average wage four years in succession, according to the competitive labour market, employment should decrease in Northern Estonia but, despite of this, employment rate has increased and reached the highest level overall (Figure 9). As the time trend of employment rate differs across regions, it might expect that minimum wage could have different impact on regions. One explanation for the change of employment rate could be, that labour force is moving to Harju count, while over half of the vacant and occupied posts are there and also, other reason could be higher salaries compare to other regions.

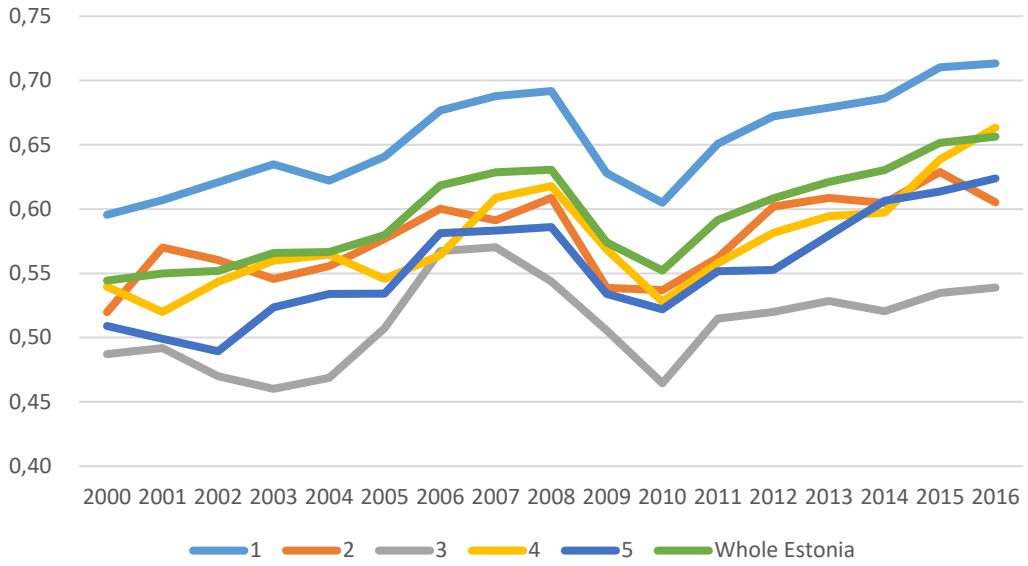

Figure 9. Employment rate across regions

Source: Statistics Estonia (2016c)

Notes: Author´s own calculation. Employment rate = occupied/total working-age population. NUTS3 classification: Region 1 – Northern Estonia, Region 2 – Central Estonia, Region 3 – North-Eastern Estonia, Region 4 – Western Estonia, Region 5 – Southern Estonia.

4. EMPIRICAL ANALYSIS

4.1. Description of the econometric model

The *probit*-regression analysis is used to estimate the probability of staying employed (not fired) after the minimum wage increase. As the Estonian LFS is partly panel data, every individual in the household is interviewed 4 times, 2 consecutive quarters and in the next year at the same quarters, which gives the opportunity to look whether the person is still employed in the next year. When the individual's status changes from employed to unemployed or not active – after the introduction of the new minimum wage – without been paid, then it is counted as fired. The post-minimum wage period is set to 1 if the study considers the 3rd quarters in every consecutive year and pre-minimum wage period is 0 if the study considers the 4th quarters before the introduction of the new minimum wage.

Probit-regression analysis enables to calculate the average marginal effects, interpreting the probability of binary characteristics on dependent variable. The dependent variable (Not fired/fired) is a dummy variable, which is set to 1 if the person is not fired (still employed) and to 0 if the person is fired (unemployed). Table 6 shows the dependent variable as binary values and the independent variables used in the *probit*-model. As explanatory variables, the model includes only socio-demographic characteristics such as age, gender, education, occupation etc. In the selection of variables, the author follows Laporšek *et al.* (2015) and Neumark *et al.* (2004) for the labor market situation in Estonia. As discussed in the Methodology and data section, the most vulnerable groups in Estonia are women, low-paid occupations and regions outside of Harju county.

Table 6. Variables used in the *probit*-model

	Variables	Description
Dependent variable	Probability of staying employed in time t+1	1 – not fired; 0 – fired
Independent variabales	$Group_j\_d$ (j=1-8)	Post-minimum wage increase times the dummy of the j-th wage group
	$Group_j$ (j=1-8)	Wage group dummies
	$Post_y$ (y=2013-2016)	Post-year dummy variable (3th quarter=1)
	Rwage	National logarithm of the real wage net of taxes
	Rwagesquare	rwage square
	Age	Years
	Agesquare	Age squared
	Gender	Dummy variable (Female=1)
	Nationality	Dummy variable (Estonian =1)
	Language	Dummy variable (More than one language =1)
	Low_education	Dummy variable (Primary education = 1)
	High_education	Dummy variable (tertiary education = 1)
	Child_18_nr	The number of children less than 18 years old (yes=1)
	Regions	1 Northern Estonia 2 Central Estonia 3 North-Eastern Estonia 4 Western Estonia 5 Southern Estonia
	Sectors	B-E Industry (except construction) G-N Services of the business economy G-J Wholesale and retail trade; transport; accommodation and food service activities; information and communication K-N Financial and insurance activities; real estate activities; professional, scientific and technical activities; administrative and support service activities O-S Public administration and defence; compulsory social security; education; human health and social work activities; arts, entertainment and recreation; other service activity.
	Occupation	1 legislature, higher officials, managers 2 high-level specialists 3 medium-level specialists, technicians 4 office clerks 5 service and sales workers 6 skilled specialists, agriculture and fishing 7 skilled specialists 8 operators of equipment and machinery 9 low-skilled workers

Source: Estonian LFS

Notes: real wages have obtained, when net wages are deflated with the Consumer Price Index (CPI).

While in the cross-sectional data might exist heteroscedasticity in the residuals, due to the missing of important characteristics, asymmetrical characteristics, the presence of outliers among observations, then the author uses the *probit*-model with robust standard errors. If in the model exists heteroscedasticity, then there might exist incorrections on the calculation of standard errors, as a result the estimates of parameters may not be effective, confidence intervals may be incorrect and the significance of the model and parameters may give false results.

4.2. Minimum wage impact on employment

Results of the *probit*-model for all workers are presented in the first column in the Table 7 with regard to the minimum wage impact on labor force movements from employment to unemployment or having involuntary absence without pay. The status from employment into unemployment and inactivity is estimated together as being fired. The effect of the minimum wage on employment is estimated on all years together. Below the estimates of coefficients are in parenthesis presented heteroscedasticity-robust standard errors. For low-paid occupations, women and region outside of Harju county, the coefficients are estimated with the same *probit*-model as for all workers, expect for the difference that other groups are excluded from the model (for example for regions outside, northern Estonia – Region 1 – that is the reference group and it is excluded from the model).

The increase of the minimum wage from 2013 to 2016 has a negative effect on the dependent variable – being not fired – for all wage groups. The most affected group, for which the interaction term between time and treated group is negatively the highest, it is Group 2 i.e. the target group. In other words, the increase of the minimum wage has the highest disemployment effect for Group 2. The coefficient β_1 for this target group is -0.976, which indicates a negative employment effect for the employees, whose wages were between the old and new minimum wage.

Table 7. Estimates of the effect of the minimum wage on employment

	(1)	(2)	(3)	(4)
	All workers	Low-paid	Women	Region outside
Group1_d	-0.547	-0.445	0.016	-0.235
	(0.411)	(0.628)	(0.566)	(0.514)
Group2_d	-0.976**	-0.747	-0.881	-1.080*
	(0.403)	(0.670)	(0.626)	(0.616)
Group3_d	-0.265	0.007	-0.030	-0.362
	(0.282)	(0.515)	(0.437)	(0.375)
Group4_d	-0.519*	-0.220	-0.064	-0.328
	(0.286)	(0.554)	(0.456)	(0.387)
Group5_d	-0.213	0.266	0.052	0.663
	(0.299)	(0.760)	(0.453)	(0.515)
Group6_d	-0.557	0.381	-0.059	-0.313
	(0.346)	(0.754)	(0.629)	(0.606)
Group8_d	-0.320	0.692	-0.049	-0.305
	(0.466)	(0.868)	(0.745)	(0.709)
Age	0.123***	0.192***	0.173***	0.111***
	(0.023)	(0.035)	(0.033)	(0.0303)
Agesquare	-0.001***	-0.002***	-0.002***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Child_18_nr (yes=1)	-0.044	-0.024	-0.214***	-0.119*
	(0.052)	(0.087)	(0.075)	(0.061)
Region1 (Harju county)	0.230*	0.182	0.069	omitted
	(0.126)	(0.208)	(0.175)	
Constant	-2.409*	-6.285**	-4.840**	-3.332*
	(1.415)	(2.481)	(2.259)	(1.989)
Observations	2,457	875	1,262	1,398
Pseudo R2	0.094			

Source: Estonian LFS
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Notes: Author´s own calculations using Stata software. Occupation 9 and Region 5 are dropped from the model due to the high collinearity. The full table is presented in Appendix 3.

