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Minimum Wage Effect on Employment:

The Case of Lithuanian Minimum Wage Rise in 2013

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Abstract: The study examines a link between the minimum wage and employment by observing a Lithuanian minimum wage increase in 2013. A difference-in-differences estimation is used to evaluate the effects. The paper applies "at-risk" methodology where the treatment group is defined as individuals earning below the upcoming minimum wage and the control group is the individuals earning slightly above the new minimum wage. In line with the main theories, the results revealed that the minimum wage reform in 2013 has reduced the probability of remaining employed for the minimum wage earners by 4.5-5%. The study also found an indication that the increase of the minimum wage positively affected minimum wage earners' probability of changing from full-time to part-time employment. No effect was observed on working hours and unemployment duration.

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Introduction

After the introduction of minimum wage, there has been a long and continuous debate on what kind of effects it brings to economy. Most frequently the discussion surrounded minimum wage effects on employment, especially for low-skilled workers. The main mechanism here is that if the minimum wage is set above the market-clearing wage level, demand for labour declines while supply increases leading to lower employment levels and higher unemployment. This theoretical basis led to the discussions on how big the negative effect on employment actually is. After the studies with more advanced empirical methods were published, notably the case of fast food restaurants after the minimum wage rise in New Jersey by Card and Krueger (1994), it came into question whether minimum wage has any impact on employment at all. Majority of studies afterwards either failed to find the relationship or found marginal negative effects for disadvantaged groups (e.g. immigrant and minority workers) and youth.

Despite the numerous attempts to measure the effect in the US and the other big countries like the UK or Canada, other countries have few studies analysing this topic, an example being Lithuania. After being strongly hit by the crisis, Lithuanian public showed their discontent by voting for the populist parties promising a minimum wage raise. After being held fixed throughout 2008-2012, the minimum wage was finally slightly increased by the newly formed government at the end of 2012 and then again raised by almost 18% in 2013. Nonetheless, little analysis of these changes has been done the few examples being a business survey by Lithuanian Free Market Institute in 2014 indicating a negative effect of minimum wage rate on employment, and a time series study by Mykolas Šuminas (2015) finding no significant effects of the increases. The frequent minimum wage raises are positively perceived by the public thus boosting the politicians' ratings; however, the economic effects of such intervention should be analysed in detail to give grounds for the upcoming increases.

This thesis examines what the effects of raising the minimum wage on employment are by studying the case of Lithuanian minimum wage increase in 2013. A difference-in-differences estimation is used by comparing the minimum wage earners with the group which earns slightly higher than the minimum wage. The representative personal income dataset is used in the analysis.

The study finds that the minimum wage raise of 2013 has reduced the probability of remaining employed by around 5% for the minimum wage earners. It also indicates a 2% higher probability of switching from full-time to part-time employment, however, these results are not as

robust and might be caused by a small variation in the sample. The paper does not find any evidence for the changes in overall hours worked and duration of the unemployment.

These results contribute to the outgoing debate on the employment effects of the minimum wage. Although the findings in the area are mixed, the study's results support the conventional theories of negative employment effects. It is also the first known study of this field examining the effects in Lithuania by using more advanced econometric methods and thus providing a more valid indication of negative employment developments in the country coming from the minimum wage reforms. This suggests that policymakers should be more cautious when raising the minimum wage even further in order to avoid adverse effects on the people they are aiming to help.

The paper is organized as follows: section 1 overviews the existing literature on minimum wage effects and shortly summarizes the Lithuanian minimum wage policies, section 2 describes the data and the methodology, section 3 discusses the results, section 4 tests the identifying assumption of the model, section 5 addresses the sensitivity of the results and section 6 concludes.

1. The Effects of a Minimum Wage Increase

1.1. Theoretical Basis

From a standard economic view, the minimum wage policies have been associated with negative outcomes. In a competitive market, supply and demand for labour leads to the market-clearing wage. If the minimum wage is set above this level, it reduces the demand for labour and increases the supply, thus leading to lower employment levels and more unemployment. For minimum wage to have positive outcomes on the economy, there has to be some kind of labour market frictions or multiple equilibria (Flinn, 2010).

1.1.1. Monopsony

One of the most analysed market imperfections is the case of monopsony. The famous Card and Krueger's (1994) study (which is discussed in more detail in the section 1.2.) which did not find minimum wage effects on employment suggested that the reason could lie in the monopsony models. The main idea is that there is one firm in a specific market which hires labour, and the friction comes from the restricted entry (Flinn, 2010). This means that the monopsonistic firm is earning non-competitive rents which creates an incentive for other firms to enter the market. Yet, this does not happen due to high entry fixed costs. Because of these reasons, the monopsonistic firm sets the employment level below that of the competitive market equilibrium, so that the firm

could pay lower wages. If a minimum wage is raised, however, it would correct for such imperfection, as the firm would be forced to set a higher wage and the level of employment would increase bringing it closer to the competitive level, hence producing positive effects on the supply side of the market (Flinn, 2010; Brown, Gilroy, & Kohen, 1982). If the minimum wage level is not too high, the monopsonistic firm would still be able to earn positive profits.