The results of the interaction term were for the target group – Group 2 – and for Group 4 significant, respectively at 5% and 10% level. For other groups, the results were insignificant (see Table 7). This can be interpreted as that the minimum wage increase has a very small or

there is no credible evidence of the impact on employment to reject or accept the null hypothesis for all wage groups. Also, the *probit*-model explanation capability is low as the coefficient of determination $R^2 = 0.094$ for all workers, which could indicate that there are also other factors which affect employment. In Estonia, one of the factor which affects employment is labor movement to Northern part of Estonia, which is explained by the overall employment increase in Harju county and also, the Work Ability Reform could be responsible for the increase of employment.

Table 8 shows the probability of being not fired using the average marginal effects at means of explanatory variables as the model is non-linear and also to have a better interpretation on the results. The marginal effects show the change in the conditional mean of the dependent variable on regressors or covariates change, by one unit. The computed marginal effect of the target group is -0.09 and it means that when minimum wage increases by 1 per cent, it will affect job retention by -0.9 per cent for Group 2. While in the reference period, the minimum wage has increased with a constant rate 10 per cent. In the comparison to the control group – Group 7 – after the minimum wage increase (post) Group 2 has 8.99 per cent lower probability for staying employed (see Table 8 column 1). The results are significant only for the group, which is directly affected from the minimum wage change – Group 2 – and for Group 4.

Table 8. Probability of staying employed after the minimum wage increase, average marginal effects at means

Reference group = Group 7	(1)	(2)	(3)	(4)
	All workers	Age 45 or less	Age above 45	Region > 1
Group1_d	-0.0504	0.0296	-0.0897***	-0.0211
	(0.0378)	(0.0565)	(0.0251)	(0.0462)
Group2_d	-0.0899**	-0.0914*	-0.1580***	-0.0970*
	(0.0373)	(0.0535)	(0.0428)	(0.0548)
Group3_d	-0.0244	-0.0035	-0.0793***	-0.0325
	(0.0259)	(0.0386)	(0.0210)	(0.0339)
Group4_d	-0.0478*	-0.0073	-0.0899***	-0.0294
	(0.0263)	(0.0365)	(0.0218)	(0.0348)
Group5_d	-0.0196	-0.0495	-0.0568***	0.0595
	(0.0276)	(0.0376)	(0.0183)	(0.0450)
Group6_d	-0.0512	-0.0380	-0.0764***	-0.0281
	(0.0319)	(0.0448)	(0.0232)	(0.0546)
Group8_d	-0.0295	-0.0848	omitted	-0.0274
	(0.0428)	(0.0586)		(0.0636)
Age	0.0113***	omitted	omitted	0.0100***
	(0.0022)			(0.0027)
Agesquare	-0.0001***	omitted	omitted	-0.0001***
	$(2.52*10^{-5})$			$(3.13*10^{-5})$
Rwage	-0.0280	-0.0729**	-0.0037	-0.0480
	(0.0223)	(0.0298)	(0.0059)	(0.0334)
Rwagesquare	0.0062**	0.0145***	0.0027***	0.0113***
	(0.0028)	(0.0031)	(0.0009)	(0.0033)
Child_18_nr (yes=1)	-0.0041	0.0135**	-0.0044**	-0.0107**
	(0.0048)	(0.0060)	(0.0020)	(0.0054)
Industrial	0.0134	0.0039	0.0083*	0.0104
	(0.0132)	(0.0189)	(0.0043)	(0.0160)
Public	0.0222	0.0122	0.0103**	0.0238
	(0.0147)	(0.0232)	(0.00459)	(0.0178)
Region1 (Harju county)	0.0212*	0.0509***	-0.0016	omitted
	(0.0117)	(0.0164)	(0.0039)	
Observations	2,457	1,253	1,025	1,398

Source: Estonian LFS
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Notes: Author´s own calculations using Stata software. The dependent variable is probability of not fired in time t+1. The full table is presented in Appendix 4.

When interpreting other coefficients, Column 1 shows that the probability of staying in the employment increases with age (1.13 per cent) and when individuals work in Northern

Estonia (2.12 per cent). This means that over half of the vacant and occupied posts are in Harju county and therefore, it might give a lower probability for not finding a job after being fired in that region. Usually, younger workers are often involved with temporary contracts and the probability of staying active in the labour market might increase with age, due to the higher costs of dismissals for older workers.

The probability of staying employed for younger workers, age 45 years and below (Column 2) is 9.14 per cent lower in the target group after the minimum wage increase compared to the reference group 7 with same age of workers. For workers with age above 45 in Column 3, the probability of being not fired in the target group is even lower (15.8 per cent), at 1% significance level. Many researchers have come to the conclusion that young workers may be in the high-risk group and, based on these results, the hypothesis for workers below 45 years is not accepted, as older workers have lower probability on being not fired.

Minimum wage increase impacts negatively regions outside Harju county (Column 4), where workers in group 2 have 9.7 per cent lower probability staying employed after the minimum wage increase compared to the reference group in the same regions. This is also marginally significant at 10% level. A preliminary conclusion can be that for those who are directly affected by the minimum wage increase in regions outside north of Estonia, they have lower probability on staying employed.

For occupations, the author proceeded to aggregate them to low-paid occupations, where have been selected only four less paid occupations. These four major occupations, which have the lowest salary in Estonia are indicated as: 5 – service and sales workers, 6 – skilled specialists, agriculture and fishing, 7 – skilled specialists and 9 – low-skilled workers. These other results are shown in Table 9. The probability of staying employed after the minimum wage increase for employees who are working in the 4 least paid occupations is the lowest for group 2 (Column 1), where they had 7.14 per cent lower probability not to be fired compared to the reference group. Although the results were none of the groups significant. The author aggregated also economic activities into four main sectors, according to NACE Rev. 2, these include industrial, services, wholesale and public sector. But for none of the sectors, the results were significant, also when the *probi*t-regression was done separately for economic activities.

Table 9. Probability of staying employed after the minimum wage increase in vulnerable groups, average marginal effects at means

Reference group = Group 7	(1)	(2)	(3)	(4)
	Low-paid	Women	Men	Low-education
Group1_d	-0.0425	0.0013	-0.313 ***	-0.0394
	(0.0603)	(0.0460)	(0.0653)	(0.0474)
Group2_d	-0.0714	-0.0717	-0.0726*	-0.1090**
	(0.0631)	(0.0509)	(0.0429)	(0.0510)
Group3_d	0.0007	-0.0024	-0.0216	-0.0122
	(0.0492)	(0.0356)	(0.0261)	(0.0335)
Group4_d	-0.0210	-0.0052	-0.0365	-0.0560
	(0.0529)	(0.0371)	(0.0232)	(0.0354)
Group5_d	0.0254	0.0043	-0.0324	-0.0097
	(0.0722)	(0.0368)	(0.0284)	(0.0385)
Group6_d	0.0364	-0.0048	-0.0587**	-0.0203
	(0.0718)	(0.0512)	(0.0283)	(0.0479)
Group8_d	0.0662	-0.0040	-0.0252	-0.0142
	(0.0827)	(0.0606)	(0.0375)	(0.0547)
Age	0.0184***	0.0141***	0.0054***	0.0125***
	(0.0036)	(0.0028)	(0.0020)	(0.0027)
Agesquare	-0.0002***	-0.0002***	$-5.64*10^{-5}$**	-0.0001***
	$(4.05*10^{-5})$	$(3.18*10^{-5})$	$(2.34*10^{-5})$	$(3.27*10^{-5})$
Rwage	-0.0591	-0.0518	0.0124	-0.0674**
	(0.0410)	(0.0328)	(0.0209)	(0.0338)
Rwagesquare	0.0165***	0.0115***	0.00142	0.0125***
	(0.0045)	(0.0033)	(0.0023)	(0.0034)
Child_18_nr (yes=1)	-0.0023	-0.0174***	0.0129**	-0.00145
	(0.0083)	(0.0060)	(0.0053)	(0.0067)
Wholesale	0.0167	0.0104	0.0287*	0.0276
	(0.0319)	(0.0213)	(0.0157)	(0.0226)
Public	0.0243	0.0157	0.0322**	0.0331
	(0.0222)	(0.0263)	(0.0163)	(0.0203)
Region1 (Harju county)	0.0174	0.0056	0.0231*	0.0118
	(0.0201)	(0.0143)	(0.0122)	(0.0154)
Region2 (Central Estonia)	-0.0148	-0.0194	0.0290**	0.0032
	(0.0182)	(0.0152)	(0.0132)	(0.0152)
Observations	875	1,262	1,118	1,543

Source: Estonian LFS
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Notes: Author´s own calculations using Stata software. The dependent variable is probability of not fired in time t+1. The full list is presented in Appendix 5.

While women are more represented in the lower part of the wage distribution than men, when looking at the probability on staying employed after the minimum wage increase, the

results also show that the highest negative impact is for workers in the target group. For women in group 2, the probability on staying employed after the increase in the minimum wage is 7.17 per cent lower than women in the reference group 7 (Column 2). But again results are not statistically significant. Having children with the age less than 18 years old impacts women negatively as there is 1.74 per cent of probability to lose their job with 1% significance level. Thus, women with children with age less than 18 years old, decreased the probability of being not fired while for men it has an opposite effect (Column 3), as they have 1.29 per cent higher probability on staying employed at 5% significance level.

Employees with low-education – primary and secondary education (Column 4) in group 2 have 10.9 per cent lower probability of staying in the labour market (be employed) after the minimum wage increase compared to the reference group, at 5% significance level. The highest negative impact is for workers in service and sales occupation, where workers with low-education have 7.07 lower probability staying employed. The results are not significant, although service and sales occupation is one of the least paid occupations, where the share of minimum wage earners is one of the highest.

The *probit*-model was used to study the effect that the increase of the minimum wage has on the probability of transition from employment to unemployment or inactivity without been paid. The results compared the probability of staying employed between workers directly affected by the minimum wage increase and workers with wages higher than the new minimum wage. A more appropriate approach to estimate the change of policy is Difference-in-Differences (DiD) approach, comparing the differences in probability of staying employed between group 2 and group 7 before and after the increase in the minimum wage.

The DiD method confirms that the increase in the minimum wage has negative impact on being not fired so, in other words, when minimum wage increases, there is a negative effect on employment. The difference in probability of staying employed for workers in the group 2 in comparison to group 7 after the increase in the minimum wage is reported in Table 10.

Table 10. DID estimations: comparison of estimates before and after minimum wage increase

Reference group: Group 7	2012 – 2013	2013 – 2014	2014 – 2015	2015 – 2016
All workers	-0.076**	-0.047*	-0.046*	-0.020
Women	-0.114**	-0.014	-0.048	0.012
Low-paid occupations	-0.147**	-0.005	-0.053	0.010
Regions outside	-0.136**	-0.058	-0.060	-0.028
Total observations	2,457			

Source: Estonian LFS

*** p<0.01, ** p<0.05, * p<0.1

Notes: Author´s own calculations using Stata software. The dependent variable is probability of not fired in time t+1. For each specification is estimated the *probit*-model. The marginal effects are presented only for the group 2. The parameter estimates of explanatory variables are the same as in the tables above.

When minimum wage started to raise faster than the average wage in the years 2012 – 2013, the difference in probability of staying employed for all workers in group 2 decreased by -7.59 per cent compared to group 7. Also in 2013, there is a high negative impact on being not fired. The model is statistically significant for the years 2013-2015, as Prob > chi2 is less than 0.1.

The results also show that minimum wage increase has larger negative effect for low-paid occupations, regions outside of north Estonia and for women. For low-paid occupations, the difference in probability of staying employed between group 2 and group 7 declined by -14.67 per cent in 2012 – 2013, for regions outside of north Estonia by -13.63 per cent and for women -11.37 per cent. For vulnerable groups the model was significant only for the year 2012 – 2013.

5. MAIN RESULTS AND DISCUSSION

The main questions that the author tries to address is whether the fast increase of minimum wage from 2013 – 2016 has a negative or positive impact on employment in Estonia. The estimated impact is measured on eight wage groups based on the position in the wage distribution. Based on the empirical analysis and previous results from the *probit*-regression, it might conclude that the increase in the minimum wage has negative significant impact only for the wage group 2 and group 4, where group 2 – represents the target group, which is directly affected by the minimum wage increase. If minimum wage is raised, it will reduce these worker's probability of staying active in labour market whose wage was before the increase between the old and new minimum wage by 9.0 per cent. Also, here should be note, that during the reference period 2013-2016 minimum wage is raised with a constant rate of 10 per cent.

The results are consistent with the previous findings on Estonia, as to similar result has also game another research on the topic by Hinnosaar and Rõõm (2003), who found that minimum wage increase has significant impact only on those workers who are directly affect by the change, workers in group 1 and 2. In their result with *probit*-regression, the increase in the minimum wage of 10 per cent reduces employment by 0.43 per cent. They pointed out that further rapid growth in minimum wage would lead to higher negative impact on employment, which was supported with the results of this thesis.

This thesis follows to the study by Laporšek *et al.* (2015), who measured the rapid growth of minimum wage in Slovenia in 2010 and they used more comprehensive data as the total working age population was covered. They found in comparison to the control group that workers in the target group had 5.6 per cent lower probability of staying in employment. The sizeable negative impact was especially significant for younger and low-education workers in treatment group, who had respectively 7.2 and 6.2 per cent lower probability staying in employment.

Similarly, to Laporšek *et al.* (2015) the author estimated with the same *probit*-regression, whether the minimum wage increase impacts more groups of workers that should be more vulnerable on the policy changes. Taking account, the situation in Estonia, these include women, regions outside of Tallinn, low-paid occupations, because of lower wages. As in Estonia women earn over 1/4 less per hour than a man and in the target group women represent 72 per cent, then the results are surprising for women as coefficients are not statistically significant none of the wage groups, although women are more represented in the bottom of the wage distribution and earn less than men. Despite this, from the results came out, that in the target group, female workers who have children with the age of less than 18 years old, decreases the probability of staying employed by 1.74 per cent while for men the results are with opposite effect as their probability increased. It is also showed by the study of Anspal *et al.* (2011), that when women have children, then they will have lower salary than women without any children. Therefore, getting lower salary increases the gap between gender and it might impact the decision whether to stay active in labour market or not.

As wages vary remarkable between regions and occupations in Estonia, it is also surprising that for four least paid occupations, the results are also not significant for any of the wage groups. However, the results are significant for regions outside north Estonia. Therefore, a conclusion can be that workers in the target group and from outside of north Estonia have 9.7 per cent lower probability of staying in employment after the minimum wage increase. Although these results are not supported by the study of Stewart (2002), where he was testing the geographical wage variation and his results did not show any significant difference for areas with high proportion of low-wage earners.

For workers below 45 years old in the target group (group 2) the probability of staying employed decreases by 9.14 per cent compared to the group 7. Among workers with age above 45 years, the increase in the minimum wage diminishes the probability of job retention by 15.8 per cent. Laporšek *et al.* (2015) also found that among older workers, the rise in the minimum wage shrank the probability of job retention, but the magnitude was smaller than for younger workers. Many researchers have reached to the conclusion that younger workers are in a worse position in the labour market compared to the older workers, usually when testing it on teen-employees. One reason for this is that older workers are more involved with permanent contracts and therefore the layoff costs are higher for them. It is not possible to take a deep look into workers below 30 years in the thesis, due to the lack of observations, but it is possible for

below 45 years old, so the hypothesis that young workers are in high-risk group was possible to accept for the workers below 45 years old.

For robustness check the author used beside of *probit*-regression also another approach – DiD method – for comparing the differences in probability of staying employed between group 2 and 7 before and after the minimum wage increase. The results also confirm that the fast minimum wage increase since 2013 has negative impact on those workers who are directly affected by the change. The difference in probability of staying employed for workers in the group 2 in comparison to workers in group 7 decreased by 7.59 percentage points in 2012 – 2013 and the negative impact has continued until 2016. The results are significant almost for all years, expect for 2016. To the same conclusion came also Laporšek *et al.* (2015), when he found that the large minimum wage increase in 2010 decreased the probability of staying employed for workers in treatment group comparison to the control group by 2.8 percentage points.

The standard model of competitive labour market says that any increase of the minimum wage would lead to a reduction in the employment level. Keeping same level of employment depends on the ability of firms to substitute other factors of production for the higher priced labour in response to the change in relative input prices. However, employment rate has reached to the highest level overall and therefore might expect that monopsonistic power might be responsible for that. From the results of the thesis could conclude, that while after the increase of minimum wage has negative significant impact on the employees, whose wages is needed to be raised, then Estonian labour market describes better competitive labour market theory. The increase in employment in recent years is not due to the minimum wage increase, but other factors, like structural reforms could be responsible for it.

Therefore, for further researches the author would suggest estimating, in the model, the impact of structural changes on employment, such as the impact of the Work Ability Reform, which started in 2016. For information, it is good to know how many people are employed after the reform and whether it provides more information about the increase in employment. The government has also set the goal of reallocation of state agencies outside of Tallinn. This can also be an input for further research.

Also, the author would suggest using as another data source the Employment register as since 2014, all legal person providing work are obligated to record their employees. The register would give a more accurate estimation for all working-age population, who are employed and

whether they have maintained the job after the increase of the minimum wage. Using employment register gives an opportunity to measure also long-term impact, as the capital input for higher price of labour takes time. When using Labour Force Survey, then it is possible only to use short-run effects of minimum wage change, while the survey is partly panel data and one individual is interviewed 2 consecutive quarters and after one year in the same quarters.

To conclude the results, then it might say that minimum wage is not an effective tool for supporting low-wage earners, as minimum wage increase has significant negative impact on the probability of staying employed after the minimum wage increase on workers in the target group – workers whose wages are between the old and new minimum wage, including low-education workers and workers outside of Harju county.

CONCLUSION

In the current thesis was researched, whether minimum wage increase during the years 2013 – 2016 has negative or positive effect on the employment or if there is any effect at all. Also, whether the results are consistent with monopsonistic or competitive labour market. The research questions are accurate as in the recent four years' minimum wage has increased faster than the nominal average wage. Currently, minimum wage ratio to the median wage is 50 per cent, but labour unions have set a target to reach 60 per cent level. Due that minimum wage increase will affect more employees in the future and as greater part of workers are affected by the minimum wage, then the more likely could be that the effect on employment is more negative. The proportion of low-wage earners is almost one quarter in Estonia, which is already now one of the highest in Europe.