At first monopsony was understood as a single firm in some specialised field hiring labour, however, the term can be applied in a broader sense (Staiger, Spetz, & Phibbs, 2010; Bhaskar, Manning, & To, 2002). Firms might face upward sloping labour supply curves due to oligopoly, firm differentiation, costs of moving, worker preferences etc. Bhaskar et al. (2002) suggest that in oligopsonistic labour market the minimum wage could have two opposing effects on employment, depending on which one dominates. A minimum wage set moderately above the market wage can increase the employment by raising labour market participation, even in case of several employers. If the new minimum wage forces some companies to exit due to the reduction of profits, however, there will be negative employment effects.

1.1.2. Search Friction Model

Another possibility is search friction models. For example, Flinn's (2010) search and bargaining model (based on Albrecht and Axell (1984) and Burdett and Mortensen (1989) search friction models) assumes heterogeneous productivity of a worker-firm pair which can be immediately observed by both sides. After some period of search, a potential worker and a firm can acknowledge whether the match creates a positive surplus, meaning that there exists such a wage when both sides would prefer entering this employment contract to the next best search option. If so, a firm and a worker negotiate a wage through a bargaining process in which both sides have a bargaining power due to the search frictions. Searching for the other equally good option would come at the price of additional effort and resources. In this scenario, minimum wage could have a positive effect on the supply side by increasing workers' "effective" bargaining power. The bargaining advantage could especially be felt by the lower-skilled workers with less training who would have a relative disadvantage compared to the workers with better skills or even machines. It would also benefit the youth who are less experienced negotiators and would likely settle for a lower wage. The result of the bargaining process should still be beneficial for both sides, as the match creates the welfare gains which are higher than those of the next best option.

In this model, if the participation decision is fixed and the contact rates between firms and searchers are exogenously determined, the minimum wage increase would lead to lower employment levels, as some of the existing matches would have to be dissolved. However, if participation and contact rate are endogenous, a decrease in unemployment is possible. The necessary condition here is that the value of unemployment search must be decreasing in the minimum wage i.e., the welfare level for individuals in the unemployment state has to be also declining.

1.1.3. Overlapping Generations Model

The models discussed previously are not variant in time. The effects over time can be explained by Cahuc and Michel (1996) overlapping generations' model. In their model individuals live for three periods. In the first period they decide whether to become skilled or remained unskilled. In the second period they join the labour market and supply one unit of labour each. In the third period the individuals retire and spend their savings.

There are also two firms which make identical goods by using different technologies. One firm uses unskilled labour and the second firm uses skilled labour for production. The low-skilled workers with lower productivity thus earn lower wages than the skilled workers employed by the more productive firm.

If the minimum wage is raised above the market clearing level, this leads to the higher probability of being unemployed for low-skilled workers and therefore more unemployment. This implies that in the short-term the unemployment of unskilled labour increases and the overall production declines. However, the other individuals now incorporate the new probability of being unemployed in their decision of whether to remain unskilled. The higher unemployment probability and lower income decreases their expected utility and thus encourages the individuals to accumulate human capital. In the long-term, there is a reallocation towards a high-skilled sector and the sector with unskilled labour might disappear. The productivity loss of higher unemployment is later offset by the increase in production caused by the higher number of high-skilled workers. Hence, the model illustrates that although in the short-term minimum wage can increase unemployment, in the long-term the market can move towards a new competitive equilibrium with low unemployment and overall economic gains from growth in productivity.

1.2. Empirical Studies

1.2.1. Early Studies

The history of research in the field of minimum wage effects on employment can be split into two parts: pre and post early-2000's studies. Most of the papers published before 2000's had simple time series framework or cross-sectional analyses. The research up to this point is best summarized by Brown, Gilroy, and Kohen (1982). They published a review of existing studies in the field and tried to disentangle the main effects. The most frequently studied group at that time was teenagers. Most studies would find that a 10% increase in minimum wage would lower the teenage employment by 1-3%. Yet, Brown, Gilroy, and Kohen (1982) suggest that the real effects were at the lower part of the range because the studies with better research design tend to produce lower estimates.

Another widely studied group at that period was young adults (20-24 years). Here, the results were also negative but at smaller magnitudes. For adults, however, the results were not as conclusive and the direction of the effect was uncertain. Brown, Gilroy, and Kohen (1982) conclude that the impact on employment is small and mostly concentrated on teenagers and younger workers.

In 1995 Card and Krueger conducted a meta-analysis of the existing minimum wage studies. They noted that the newer studies had access to more observations than the previous studies which allowed for better quality research. Yet, the newer studies failed to replicate the negative employment effects found in the previous studies, questioning the validity of the older time-series results. Indeed, Card and Krueger's analysis points out that the previous significant results were "affected by specification-searching and publication biases" and insignificant or wrong-signed results tended to be underrepresented in the literature.

1.2.2. State Level Comparisons in the US

Afterwards, the researchers started taking a different approach to the topic and exploiting a natural experiment setting. The ground-breaking study in the field came from Card and Krueger (1994). Using the difference-in-differences estimation they compared employment changes in the fast-food restaurants in New Jersey which experienced a minimum wage increase, and in neighbouring Pennsylvania which did not see an increase in the minimum wage. They also compared the low-wage restaurants to high-wage restaurants within the New Jersey. In both cases no negative effect on employment was found.

Card and Krueger's research attracted a lot of attention and critique. In a replication study Neumark and Wascher (2000) found the opposite results which indicated that there was indeed a reduction of hours worked. Their claim is that these differences might have been caused by a measurement error in Card and Krueger's dataset, as instead of hours worked from the payroll records they used the employment levels obtained from the phone surveys. Additionally, others claim that Pennsylvania is not a good counterfactual, as the developments in the two states were not entirely the same which would have made two states not suitable for comparison and biased the results (Angrist & Pischke, 2008)

Doucouliagos & Stanley (2009) in their meta-analysis research on 64 US minimum wage studies (published between 1972 and 2007) suggest that the idea of negative employment effects of minimum wage is influenced by the publication selection bias, the result that was also found in the earlier meta-analysis by Card and Krueger (1995). After it is corrected, evidence for the negative effects on employment vanishes.

1.2.3. Studies with Individual-Level Data

Alternative approach to using minimum wage differences between states is comparing the individuals of different income groups which is more applicable for countries that have a country-wide minimum wage. Currie and Fallick (1993) by using the longitudinal data on individuals compare the probability of making transition to a non-employment state given the increase in the federal minimum wage rate. They found that individuals earning below the new minimum wage (and thus who were affected by the federal rate increase) were 3% more likely to be unemployed a year later than the individuals not affected by the minimum wage increase.

Abowd et al. (2000) also compare the disemployment effects of the minimum wage for two contrasting countries: France and the United States. They found that in the U.S. exists from labour market were not affected by the minimum wage policies, however, a strong negative effect was found in France, pointing towards the significance of the institutional setting in a country.

An interesting study on Portugal by Pereira (2003) exploits a natural experiment setting created by the significant minimum wage increase for teenagers. Up to 1987, workers of 18-19 years of age could only receive 75% of adult minimum wage while workers of 20 years and above would receive full statutory minimum wage. This changed in 1987 when younger workers were entitled to get a full minimum wage which meant a real minimum wage increase of 35.5%. Using firm-level data, Pereira compared employment effects on 18- to 19-year-old group to 20- to 25-

year olds and 30- to 35-year-olds. She found that employment of younger workers fell with employment elasticity between −0.2 and –0.4. Moreover, the study found a substantial substitution effect towards 20- to 25-year-old group.

Stewart (2004) studied the effects of the United Kingdom minimum wage introduction. The United Kingdom did not have a country-wide minimum wage for many years until 1999. This allowed for a cleaner quasi-experiment setting of a full minimum wage introduction rather than just a rise in a minimum wage. Steward used three different datasets with individual data to estimate the impact on probability of remaining employed. The individual income datasets also allowed for the estimation of a continuous wage gap to the minimum variable which provided more precision than the dummy variable of difference-in-differences method. The treatment group is described as individuals earning below the minimum wage while the control group are the individuals earning slightly above the minimum wage before the minimum wage introduction. Steward did not find any significant impact on the probability of remaining employed overall as well as for different demographic subgroups and datasets.

Having observed Stewart's and the other research on the United Kingdom which found small or no effects on employment, Metcalf (2008) examined the possible reasons for this lack of relationship. The most realistic explanations were that firms instead adjusted prices, accepted the lower profits, reduced hours rather than workers, and could not reduce employment due to labour market frictions.

Indeed, in the follow up study on the United Kingdom's minimum wage introduction, Stewart and Swaffield (2008) when using the same method of Stewart (2004) found that introduction of minimum wage reduced working hours of low-wage workers by 1-2 hours per week.

1.2.4. Current Research

Most of the newest studies try to explain the controversial employment effects by distinguish between different types of employment and unemployment. A study by Campolieti, Gunderson and Lee (2014) on the Canadian labour market estimated probabilities of remaining employed and found that minimum wage increases are associated with adverse employment effects for teenagers and youths. The study also found that the negative employment effects are driven by the permanent workers: the results were insignificant for temporary minimum wage workers but significant and substantially larger for the permanent minimum wage workers. Additionally,

Dickens, Riley, and Wilkinson (2015) find that the minimum wage is associated with reduction in employment retention for the part-time females in the UK.

Regarding unemployment, Roberto and Rohn (2011) found that the minimum wage increased the unemployment duration for male high school dropouts and females who are older and in lower-skilled occupations. This finding is based on the idea that if the employers are forced to increase the wage they will look more thoroughly to find more experienced or skilled workers. This then makes it harder for more disadvantaged individuals to find a job and prolongs their unemployment.

The other authors suggest that employment effects from minimum wage increases can be different over time. Using state-level data and comparing the shares of minimum wage earners in the UK, Dolton, Bondibene, and Wadsworth (2012) find that the average employment effect is neutral but minimum wage effect from 2003 onwards is associated with positive effects on employment in the medium-term.

There is also more research which examines effects on other countries rather than the U.S or the U.K. Negative employment effects of minimum wage on youth were found in the sample of European Union countries (Laporšek, 2013) and Canadian provinces (Sen, Rybczynski, & Van De Waal, 2011), but no significant effects in the studies examining Finland (Böckerman & Uusitalo, 2009) and Poland (Majchrowska, Broniatowska, & Żółkiewski, 2016). Adverse employment effects from minimum wage increases were also discovered in the German roofing sector (Aretz, Arntz, & Gregory, 2013) and in the private covered sector in Nicaragua (Alaniz, Gindling, & Terrell, 2011). A study on China reported heterogeneous effects for males and females: men workers' employment was not affected and they worked more hours after the minimum wage increase, while female workers' employment decreased and working hours remained unchanged (Jia, 2014).