In the first section of the thesis is presented the theoretical part and recent new evidences of the impact on employment. Also, the theory on traditional competitive labour market and the difference with monopsony. According to standard model of competitive labour market, when minimum wage increases, then it will affect negatively the employment as to respond to higher costs on workers, employer prefers to substitute the increase of minimum wage with higher capital input. As the input factors change takes time, then it is good to look both short- and long-run effects of minimum wage changes. But while for the estimation is used Labour Force Survey and in the questionnaire each individual is interviewed two consecutive quarters and in the next year in the same quarters, then for the author it is possible to look only on short-run effects.

In the recent theory, there is no common ground found, whether minimum wage increases or decreases employment. Minimum wage impact on employment stay´s economically controversial question. Although more of the recent literature have concluded that minimum wages have a little or neutral effect on employment. When estimating the effect on employment most of the studies have used simple policy-on policy-off or treatment and control group comparison Difference-in-Difference approach.

In the second section is presented an overview of Estonian labour market, on the change of minimum wage and average nominal wage during the years. Also, comparison of minimum wages and low-wage earners in Estonia with other European countries. Third section presents the used methodology for estimating the impact on employment and the description of the dataset. The author is using two models – the *probit*-regression for estimating whether the employee is staying active in labour market (not fired) after the minimum wage increase and Difference-in-Differences for comparing the changes of the marginal effects after the minimum wage increase.

Before the empirical analysis of the econometric model, when taking into account the situation of Estonian labour market and the related literature on the topic, considers the author necessary to find an answer to the following research questions:

1) Is minimum wage an effective tool for supporting the low-wage earners?
2) Does the rapid minimum wage growth of recent years have a negative impact on employment or whether there is any significant effect?
3) Does geographical unit matter?

The analysis of the econometric model was mainly on binary data (fired/not fired), but the model includes also socio-demographic characteristics, like age, nationality, number of children below 18 years old, profession, economic activity, education, gender etc. While the dependent variable is binary, then the author used *probit*-regression analysis and for a better interpretation of the results the author calculated also the marginal effects of the *probit*-model. The marginal effects show the change in the conditional mean of the dependent variable on regressors or covariates change, by one unit. For robustness check the author used also second estimation method – Difference-in-Differences approach – and compared the differences in probability of staying employed before and after the increase in the minimum wage. As comparison group are used employees higher from the wage distribution.

According to the results of *probit*-regression and Difference-in-Differences, the author supports the results of previous findings on Estonia. Using Estonian LFS data the estimated impact of the increase of the minimum wage on the probability of remaining in employment is significant only for the wage groups 2 and 4. For other five wage groups the impact is insignificantly different from zero. The rapid growth of minimum wage has negative impact on employment. The effect is statistically significant only for the group which is directly affected

by the minimum wage increase – group 2 – and on group 4. Group 2 consists of employees whose wages were between the old and new minimum wage and in group 4 are employees whose wages were after the introduction of the new minimum wages 1.4 times higher and 1.8 times smaller from the new minimum wages.

While the nominal average wages and employment rate vary remarkable between regions, then the author estimated in the same *probit*-regression the effect on regions outside of Harju county. The results confirm that minimum wage increase has negative significant impact on regions outside of Harju county only for the target group – group 2. For vulnerable groups – low-paid occupations, gender, sectors the author did not find any significant results, but when estimating the impact on women and men who have children with age below 18 years, the results differ between genders. For women having children the probability staying employed after minimum wage increase decreased and for men it increased. In Estonia, the gender pay gap is the highest in Europe and the results confirm that women, who have children, are more likely to lose their job after the minimum wage increase.

For further research, the author would suggest using as another data source the Employment register as since 2014, all legal person providing work are obligated to record their employees. The register would give a more accurate estimation for all working-age population, who are employed and whether they have maintained the job after the increase of the minimum wage. Also, using the register gives an opportunity to estimate long-run effects on employment. Another suggestion would be also to estimate, in the model, the impact of structural changes on employment, such as the impact of the Work Ability Reform, which started in 2016. For information, it is good to know how many people are employed after the reform and whether it provides more information about the increase in employment. The government has also set the goal of reallocation of state agencies outside of Tallinn. This can also be an input for further research.

From the results of the thesis could conclude, that Estonian labour market is better describing competitive labour market, as minimum wage increase has negative impact on those, whose wages is needed to be raised. Monopsonistic power is not responsible for the increase in employment in recent years, but other factors, like structural reforms could provide better clarification.

Whether minimum wage is an effective tool for supporting low-wage earners, then there might conclude, that it is not, as it decreases employment of minimum wage earners. Also, the

results have significant negative impact for minimum wage earners who have low-education or working in regions outside of Harju county. For further researches the author would suggest taking account also poverty.

KOKKUVÕTE

ALAMPALGA MÕJU TÖÖHÕIVELE EESTIS

Birgit Hänilane

Antud töö eesmärgiks on uurida, milline on 2013 – 2016. aasta alampalga tõstmise mõju tööhõivele või kui üldse leidub mingit mõju. Samuti kas tulemuste põhjal võib öelda, kumb teooria kirjeldab paremini Eesti tööjõuturgu – monopson või konkurentsivõimeline. Uurimisküsimused on aktuaalsed, kuna viimase nelja aasta jooksul on alampalk kasvanud kiiremini kui keskmine nominaal palk. Hetkel on alampalga ja mediaani suhe 50 protsenti, kuid ametiühingud on võtnud eesmärgiks tõsta alampalka seni kuni see moodustab 60 protsenti mediaanist. Seega tulevikus mõjutab alampalk suuremat osa töötajaskonnast ja kuna suurem osa on sellest mõjutatud, siis seda tõenäolisem on, et mõju tööhõivele on rohkem negatiivsem. Madalapalgaliste osatähtsus on Eestis peaaegu üks neljandik, mis on juba üks suuremaid Euroopas.

Esimeses peatükis on välja toodud teoreetiline osa ja aktuaalsemad uurimustulemused alampalkade mõjust tööhõivele. Samuti traditsioonilise konkurentsivõimelise tööjõuturu ja monopsoni erinevus. Vastavalt traditsioonilisele konkurentsivõimelisele teooriale, kui alampalka tõstetakse, siis see mõjutab tööhõivet negatiivselt, kuna tööandja eelistab tööjõukulude tõusu korvata kapitali asendamise arvelt. Kuna kapitali asendamine võtab aega, siis oleks hea vaadata nii lühi- kui pikaajalist alampalga muutuse mõju. Kuid kuna Tööjõu-uuring on osaliselt paneelandmestik, igat isikut uuritakse kahes järjestikuses kvartalis ja uuesti järgmisel aastal samades kvartalites, siis nende andmete põhjal on võimalik hinnata ainult lühiajalist mõju.

Viimase aja kirjanduses ei ole jõutud ühisele tulemusele, kas alampalk tõstab või alandab tööhõivet. Seetõttu küsimus alampalga mõjust jääb majanduslikult vastuoluliseks. Kuigi rohkem on jõutud järeldusele, et alampalga tõstmisel on pigem väike või neutraalne mõju

tööhõivele. Enamus viimase aja uuringuid on kasutanud tööhõive mõju hindamisel DiD lähenemist, kus võrreldakse sihtgruppi kontrollgrupiga ennem ja pärast poliitika muutust.

Teises peatükis on toodud Eesti tööjõuturu ülevaade, alampalga ning keskmise nominaal palga muutused läbi aegade. Samuti Eesti alampalga ning madalapalgaliste võrdlus teiste Euroopa Liidu riikidega. Kolmas peatükk kirjeldab kasutatud metoodikat ning välja on toodud andmete kirjeldus. Autor kasutab kahte ökonomeetrilist mudelit – *probit*-regressioon analüüsi kasutatakse, et hinnata, kas peale alampalga tõusu on töötaja endiselt aktiivne tööjõuturul ning DiD mudelit, et võrrelda marginaalsete mõjude erinevust peale alampalga tõusu.

Ennem ökonomeetrilise mudeli empiirilist analüüsi, võttes arvesse Eesti tööjõuturu ja sarnase kirjanduse antud teemal, leiab autor vajalikuks leida vastused järgnevatele küsimustele:

1) Kas alampalk on efektiivne tööjõuturu institutsioon aitamaks madala palgalisi?
2) Kas viimase nelja aasta kiirel alampalga tõusul on negatiivne mõju tööhõivele või kas üldse on seal mingi mõju?
3) Kas geograafiline mõõde on oluline?

Ökonomeetrilise mudeli analüüs on põhiliselt binaarsete andmete põhjal (vallandatud/mitte vallandatud), kuid samuti sisaldab mudel ka sotsiaal-demograafilisi andmeid, nagu näiteks vanus, rahvus, laste arv alla 18. aasta, ametiala, sektor, haridus, sugu jne. Kuna sõltuv muutuja on binaarne, siis autor kasutab *probit*-regressioon analüüsi ja et paremini tõlgendada tulemusi on arvutatud ka marginaalsed efektid. Marginaalsed efektid näitavad sõltuva muutuja muutust ühe ühiku võrra. Robustsuse testimiseks kasutab autor ka teist mõju hindamise meetodit – DiD lähenemist – millega võrreldakse tööturule jäämise võimalikkuste erinevust peale alampalga tõstmist.

Vastavalt mõlema ökonomeetrilise mudeli tulemustele võib öelda, et autor toetab eelnevat uurimustöö tulemust, mis on tehtud Eesti kohta. Kiirel alampalga tõusul on negatiivne mõju tööhõivele. Mõju on statistiliselt oluline ainult sellele grupile, kes on otseselt mõjutatud alampalga tõusust – grupp 2 – ja grupp 4. Grupis 2 on töötajad, kelle netopalk on hetkel kehtiva alampalga ja uue alampalga vahel ning grupis 4 on töötajad, kelle palk on peale alampalga tõusu 1.4 korda suurem ja 1.8 korda väiksem uuest alampalgast.

Kuna nominaalpalk ning tööhõive määr varieerub märkimisväärselt piirkonniti, siis autor on hinnanud mõju sama *probit*-regressioon mudeliga ka piirkondadele väljaspool Harju maakonda. Tulemused kinnitavad, et alampalga tõusul on negatiivne oluline mõju väljaspool

Harju piirkonda ainult sihtgrupis – grupp 2. Haavatavatele gruppidele – madalalt tasustatud ametikohtadele, sektoritele, naistele ei leidnud autor statistiliselt olulist mõju. Kui naistel on alla 18. aastaseid lapsi, siis mõjutas see nende tööle jäämist negatiivselt, samas kui meestele oli mõju positiivne.

Edaspidisteks analüüsideks soovitab autor kasutada andmeallikana Töötamise registrit, mis käivitus 2014. aastast. Register annab täpsema hinnangu kogu tööealise rahvastiku kohta, kes on tööga hõivatud ning võimaldab hinnata, kas nad on säilitanud töökoha peale alampalga tõusu. Samuti võimaldab register hinnata pikaajalist mõju. Teine soovitus oleks hinnata struktuurseid muutusi tööhõivele, nagu Tööhõivereform ehk vähenenud töövõimega inimeste tööturule aitamine, mis käivitus 2016. aastast. See annaks parema informatsiooni, kas tööhõive tõus võib osaliselt olla tingitud sellest. Samuti on valitsus seadnud eesmärgiks riigiasutuste välja kolimise Tallinnast, mis võiks ka olla sisendiks edaspidistele analüüsidele, kuna loob uusi töökohti väljaspool Harju maakonda.

REFERENCES

Adult Education Act. Entry into force 01.07.2015 – RT I, 23.03.2015, 5.

Aeberhardt, R., Givord, P., Marbot, C. (2015). Spillover effect of the minimum wage in France: an conditional quantile regression approach. – *Document de travail de l'INSEE*, (G2012/07).

Allegretto, S., Dube, A., Reich, M., Zipperer, B. (2017). Credible research designs for minimum wage studies: A response to Neumark, Salas, and Wascher. – *ILR Review*, vol. 70, no. 3, pp. 1–34.

Allegretto, S. A., Dube, A., Reich, M., Zipperer, B. (2013). Credible research designs for minimum wage studies. – *IZA Discussion Paper Series, no. 7638.*

Allegretto, S. A., Dube, A., Reich, M. (2011). Do minimum wages really reduce teen employment? Accounting for heterogeneity and selectivity in state panel data. – *Industrial Relations*, vol. 50, no. 2, pp. 205–240.

Anspal, S., Rõõm, T., Anspal, S., Kraut, L., Rõõm, T. (2011). Gender pay gap in Estonia: empirical analysis. – *Report for the Estonian ministry of social affairs. Tallinn: Ministry of Social Affairs*.

Baek, J., W. Park. (2016). Minimum wage introduction and employment: Evidence from South Korea, *Economic Letters*, vol. 139, pp. 18–21.

Bazen, S., Cardebat, J. M. (2001). The impact of trade on the relative wages and employment of low skill workers in France. – *Applied Economics*, vol. 33, no. 6, pp. 801–810.

Bazen, S., Martin, J. P. (1991). The impact of the minimum wage on earnings and employment in France. – *OECD Economic Studies*, no. 16, pp. 199–221.

Bodnar, K., Fadejeva, L., Iordache, S., Malk, L., Paskaleva, D., Pesliakaite, J., Todorovic Jemec, N., Toth, P., Wyszynski, R. (2017). Raising the minimum wage – at what cost? – *Firms´survey evidence from the New EU Member States*.

Bossler, M., Gerner, H.D. (2016). Employment effects of the new German Minimum wage: evidence from establishment-level micro data. – *Institute for Employment Research*. Discussion Paper 10/2016.

Brown, C., Gilroy, C., Kohen, A. (1982). The Effect of the Minimum Wage on Employment and Unemployment, *Journal of Economic Literature*, vol. 20, no. 2, pp. 487–528.

Cameron, A. C., Trivedi, P. K. (2009). Microeconometrics: methods and applications. – Cambridge University press.

Card, D., Krueger, A.B. (1995). Myth and measurement: the new economics of the minimum wage. – *Princeton University Press*, Princeton.

Card, D., Krueger, A.B. (1994). Minimum wages and employment: A case study of the fast-food industry in New Jersey and Pennsylvania. – *The American Economic Review*, vol. 84, no. 4, pp.772–793.

Card, D. (1992a). Do minimum wages reduce employment? A case study of California, 1987 – 89. – *ILR Review*, vol. 46, no. 1, pp. 38–54.

Card, D. (1992b). Using regional variation in wages to measure the effects of the federal minimum wage. – *Industrial and Labor Relations Review*, vol. 46, no. 1, pp. 22–37.

De Linde Leonard, M., Stanley, M., Doucouliagos, H. (2014). Does the UK Minimum Wage Reduce Employment? A Meta-Regression Analysis. – *British Journal of Industrial Relations*, Vol. 52, No. 3, pp 499–520.

Dickens, R., Riley, R., Wilkinson, D. (2012). Re-examining the impact of the national Minimum wage on earnings, employment and hours: The importance of recession and firm size. – *Report for the Low Pay Commission*, UK.

Dickens, R., S. Machin, A. Manning. (1999): The Effects of Minimum Wages on Employment: Theory and Evidence from Britain. – *Journal of Labour Economics*, vol. 17, no 1, pp. 1–23.

Dolton, P., Bondibene, C. R., Stops, M. (2015). Identifying the employment effect of invoking and changing the minimum wage: A spatial analysis of the UK. – *Labour Economics*, vol. 37, pp. 54–76.

Dolton, P., Bondibene, C.R., Wadsworth, J. (2012): Employment, Inequality and UK National Minimum Wage over the Medium-Term. – *Oxford Bulletin of Economics and Statistics*, vol. 74, no. 1, pp. 78–106.

Dube, A., Lester, T.W., Reich, M. (2010). Minimum wage effects across state borders: Estimates using contiguous counties. – *The Review of Economics and Statistics*, vol. 92, no. 4, pp. 945–964.

Edagbami O. (2006): The Employment Effects of the Minimum Wage: A Review of the Literature, Canadian Policy Research Networks, Research Report W|32 Work Network, Ottawa.

Eurostat. (2016). Monthly minimum wages - bi-annual data. http://appsso.eurostat.ec.europa.eu/-/ earn_mw_cur (06.02.2017)

Eurostat. (2015). Gender pay gap in unadjusted form by NACE Rev. 2 activity - structure of earnings survey – annual data. http://appsso.eurostat.ec.europa.eu/-/ earn_gr_gpgr2 (08.03.2017)

Eurostat. (2014a). Median hourly earnings, all employees (excluding apprentices) by sex – annual data. http://ec.europa.eu/eurostat/web/-/earn_ses_pub2s (09.02.2017)

Eurostat. (2014b). Low-wage earners as a proportion of all employees (excluding apprentices) by sex – annual data. http://ec.europa.eu/eurostat/web/labour-market/-/earn_ses_pub1s (07.12.2016)

Estonian Labour Force Survey. Methodology. (2012). Statistics Estonia. http://www.stat.ee/dokumendid/65481

Ferraro, S., Meriküll, J., Staehr, K. (2016): Minimum wages and the wage distribution in Estonia. Working Paper Series 6/2016. – *Eesti Pank.*

Gertler, P. J., Martinez, S., Premand, P., Rawlings, L. B., Vermeersch, C. M. (2016). Impact evaluation in practice. – *World Bank Publications*. Washington.

Harasztosi, P., Linder, A., Bank, M. N., Berkley, H. U. (2015). Who Pays for the minimum Wage? – *UC Berkeley*.

Health Insurance Act. Entered into force in accordance with § 90 – RT I 2002, 62, 377.

Hinnosaar, M., Rõõm, T. (2003). The impact of minimum wage on the labour market in Estonia: an empirical analysis. Working Paper Series No. 8/2003. – *Eesti Pank.*

Laporšek, S., Vodopivec, M., Vodopivec, M. (2015). The Employment and Wage Spillover Effects of Slovenia's 2010 Minimum Wage Increase. – *Proceeding of the Australasian Conference on Business and Social Sciences 2015,* Sydney: Australian Academy of Business and Social Sciences, pp. 652–679.