1.3. Minimum Wage in Lithuania

Like most of the EU countries Lithuania has a statutory minimum wage. The wages are largely determined by the market, yet the government decides on the minimum wage level after tripartite consultations which are not binding (International Monetary Fund, 2016). According to the Eurostat data (2017), 9.5 % of the Lithuanian workers earned less than 105% of the national minimum wage in 2014, one of the highest proportion in the EU. As of January 2017 the national minimum wage in Lithuania was the third lowest in the EU, after Bulgaria and Romania (Eurostat,

2017). Unsurprisingly, a large social inequality and high emigration rates in Lithuania are linked to the low minimum wage (Kamandulienė & Paulauskaitė, 2013; Karalevičienė & Matuzevičiūtė, 2009).

1.3.1. Minimum Wage Developments

Despite being low, the Lithuanian minimum wage has been rapidly growing over the years. In the period of 2001-2007, the real hourly minimum wage increased by 46.7% (Schulten, 2014). The country was strongly hit by the economic crisis, and the minimum wage was held fixed for five years until the increase in 2012. Over this period, the real minimum wage has contracted by 25.2% (Schulten, 2014).

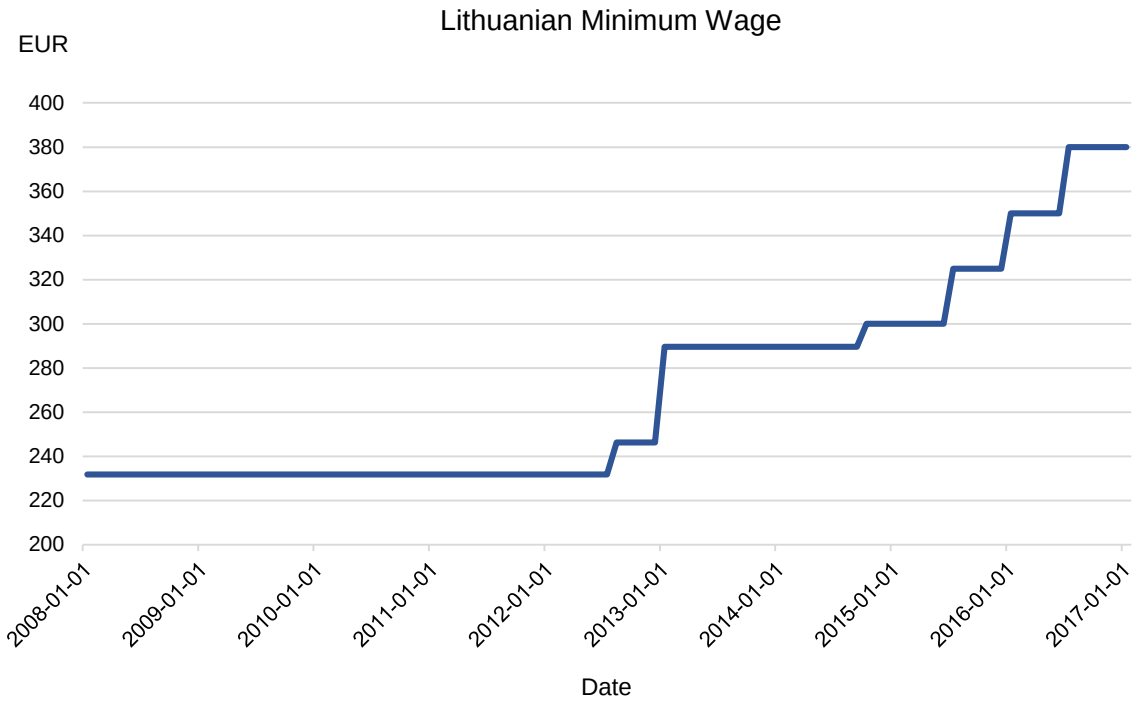

Figure 1. Minimum Wage in Lithuania

Low income, high unemployment and generally bad economic conditions led to an outrage among general public and thus the parliamentary election of 2012 was won by the opposition parties promising minimum wage raises (Jurkynas, 2014). The national minimum wage was slightly increased by the end of 2012 which was followed by a large 17.6% increase from 850 LTL (246.2 EUR) to 1000 LTL (289.6 EUR) per month in 2013. Afterwards, the minimum wage was raised even further and as of January 2017 reached 380 EUR (for the developments in minimum wage see Figure 1).

1.3.2. Evaluation of the Lithuanian Minimum Wage Policies

The evaluation of these rapid increases has been controversial. Some argue that these minimum wage increases were necessary in order to improve the well-being of the poor. A study by Kamandulienė and Paulauskaitė (2013) concluded that the minimum wage in 2013 was too low to satisfy "physiological and social needs of employed individuals" and it did not provide minimum-wage earners with an adequate purchasing power.

Although the minimum wage can improve the economic well-being of an individual it is linked to potentially adverse effects on Lithuanian economy. A report by IMF (2016) states that "securing continued competitiveness in a tightening labour market" is one of the key issues of the Lithuanian economy and proposed pausing the minimum wage increases. The minimum wage has surpassed 50% of the average wage in 2017 which is unusually high by international standards. These high ratios are usually linked with naturally high unemployment and other labour market rigidities (International Monetary Fund, 2016). Additionally, the minimum wage increases are contributing to the overall wage growth which is not backed by productivity gains and thus negatively affects the competiveness. This in turn weights down export performance and leads to lower profit and employment growth in exporting sectors. Finally, the report concludes that these minimum wage hikes could lower the employment prospects for the young and unskilled workers.