Laporšek, S. (2013), Minimum wage effects on youth employment in the European Union. – *Applied Economics Letters,* Vol. 20, No. 14, pp 1288–1292.

Manning, A. (2003). Monopsony in motion: Imperfect competition in labor markets. *Princeton University Press.*

Metcalf, D. (2008). Why has the British national minimum wage had little or no impact on employment? – *Journal of Industrial relations,* vol. 50, no. 3, pp. 489–512.

Ministry of Finance. (2017). 2017 spring economic forecast summary. http://www.fin.ee/majandusprognoosid (12.04.2017)

Muravyev, A., Oshchepkov, A. (2016). The effect of doubling the minimum wage on employment: evidence from Russia. – *IZA Journal of Labor and Development*, vol. 5, no. 6, pp. 1–20.

Muravyev, A., Oshchepkov, A. (2013): Minimum Wages, Unemployment and Informality: Evidence from Panel Data on Russian Regions. IZA Discussion Paper Series no. 7878.

Neumark, D., Wascher, W. (2015). The effects of minimum wages on employment. – *FRBSF Economic Letter, 2015*, 37.

Neumark, D., Wascher, W.L. (2007). Minimum wages and employment. – *IZA Discussion Paper*, no. 2570.

Neumark, D., Schweitzer, M., Wascher, W. (2004). Minimum wage effects throughout the wage distribution. – *Journal of Human Resources*, 39(2), pp. 425–450.

Neumark, D., Schweitzer, M., Washcer, W. (2000). The Effects of Minimum Wages Throughout the Wage distribution. – *NBER Working Paper*, no 7519.

OECD. (2013). Trade union density – annual data. *Paris.* https://stats.oecd.org/Index.aspx?DataSetCode=UN_DE (18.04.2017)

O'Neill, D. (2015). Divided Opinion on The Fair Minimum Wage Act of 2013: Random or Systematic Differences. – *Economics Letters*, vol. 136, 175–178.

Parental Benefit Act. Entry into force 01.01.2004 – RT I 2003, 82, 549.

Schmitt, J. (2013). Why does the minimum wage have no discernible effect on employment? – *Center for Economic and Policy Research*. Washington.

Schneider, F., & Kearney, A. T. (2013). The shadow economy in Europe, 2013. *Johannes Kepler Universitat*, Linz.

Social Tax Act. Entry into force 01.01.2001, partially 01.01.2002 – RT I 2000, 102, 675.

Statistics Estonia. (2017a). The Estonian economy grew last year. http://www.stat.ee/news-release-2017-022 (28.02.2017)

Statistics Estonia. (2017b). No major changes in the labour market. http://www.stat.ee/news-release-2017-019 (14.02.2017)

Statistics Estonia. (2016a). Average monthly gross and net wages (salaries) by county – annual data. http://pub.stat.ee/px-web.2001/Dialog/-/ws5321 (24.03.2017)

Statistics Estonia. (2016b). Job vacancies and occupied post – quarterly data. http://pub.stat.ee/px-web.2001/Dialog/-/wsv011 (10.03.2017)

Statistics Estonia. (2016c). Labour status of population aged 15-74 by region (quarters) – quarterly data. http://pub.stat.ee/px-web.2001/Dialog/-/ml467 (15.05.2017)

Statistics Estonia. (2014). Gross monthly earnings and deciles of full-time employees by sex and major group of occupation – annual data. http://pub.stat.ee/px-web.2001/Dialog/-/ (30.06.2016)

Stewart, M.B. (2004a). The impact of the introduction of the UK minimum wage on the employment probabilities of low-wage workers. – *Journal of the European Economic Association*, Vol. 2, No. 1, pp. 67–97.

Stewart, M. B. (2004b). The employment effects of the national minimum wage. – *The Economic Journal*, vol. 114, no. 494, C110–C116.

Stewart, M.B. (2002). Estimating the impact of the Minimum wage using geographical wage variation. – *Oxford Bulletin of Economics and Statistics*, vol. 64, Issue supplement, pp. 583–605.

Unemployment Insurance Act. Entry into force 01.01.2002 – RT I 2001, 59, 359.

Wooldridge, J. (2002). 'Econometric Analysis of Cross Section and Panel Data', MIT Press, London, England.

Work Ability Reform. Ministry of Social Affairs. http://www.sm.ee/en/work-ability-reform (10.05.2017)

APPENDICES

Appendix 1. Summary of minimum wage, average wage and employment

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Minimum wage, euros	89	102	118	138	159	172	192	230	278	278	278	278	290	320	355	390	430
Increase of minimum wage, %	12.0	14.3	15.6	16.8	14.8	8.5	11.5	20.0	20.8	0.0	0.0	0.0	4.3	**10.3**	**10.9**	**9.9**	**10.3**
Employment rate of 15-74 years old, %	54.4	55.0	55.2	56.6	56.7	58.1	61.8	62.9	63.1	57.4	55.2	59.1	60.8	62.1	63.0	65.2	65.6
Average wage, euros	314	352	393	430	466	516	601	725	825	784	792	839	887	949	1005	1 065	1146
Increase of the average wage, %	10.5	12.3	11.5	9.4	8.4	10.8	16.5	20.5	13.9	-5.0	1.1	5.9	5.7	**7.0**	**5.9**	**6.0**	**7.6**
Minimum to average wage, %	28.7	29.0	30.0	32.1	34.1	33.3	31.9	31.7	33.7	35.5	35.1	33.1	32.7	33.7	35.3	36.6	37.5

Source: Statistics Estonia/Eurostat
Notes: Authors´ own calculations.

Appendix 2. Empirical results of the previous studies on employment

Authors	Study	Country	Results	Methods used
Allegretto, Dube and Reich (2011)	Do minimum wages really reduce teen employment?	US	Indistinguishable from zero, do not reduce employment.	Canonical fixed-effects model.
Allegretto, Dube, Reich and Zipperer (2013)	Credible research designs for minimum wage studies	US	The employment effects are small in magnitude for the range of increases that have been implemented since 1990.	Canonical two-way fixed effects model.
Baek and Park (2016)	Minimum wage introduction and employment: Evidence from South Korea	South-Korea	No discernible adverse effect on plant level employment	Difference in difference
Bazen and Martin (1991)	The impact of the minimum wage on earnings and employment in France	France	Negative impact on youth employment	Alternative approach
Bossler and Gerner (2016)	Employment effects of the new German minimum wage	Germany	Meaningful job loss induced by the minimum wage in the treatment group	Difference in difference comparison of a treatment group affected establishments with a control group of unaffected establishments.

Appendix 2 continued

Card and Kruger (1994)	Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania	US	No negative employment effect.	Difference in difference
De Linde Leonard, Stanley and Doucouliagos (2014)	Does the UK minimum wage reduce employment? A Meta-Regression Analysis	UK	No evidence of negative effect.	Fixed effect panel meta-regression analysis (MRA) model. Hausman test before that.
Dolton, Bondibene and Wadsworth (2012)	Employment, Inequality and the UK National Minimum Wage over the Medium-Term	UK	Neutral effects.	Incremental differences-in-differences' (IDiD) estimator
Dolton, Bondibene and Stops (2015)	Identifying the employment effect of invoking and changing the minimum wage: A spatial analysis of the UK	UK	Using GMM (generalized method of moments) there is no discernible effect of the NMW.	Incremental Diff-in-Diff (IDiD) estimator
Dube, Lester and Reich (2010)	Minimum wage effects across state borders: estimates using contiguous counties	US	Indistinguishable from zero, do not reduce employment.	Time and place fixed effects specification. Heterogeneity should be measured.

Appendix 2 continued

Harasztosi, Bank, Linder and Berkley (2015)	Who pays for the minimum wage?	Hungary	Disemployment effect, especially in exporting and manufacturing firms.	Difference-in-difference
Hinnosaar and Rõõm (2003)	The Impact of Minimum Wage on the Labour Market in Estonia: An Empirical Analysis	Estonia	Reduction of 0.43% - 0.66% in employment	Heckman selection model
Laporšek, Vodopivec Matija and Vodopivec Milan (2013)	The Employment and Wage Spillovers of Slovenia´s 2010 Minimum Wage Increase	Slovenia	Significant negative effect on job retention of minimum wage recipients.	Difference-in-difference
Muravyev and Oschchepkov (2013)	Minimum Wages, Unemployment and Informality: Evidence from Panel Data on Russian Regions	Russia	Some evidence of adverse effects of the minimum wage on employment.	Neumark and Wascher (1992) Panel data analysis
Muravyev and Oschchepkov (2016)	The effect of doubling the minimum wage on employment: evidence from Russia	Russia	Some evidence of adverse effects of the minimum wage on employment.	Card (1992)
Stewart (2004b)	The employment effects on the national minimum wage	UK	No significant effect.	Difference in difference estimator. Low wage earners group is compared to higher wage earners group.

Appendix 3. Estimates of the effect of the minimum wage on employment

	(1)	(2)	(3)	(4)
	All workers	Low-paid	Women	Region outside
Group1_d	-0.547	-0.445	0.016	-0.235
	(0.411)	(0.628)	(0.566)	(0.514)
Group2_d	-0.976**	-0.747	-0.881	-1.080*
	(0.403)	(0.670)	(0.626)	(0.616)
Group3_d	-0.265	0.007	-0.030	-0.362
	(0.282)	(0.515)	(0.437)	(0.375)
Group4_d	-0.519*	-0.220	-0.064	-0.328
	(0.286)	(0.554)	(0.456)	(0.387)
Group5_d	-0.213	0.266	0.052	0.663
	(0.299)	(0.760)	(0.453)	(0.515)
Group6_d	-0.557	0.381	-0.059	-0.313
	(0.346)	(0.754)	(0.629)	(0.606)
Group8_d	-0.320	0.692	-0.049	-0.305
	(0.466)	(0.868)	(0.745)	(0.709)
Group1	0.497	1.587**	1.169**	0.851
	(0.462)	(0.741)	(0.597)	(0.552)
Group2	0.866*	2.143***	2.015***	1.743***
	(0.488)	(0.788)	(0.650)	(0.673)
Group3	0.329	1.167*	1.009**	0.757*
	(0.324)	(0.600)	(0.461)	(0.407)
Group4	0.410	0.757	0.939**	0.539
	(0.275)	(0.526)	(0.422)	(0.340)
Group5	0.087	0.718	0.156	0.110
	(0.234)	(0.551)	(0.353)	(0.298)
Group6	0.224	-0.030	0.578	0.604
	(0.252)	(0.510)	(0.420)	(0.414)
Group8	0.013	-1.348*	-0.701	-0.185
	(0.378)	(0.772)	(0.584)	(0.541)
Post2013	0.858***	1.100**	0.968**	1.117***
	(0.225)	(0.481)	(0.430)	(0.337)
Post2014	0.531**	0.034	0.117	0.476
	(0.234)	(0.507)	(0.376)	(0.317)
Post2015	0.517**	0.394	0.405	0.495
	(0.249)	(0.508)	(0.417)	(0.349)

Appendix 3 continued

Post2016	0.227	-0.072	-0.100	0.228
	(0.231)	(0.473)	(0.383)	(0.340)
Age	0.123***	0.192***	0.173***	0.111***
	(0.023)	(0.035)	(0.033)	(0.030)
Agesquare	-0.001***	-0.002***	-0.002***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Rwage	-0.304	-0.618	-0.637*	-0.534
	(0.243)	(0.421)	(0.383)	(0.365)
Rwagesquare	0.068**	0.173***	0.141***	0.126***
	(0.031)	(0.046)	(0.037)	(0.036)
Gender (Female=1)	-0.056	-0.240	omitted	0.027
	(0.105)	(0.173)		(0.133)
Nationality (Estonia=1)	0.025	-0.296	0.186	-0.017
	(0.128)	(0.214)	(0.167)	(0.158)
Child_18_nr (yes=1)	-0.044	-0.024	-0.214***	-0.119*
	(0.052)	(0.087)	(0.075)	(0.061)
Language (more than one language=1)	-0.075	-0.077	0.086	-0.010
	(0.168)	(0.238)	(0.216)	(0.181)
High_education	0.073	-0.082	0.009	-0.005
	(0.129)	(0.256)	(0.176)	(0.178)
Low_education	0.027	0.037	-0.019	0.060
	(0.134)	(0.188)	(0.206)	(0.167)
Industrial	0.145	0.124	0.166	0.116
	(0.143)	(0.219)	(0.373)	(0.178)
Services	0.042	0.006	0.205	0.155
	(0.204)	(0.353)	(0.376)	(0.327)
Wholesale	0.186	0.175	0.128	0.055
	(0.180)	(0.330)	(0.261)	(0.312)
Public	0.241	0.255	0.193	0.265
	(0.161)	(0.225)	(0.323)	(0.200)
Occ1	-0.210	omitted	0.122	-0.083
	(0.227)		(0.334)	(0.285)
Occ2	-0.107	omitted	0.071	0.075
	(0.216)		(0.284)	(0.266)
Occ3	0.124	omitted	0.208	0.308
	(0.204)		(0.276)	(0.265)

Appendix 3 continued

Occ4	-0.155	omitted	-0.229	-0.264
	(0.207)		(0.256)	(0.277)
Occ5	-0.275	omitted	-0.274	-0.168
	(0.175)		(0.212)	(0.195)
Occ6	0.231	omitted	0.364	0.306
	(0.401)		(0.770)	(0.445)
Occ7	-0.061	omitted	-0.290	0.019
	(0.183)		(0.327)	(0.226)
Occ8	0.046	omitted	0.336	0.306
	(0.183)		(0.330)	(0.221)
Region1	0.230*	0.182	0.069	omitted
	(0.126)	(0.208)	(0.175)	
Region2	0.127	-0.155	-0.239	omitted
	(0.131)	(0.194)	(0.190)	
Region3	0.024	-0.143	-0.296	omitted
	(0.206)	(0.318)	(0.272)	
Region4	0.107	0.284	0.012	omitted
	(0.144)	(0.225)	(0.212)	
Constant	-2.409*	-6.285**	-4.840**	-3.332*
	(1.415)	(2.481)	(2.259)	(1.989)
Observations	2,457	875	1,262	1,398
Pseudo R2	0.094			

Source: Estonian LFS
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Notes: Author´s own calculations using Stata software. Occupation 9 and Region 5 are dropped from the model due to the high collinearity.

Appendix 4. Probability of staying employed after the minimum wage increase, average marginal effects at means

Reference group = Group 7	(1)	(2)	(3)	(4)
	All workers	Age 45 or less	Age above 45	Region > 1
Group1_d	-0.0504	0.0296	-0.0897***	-0.0211
	(0.0378)	(0.0565)	(0.0251)	(0.0462)
Group2_d	-0.0899**	-0.0914*	-0.158***	-0.0970*
	(0.0373)	(0.0535)	(0.0428)	(0.0548)
Group3_d	-0.0244	-0.0035	-0.0793***	-0.0325
	(0.0259)	(0.0386)	(0.0210)	(0.0339)
Group4_d	-0.0478*	-0.0073	-0.0899***	-0.0294
	(0.0263)	(0.0365)	(0.0218)	(0.0348)
Group5_d	-0.0196	-0.0495	-0.0568***	0.0595
	(0.0276)	(0.0376)	(0.0183)	(0.0450)
Group6_d	-0.0512	-0.0380	-0.0764***	-0.0281
	(0.0319)	(0.0448)	(0.0232)	(0.0546)
Group8_d	-0.0295	-0.0848	omitted	-0.0274
	(0.0428)	(0.0586)		(0.0636)
Group1	0.0458	0.0876	0.0301**	0.0764
	(0.0419)	(0.0556)	(0.0148)	(0.0491)
Group2	0.0798*	0.144***	0.106***	0.156***
	(0.0439)	(0.0555)	(0.0282)	(0.0591)
Group3	0.0303	0.101***	0.0172*	0.0679*
	(0.0293)	(0.0388)	(0.0092)	(0.0362)
Group4	0.0378	0.0653**	0.0195**	0.0484
	(0.0250)	(0.0332)	(0.0087)	(0.0306)
Group5	0.0080	0.0448	-0.0024	0.0099
	(0.0215)	(0.0303)	(0.0069)	(0.0267)
Group6	0.0206	0.0277	0.0045	0.0542
	(0.0232)	(0.0348)	(0.0074)	(0.0366)
Group8	0.0012	0.0187	omitted	-0.0166
	(0.0348)	(0.0505)		(0.0486)
Post2013	0.0790***	0.0942***	0.0983***	0.100***
	(0.0200)	(0.0282)	(0.0242)	(0.0305)
Post2014	0.0489**	0.0479*	0.0837***	0.0427
	(0.0215)	(0.0290)	(0.0219)	(0.0290)
Post2015	0.0476**	0.0375	0.0805***	0.0444
	(0.0229)	(0.0306)	(0.0212)	(0.0313)
Post2016	0.0209	0.0331	0.0697***	0.0205
	(0.0213)	(0.0296)	(0.0191)	(0.0307)
Age	0.0113***	omitted	omitted	0.010***
	(0.0022)			(0.0027)
Agesquare	-0.0001***	omitted	omitted	-0.0001***
	$(2.52*10^{-5})$			$(3.13*10^{-5})$
Rwage	-0.0280	-0.0729**	-0.0037	-0.0480
	(0.0223)	(0.0298)	(0.0059)	(0.0334)