The report also highlighted a problem of a shadow economy. The minimum wage hikes might not actually raise the remuneration due to the prevalence of the "envelope payments" and the reduction of official working hours (International Monetary Fund, 2016). Indeed, according to the survey by the Lithuanian Free Market Institute (2015) 47% of respondents in Lithuania received a part of their wage in under-the-table payments. In addition, a governmental report on the shadow economy developments revealed that, among the breaches in the labour relations, the breaches in work-leisure regulations have been sharply increasing and have become the most common reaching 77% of the cases in 2015 (compared to 40% in 2011) (Lietuvos respublicos vyriausybės kanceliarija, 2017). These findings suggest that due to the under-the-table payments and working hours breaches the minimum wage increases might not be as effective in improving the standard of living for the poor.

1.3.3. Minimum Wage Impact on Lithuanian Labour Market

There have been a few attempts to evaluate the impact of a minimum wage increase on the Lithuanian labour market. After the proposals to raise the minimum wage from 800LTL to

900LTL,Vita Karpuškienė (2011) estimated a polynomial regression model on Lithuanian labour market for the period 2000–2008. She found that increasing the minimum wage further from 670 LTL would negatively affect employment.

Lithuanian Free Market Institute (2014) conducted a business survey on 181 Lithuanian enterprises to examine what were the responses of these companies regarding the three minimum wage raises over the period 2012-2014. The institute found that 33% of the companies were negatively affected by these increases. Further increase would have negatively affected 46% of the companies. 29% of the companies agreed that they would have to lay off workers if the minimum wage was increased by 200LTL while 30% claimed they would reduce working hours.

Although the previous research indicated negative employment effects, a time series study by Šuminas (2015) failed to find evidence for such claims. Based on aggregate data for 2003Q1–2014Q1, the author found the real minimum wage elasticity to be between –0.03–0.03, yet, none of his models were statistically significant. The author suggested that companies use other channels to reduce an impact of minimum wage increases rather than laying off workers.

1.4. Formulation of Hypotheses

The theoretical as well as empirical evidence does not result in a consensus on what the employment effects of the minimum wage are. The theory generally points towards a negative effect of minimum wage on employment and only under certain conditions the minimum wage effects could be neutral or slightly positive. The empirical studies produce much more conflicting results, yet most of them agree that the effect on employment is generally low. This thesis goes in line with the prevailing theory and aims to test for the negative employment effects. This direction is also based on the studies of Lithuanian labour market which mostly points towards negative impact. Additionally, the studied minimum wage increase of 2013 is relatively high which makes the possibility of negative effects stronger based on both theory and empirical studies. Therefore, this thesis tests the following hypothesis:

H1: Minimum wage increase has a negative effect on the employment probability of the minimum wage-earners.

The newer studies also examine the heterogeneity of unemployment. The minimum wage could lead to longer unemployment duration of the lowest-skilled individuals. Assuming that these individuals are the minimum wage earners, the heterogeneity is tested by the following hypothesis:

H2: Minimum wage has a negative effect on the duration of unemployment of the minimum wage-earners.

The minimum wage effects can also work through other channels. Some of the studies which tried to explain the insignificance of the minimum wage effect on employment looked at the hours worked. The evidence suggests that workers might be forced to reduce their working hours following the minimum wage raise or even switch to part-time employment. The claim is also applicable to the Lithuanian labour market, as the potential behaviour of the companies point towards an official reduction of working hours. This leads to the last hypotheses:

H3: Minimum wage increase has a negative effect on the hours worked of the minimum wage-earners.

H4: Minimum wage increase raises the probability of part-time employment of the minimum wage earners.

The following sections test these hypotheses empirically.

2. Empirical Strategy

Even in the absence of minimum wage policies, minimum wage earners tend to have higher unemployment levels due to their observable and unobservable characteristics: they usually have lower education level and are not as flexible in the job market. Therefore, directly comparing minimum wage earners with other groups would likely produce biased coefficients. A national minimum wage raise creates a quasi-experiment setting which could be used for a difference-in-differences estimation and which would allow for a causal inference. The method is applied to estimate the effects of the minimum wage raise for the years 2012 and 2013.

2.1. Difference-in-Differences Estimation

The simplest way to measure the effect of a minimum wage raise on minimum wage earners' employment is to compare the employment before and after the intervention. However, the observed changes could also be induced by other factors which are changing in time. Therefore, to actually capture the effect of the reform it is necessary to know how the employment would develop if there was no change in the minimum wage policy. This causes an issue for causal inference, as it is impossible to observe both of these outcomes at the same time.

The difference-in-differences method provides a solution for this problem by observing a counterfactual. Instead of comparing only one group before and after, two groups – treatment and

control – are formed and observed. At t=0 both groups are not treated. At t=1 the treatment group receives the intervention, while the control group does not. This way it is possible to observe how both groups change over time.