Appendix 4 continued

Rwagesquare	0.0062**	0.0145***	0.0027***	0.0113***
	(0.0028)	(0.0031)	(0.0009)	(0.0033)
Gender (Female=1)	-0.0051	-0.0050	0.0009	0.0025
	(0.0097)	(0.0144)	(0.0031)	(0.0119)
Nationality (Estonian=1)	0.0023	0.0147	-0.0045	-0.0015
	(0.0118)	(0.0170)	(0.0039)	(0.0141)
Child_18_nr (yes=1)	-0.0041	0.0135**	-0.0044**	-0.0107**
	(0.0048)	(0.0060)	(0.0020)	(0.0054)
Language (more than one language=1)	-0.0069	-0.0048	-0.0052	-0.0009
	(0.0154)	(0.0224)	(0.0048)	(0.0163)
High_education	0.0067	0.0041	-0.0015	-0.0005
	(0.0119)	(0.0176)	(0.0037)	(0.0159)
Low_education	0.0025	-0.0119	-0.0011	0.0054
	(0.0124)	(0.0176)	(0.0043)	(0.0150)
Industrial	0.0134	0.0039	0.0083*	0.0104
	(0.0132)	(0.0189)	(0.0043)	(0.0160)
Services	0.0039	-0.0144	0.0035	0.0139
	(0.0188)	(0.0271)	(0.0065)	(0.0293)
Wholesale	0.0171	0.0198	0.0064	0.0049
	(0.0166)	(0.0229)	(0.0061)	(0.0280)
Public	0.0222	0.0122	0.0103**	0.0238
	(0.0147)	(0.0232)	(0.0046)	(0.0178)
Occ1	-0.0193	-0.0307	0.0015	-0.0075
	(0.0210)	(0.0316)	(0.0065)	(0.0256)
Occ2	-0.0099	-0.0234	0.0048	0.0067
	(0.0199)	(0.0293)	(0.0068)	(0.0238)
Occ3	0.0115	0.0245	0.0070	0.0277
	(0.0187)	(0.0285)	(0.0065)	(0.0239)
Occ4	-0.0143	-0.0140	-0.0042	-0.0237
	(0.0191)	(0.0284)	(0.0059)	(0.0252)
Occ5	-0.0254	-0.0333	-0.0017	-0.0151
	(0.0161)	(0.0255)	(0.0047)	(0.0175)
Occ6	0.0212	0.0299	0.0035	0.0274
	(0.0369)	(0.0563)	(0.0106)	(0.0398)
Occ7	-0.0056	0.0081	-0.0034	0.0017
	(0.0168)	(0.0249)	(0.0049)	(0.0203)
Occ8	0.0043	0.0341	0.0022	0.0275
	(0.0168)	(0.0259)	(0.0050)	(0.0196)
Region1	0.0212*	0.0509***	-0.0016	omitted
	(0.0117)	(0.0164)	(0.0039)	
Region2	0.0117	0.0207	-0.0023	omitted
	(0.0121)	(0.0185)	(0.0038)	
Region3	0.0022	0.0253	-0.0050	omitted
	(0.0190)	(0.0267)	(0.0053)	
Region4	0.0098	0.0182	-0.0028	omitted
	(0.0133)	(0.0213)	(0.0040)	

Observations	2,457	1,253	1,025	1,398

Source: Estonian LFS
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Notes: Author´s own calculations using Stata software. The dependent variable is probability of not fired in time t+1.

Appendix 5. Probability of staying employed after the minimum wage increase in vulnerable groups, average marginal effects at means

Reference group = Group 7	(1)	(2)	(3)	(4)
	Low-paid	Women	Men	Low-education
Group1_d	-0.0425	0.0013	-0.313***	-0.0394
	(0.0603)	(0.0460)	(0.0653)	(0.0474)
Group2_d	-0.0714	-0.0717	-0.0726*	-0.1090**
	(0.0631)	(0.0509)	(0.0429)	(0.0510)
Group3_d	0.0007	-0.0024	-0.0216	-0.0122
	(0.0492)	(0.0356)	(0.0261)	(0.0335)
Group4_d	-0.0210	-0.0052	-0.0365	-0.0560
	(0.0529)	(0.0371)	(0.0232)	(0.0354)
Group5_d	0.0254	0.0043	-0.0324	-0.0097
	(0.0722)	(0.0368)	(0.0284)	(0.0385)
Group6_d	0.0364	-0.0048	-0.0587**	-0.0203
	(0.0718)	(0.0512)	(0.0283)	(0.0479)
Group8_d	0.0662	-0.0040	-0.0252	-0.0142
	(0.0827)	(0.0606)	(0.0375)	(0.0547)
Group1	0.1520**	0.0951**	0.3290***	0.1110**
	(0.0707)	(0.0479)	(0.0608)	(0.0479)
Group2	0.2050***	0.1640***	0.0458	0.1680***
	(0.0725)	(0.0525)	(0.0406)	(0.0527)
Group3	0.112**	0.0821**	0.0206	0.0821**
	(0.0567)	(0.0371)	(0.0240)	(0.0350)
Group4	0.0724	0.0764**	0.0137	0.0872***
	(0.0499)	(0.0344)	(0.0207)	(0.0312)
Group5	0.0686	0.0127	0.0317	0.0374
	(0.0526)	(0.0288)	(0.0224)	(0.0286)
Group6	-0.0029	0.0470	0.0161	0.0377
	(0.0488)	(0.0344)	(0.0202)	(0.0318)
Group8	-0.129*	-0.0570	0.0186	-0.0512
	(0.0731)	(0.0483)	(0.0306)	(0.0440)
Post2013	0.1050**	0.0788**	0.0620***	0.1040***
	(0.0463)	(0.0338)	(0.0197)	(0.0269)
Post2014	0.0033	0.0095	0.0568**	0.0342
	(0.0484)	(0.0307)	(0.0243)	(0.0293)
Post2015	0.0376	0.0330	0.0320*	0.0361
	(0.0485)	(0.0342)	(0.0189)	(0.0299)
Post2016	-0.0069	-0.0081	0.0170	0.0129
	(0.0453)	(0.0311)	(0.0185)	(0.0292)
Age	0.0184***	0.0141***	0.0054***	0.0125***
	(0.0036)	(0.0028)	(0.0020)	(0.0027)
Agesquare	-0.0002***	-0.0002***	$-5.64*10^{-5}$**	-0.0001***
	$(4.05*10^{-5})$	$(3.18*10^{-5})$	$(2.34*10^{-5})$	$(3.27*10^{-5})$
Rwage	-0.0591	-0.0518	0.0124	-0.0674**
	(0.0410)	(0.0328)	(0.0209)	(0.0338)
Rwagesquare	0.0165***	0.0115***	0.0014	0.0125***

Appendix 5 continued

	(0.0045)	(0.0033)	(0.0023)	(0.0034)
Gender (Female=1)	-0.0230	omitted	omitted	-0.0110
	(0.0164)			(0.0127)
Nationality (Estonian=1)	-0.0283	0.0152	-0.0083	-0.0082
	(0.0205)	(0.0137)	(0.0127)	(0.0153)
Child_18_nr (yes=1)	-0.0023	-0.0174***	0.0129**	-0.0015
	(0.0083)	(0.0060)	(0.0053)	(0.0067)
Language (speaks more than one language=1)	-0.0074	0.0070	-0.0030	-0.0002
	(0.0227)	(0.0176)	(0.0150)	(0.0182)
High_education	-0.0078	0.0008	0.0085	omitted
	(0.0244)	(0.0143)	(0.0153)	
Low_education	0.0035	-0.0016	-0.0017	omitted
	(0.0179)	(0.0167)	(0.0110)	
Industrial	0.0119	0.0135	0.0120	0.0227
	(0.0212)	(0.0304)	(0.0103)	(0.0161)
Services	0.0006	0.0167	-0.0231	-0.0068
	(0.0338)	(0.0307)	(0.0159)	(0.0251)
Wholesale	0.0167	0.0104	0.0287*	0.0276
	(0.0319)	(0.0213)	(0.0157)	(0.0226)
Public	0.0243	0.0157	0.0322**	0.0331
	(0.0222)	(0.0263)	(0.0163)	(0.0203)
Occ1	omitted	0.0099	-0.0192	-0.0088
		(0.0273)	(0.0205)	(0.0282)
Occ2	omitted	0.0058	-0.0061	-0.0052
		(0.0231)	(0.0244)	(0.0276)
Occ3	omitted	0.0169	0.0111	0.0409
		(0.0223)	(0.0187)	(0.0252)
Occ4	omitted	-0.0186	0.0129	-0.0054
		(0.0207)	(0.0242)	(0.0234)
Occ5	omitted	-0.0223	0.0019	-0.0277
		(0.0169)	(0.0202)	(0.0180)
Occ6	omitted	0.0296	0.0241	0.0274
		(0.0623)	(0.0336)	(0.0431)
Occ7	omitted	-0.0236	0.0137	0.0067
		(0.0264)	(0.0149)	(0.0198)
Occ8	omitted	0.0273	0.0091	0.0161
		(0.0271)	(0.0145)	(0.0192)
Region1	0.0174	0.0056	0.0231*	0.0118
	(0.0201)	(0.0143)	(0.0122)	(0.0154)
Region2	-0.0148	-0.0194	0.0290**	0.0032
	(0.0182)	(0.0152)	(0.0132)	(0.0152)
Region3	-0.0137	-0.0240	0.0259	-0.0058
	(0.0304)	(0.0218)	(0.0227)	(0.0243)
Region4	0.0272	0.0010	0.0100	0.00341
	(0.0221)	(0.0172)	(0.0129)	(0.0175)

Observations	875	1,262	1,118	1,543

Source: (Labour Force Survey)
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Notes: Author´s own calculations using Stata software. The dependent variable is probability of not fired in time t+1.