The differences in the control group capture the baseline trend which is present without a treatment:

$$E\left[Y_{itg}\middle|t=1,g=0\right]-E\left[Y_{itg}\middle|t=0,g=0\right]=\alpha$$

The expression shows a difference in expected values of the dependent variable *Y* for the individual *i* over two periods: a treatment period $t=1$ and a period without the treatment $t=0$. $g=0$ indicates that the individual is in a control group – he is not affected by the treatment. Because this individual is not affected by the treatment, it is possible to observe the changes which happen overtime in the variable *Y* without the intervention which is denoted by α.

The changes in the treatment group capture both, the baseline trend and the treatment effect:

$$E\left[Y_{itg}\middle|t=1,g=1\right]-E\left[Y_{itg}\middle|t=0,g=1\right]=\alpha+\beta$$

The individual *i* belongs to the treatment group as indicated by g= 1. The dependent variable *Y* for this individual is not only affected by the natural developments captured by α but also by the treatment which is denoted by β.

Taking a difference of these changes allows to capture the causal effect β, as the overall trend cancels out:

$$\left\{E\left[Y_{itg}\middle|t=1,g=1\right]-E\left[Y_{itg}\middle|t=0,g=1\right]\right\}-\left\{E\left[Y_{itg}\middle|t=1,g=0\right]-E\left[Y_{itg}\middle|t=0,g=0\right]\right\}$$
$$=\alpha+\beta-\alpha=\beta$$

The key assumption which is required for the causal inference is that the baseline trend α for the treatment and control groups has to be the same (Angrist & Pischke, 2008). This means that while the two groups can be different, their differences should stay constant over time. Through differencing, both groups' characteristics and time effects cancel out which allows to capture the effect of the treatment. The common trend assumption will be addressed in the section 4.

Additionally, the treatment should not have an effect on the control group. Stewart (2004) names two threats to this assumption in terms of employment effects of the minimum wage. Firstly,

there might be wage spillovers as the control group would ask to raise their wages accordingly. Secondly, there might be a substitution between the two groups. These two effects are expected to work in the opposing ways. The assumption is taken into account when composing the treatment and control groups in section 2.3.

2.2. Data

The thesis uses Lithuanian Income and Living Conditions Survey available for the years 2010-2015, retrieved from Lithuanian Statistics Department Database's public data files. The survey is conducted yearly and is representative of Lithuanian population. The dataset consists of roughly 12,000 observations every year and includes information on total gross and net yearly income from main economic activity, average weekly hours worked, current economic activity, months being unemployed, professional code, sector, level of education, age, region and many other variables of individual characteristics. 69 percent of individuals have been interviewed more than once, thus the sample for 2012 and 2013 consists of 9,686 unique observations.

Information on the monthly hourly minimum wage is also retrieved from the Lithuanian Statistics Department Database. In August 2012 the minimum wage was raised from 800 LTL (231.7 EUR) to 850 LTL (246.2 EUR). This raise was followed by the larger increase to 1000 LTL (289.6 EUR) in January 2013 and it stayed fixed throughout 2013.

2.3. Defining Treatment and Control Groups.

In order for the research results to be valid, the treatment and control groups have to be properly defined. Because Lithuania has a national minimum wage, it is impossible to use regional variation for the group formation. Therefore, this paper uses "at-risk" methodology to define the treatment and control groups (as seen in Currie & Fallick (1993), Abowd et al. (2000), Stewart (2004), Campolieti et al. (2014) and others).

The treatment group is defined as individuals "at risk", meaning that they fall in between the current minimum wage and the upcoming minimum wage. This group of individuals is expected to be directly affected by the upcoming reform, as their wages have to be raised to comply with the new law. Therefore, it is expected that for some companies this change would be too costly and they would choose to lay some people off resulting in the lower employment probability for the treatment group.

The control group is the individuals who earn slightly above the new minimum wage. As their wages already comply with the upcoming reform they do not have to be artificially raised.

Therefore, these individuals are not expected to be directly affected by the new law, so their employment probabilities should not change. The control group should not be too far away from the treatment group in terms of income. A high earnings ability could imply different unobserved individual characteristics which might affect the employment probability differently than that of the treatment group. Individuals with only slightly higher income are expected to be relatively similar in terms of their characteristics which would improve the comparability of the two groups.

There is thus always a trade-off when choosing to work with micro-level datasets over macro-level datasets. Using individual data instead of state-level comparisons eliminates the macro-level differences which can bias the results. However, using micro-level datasets comes at a price of potential biases from unobserved individual characteristics (Currie & Fallick, 1993).

Another potential issue in this research design is that the dataset includes person's annual earnings instead of monthly earnings which makes it more difficult to identify who the target group is. Therefore, the monthly income had to be estimated. The calculation of the monthly wages resulted in many observations below the minimum wage, some being as low as 2 LTL (0.58 EUR) per month. As the dataset is constructed from the surveys, these low values potentially come from reporting errors. Dropping the observations which were lower than the official minimum wage leaves with a sample of 708 individuals.

Table 1
Means and frequencies of the main variables

Variable	Treatment		Control	
	2012	2013	2012	2013
Age	46.0	47.0	44.5	45.5
Hours worked a week	38.0	37.5	38.8	38.8
Months worked full time	10.1	10.2	10.7	10.8
Months worked part time	1.2	1.3	0.8	0.8
Months unemployed	0.4	0.2	0.3	0.2
Monthly earnings	875.6	1042.3	1098.9	1244.1

Number of observations	386	322
Unemployed in 2013	44 *11.4%*	20 *6.2%*
Male	144 *37.3%*	150 *46.6%*
Female	242 *62.7%*	172 *53.4%*

The treatment group is described as the individuals who, given their hours worked and months being employed, gain below the 2013 minimum wage (1000 LTL) in 2012. The control group is the individuals who earn 1000 LTL and 20% higher in 2012. Other similar studies (e.g. Stewart(2004), Abowd et al. (2000)), described the control group by 10% or 15% higher incomes to make the two groups as similar as possible, however, according to the estimates, around 10% of Lithuanian population earn the minimum wage (Eurostat, 2017) and this leads to significantly higher number of observations in the treatment than in the control group. Therefore, the 20% threshold is used to make the groups more balanced in size. Additionally, making a larger distance between groups softens the potential wage spilliver and worker substitution effects. The means of the main variables are provided in Table 1 above. The detailed descriptions of the two groups can be found in the Appendix A. In total there are 386 individuals in the treatment group and 322 individuals in the control group.

2.4. The Model

The regression adjusted difference-in-differences estimation is used to estimate several employment effects. The first specification estimates the conditional probability of remaining employed. This means that solely the individuals who are employed in 2012 are considered. Only full time and part time workers count as being employed in the first period. The rationale is that minimum wage policies mostly affect employees and thus self-employed persons are not considered as employed in the first period due to larger control over their earnings and hours worked. On the contrary, switching to self-employment is considered a transition to non-employment state. Other reasons for leaving the labour market like retirement, parental leave or studies are also considered as moving towards non-employment.

The employment status of employed individuals in 2012 is again observed in 2013. The disemployment probability is then calculated by comparing how many people left the labour market the following year in the two groups. The linear probability model takes the following form:

$$(1) \qquad E_{i,t} = \alpha + \rho G_i + \gamma t_t + \beta(G_i * t_t) + X_{i,t} + \varepsilon_{i,t}$$

Here, $E_{i,t}$ is employment status, which is equal to 1 if a person is employed (which is the case for all individuals in 2012[1]) and 0 if a person becomes unemployed. G_i is a dummy variable indicating if a person is in a treatment (=1) or a control (=0) group. t_t is a year dummy equal to 0 in 2012 and 1 in the treatment period 2013. Parameter β measures the estimated treatment effect of the minimum wage change, as it only considers the affected people in the treatment period. $X_{i,t}$ is a set of control variables and $\varepsilon_{i,t}$ is the error term.

Similarly, the same equation is also applied for identifying the changes from full-time employment to part-time employment. $E_{i,t}$ in this case is equal to 1 if a person works full time and 0 if a person works part time. Only people employed full time in the first period are taken into account and then followed the next year to see how many of them switched to part time employment due to the minimum wage raise.

The last two models which are used to measure employment effects also take form of the equation 1, but the dependent variables here are continuous. In the first one, $E_{i,t}$ expresses the average hours worked a week of an individual *i*. In the second one, $E_{i,t}$ is the months being unemployed of an individual *i*. The same employed people are included in the analysis to measure the duration of unemployment as in the first model of employment probabilities. In order to see the reduction of hours worked, only the individuals who are employed in both periods are considered, as the model aims to test whether workers were required to officially reduce their working hours.

3. Results

Table 2 below reports the estimation results for the models of five different dependent variables (A.-D. rows in the table). Column (1) includes the results of a raw difference-in-differences estimation without any controls and column (2) includes the results of the estimations with the control variables. All models were first run with conventional standard errors and then tested for homoscedasticity. The Breusch-Pagan / Cook-Weisberg test reported that errors are heteroscedastic and thus robust standard errors are used in the estimations.

[1] It is important to note that this model only captures the disemployment effect, that is it only considers transitions to unemployment. The transitions from unemployment state to employment due to the minimum wage raise are not accounted for in this research.

The results show that the minimum wage increase reduced the probability of being employed for the minimum wage earners by 5.1%. This corresponds to the employment elasticity of -0.29.

Table 2
Difference-in-differences estimation results for different independent variables

Specification	(1) Without controls	(2) With controls
A. Employment status		
Coefficient	-0.0519**	-0.0513**
S.E.	(0.0211)	(0.0209)
R-squared	0.0551	0.0820
Observations	1,416	1,416
B. Hours worked a week		
Coefficient	-0.4604	-0.4527
S.E.	(0.6885)	(0.6804)
R-squared	0.0080	0.0447
Observations	1,288	1,288
C. Months unemployed		
Coefficient	-0.1027	-0.1033
S.E.	(0.1315)	(0. 1308)
R-squared	0.0062	0.0252
Observations	1,416	1,416
D. Employed full-time		
Coefficient	-0.0245*	-0.0242*
S.E.	(0.0139)	(0.0138)
R-squared	0.0205	0.0388
Observations	1,182	1,182

Notes: Column (2) includes the following controls: urban/rural area, highest level of education, gender, age, age squared, and family status. Robust standard errors in parentheses. Significance levels *** 1%, ** 5%, * 10%.

The higher minimum wage also increased the probability of switching from full-time employment to part-time employment by 2.4%. This translates into elasticity of -0.14. The results are robust for the raw difference-in-differences model and for the model with demographic controls. The minimum wage increase also indicates negative effect on hours worked and months being unemployed. None of these results, however, are significant.

The significant negative results for employment probability and switching towards part time employment were expected. The Lithuanian business survey (Lithuanian Free Market

Institute, 2014) clearly indicated that the businesses would respond to the minimum wage increase by laying off workers and shortening the working hours. Interestingly, this change was not reflected in the estimation of hours worked a week, only by the full time – part time employment switching probability. The table 3 below shows that on average both groups have decreased their working hours slightly. However, separately, part-time workers in both groups increased their working hours. Overall, these differences were not big enough to show the causal effect and were mostly driven by moving from full time to part time employment.

Table 3
Average weekly working hours

	2012	2013
Part-time workers		
Control group	21.84	22.78
Treatment group	19.65	19.77
Full-time workers		
Control group	39.95	39.81
Treatment group	39.98	40.04
All workers		
Control group	38.81	38.79
Treatment group	37.96	37.49

The models for months being unemployed indicate no significant changes in duration of unemployment. The sample used in the models contained unemployment duration over a year of both currently employed and unemployed persons. To better see how the minimum wage increase affected the unemployment duration a larger sample of mostly unemployed individuals should be used. Moreover, one-year period could be too little to estimate the actual effects on unemployment duration.

4. Testing the Fundamental Identifying Assumption

Difference-in-differences estimation relies fundamentally on the common trend assumption. The assumption implies that although treatment and control groups might differ in their characteristics, these differences should stay constant over time. The common trend assumption allows to capture the effect of the minimum wage increase, as changes in employment levels for treatment and control groups should be the same in absence of the change in policy.

As suggested by Stewart (2004), the assumption could be tested by making a pre-minimum model and observing the significance of the interaction term. If the trends between the two groups are the same, there should be no significant effect of the interaction term $G_i * t_t$ when the minimum wage law is not changed.

There were no changes in the minimum wage policies from 2010 to the end of 2012. Therefore, the new models were estimated for two different time periods 2010-2011 and 2011-2012. The minimum wage increase in August 2012 was relatively small and is not expected to have a significant impact on employment.

Table 4
Difference-in-differences estimation results for pre-minimum samples

Specification	2010-2011		2011-2012	
	(1) Without controls	(2) With controls	(3) Without controls	(4) With controls
A. Employment status				
Coefficient	-0.000401	0.00517	-0.0130	-0.0103
S.E.	(0.0248)	(0.0238)	(0.0231)	(0.0223)
R-squared	0.060	0.155	0.065	0.144
Observations	1,562	1,557	1,624	1,621
B. Hours worked a week				
Coefficient	-0.372	-0.370	0.275	0.301
S.E.	(0.646)	(0.638)	(0.650)	(0.641)
R-squared	0.001	0.040	0.000	0.044
Observations	1,470	1,468	1,541	1,540
C. Months unemployed				
Coefficient	0.0614	0.0605	-0.0393	-0.0337
S.E.	(0.141)	(0.141)	(0.138)	(0.135)
R-squared	0.003	0.018	0.000	0.053
Observations	1,559	1,557	1,622	1,621
D. Employed full-time				
Coefficient	-0.0100	-0.0101	-0.0203	-0.0205
S.E.	(0.0124)	(0.0124)	(0.0130)	(0.0130)
R-squared	0.016	0.030	0.018	0.032
Observations	1,357	1,355	1,330	1,329

Notes: Columns (2) and (4) include the following controls: urban/rural area, highest level of education, gender, age, age squared, and family status. Robust standard errors in parentheses. Significance levels *** 1%, ** 5%, * 10%.

The treatment and control groups were defined the same way as before: control – individuals earning upcoming minimum wage and up to 20% more; and treatment – "at risk" individuals whose wages fall between the current minimum wage and the upcoming minimum wage.

The results of the estimated equations are provided in the table 4 above. The coefficients are highly insignificant for the models estimating the employment status probability, hours worked and months unemployed (rows A.-C.). This is especially true for the sample of 2010-2011. T-values increased slightly for the sample of 2011-2012, yet, this was expected due to the 50 LTL raise in monthly minimum wage from August 2012.

The treatment effect on probability of switching from full-time employment to part-time is also insignificant, but the t-values are much larger when compared to the other three models. These higher values are likely to be caused by accident, as the variation in the sample is very small: only 18 people switched towards part-time employment in 2011 and 19 people in 2012.

The overall insignificant results indicate that there are no breaches to the common trend assumption.

Unfortunately, a limited availability of the data does not allow to check for the trend after the minimum wage increase in 2013, as all the following years had changes in the policy at least once a year. Moreover, these changes were not only much smaller in size but also did not occur in the beginning of the year which makes it complicated to disentangle the effects due to the yearly structure of the data.

5. Sensitivity Analysis

Quite often the results of the models are highly dependent on the sample selection which is especially the case in the studies of minimum wage effects on employment. In this section the composition of treatment and control groups is altered to check the robustness of the estimates. The results can be found in the Appendix B.

5.1. Changing the Control Group

The sample selection of this study considered potential non-linearities between the individuals of different income groups, thus the sample was restricted to the individuals who are not too far away in the income distribution (MW+20%). Most of the previous studies used even

smaller distances when constructing the control group, usually with individuals who earn 10% or 15% more than the minimum wage. The sample was therefore reduced to these numbers.

Narrowing the sample of the control group did not change the main result by a lot: the nonemployment probability ranges between -0.049 and -0.057. These results are significant and close to original estimation of -0.051.

The models for hours worked a week and months unemployed continued to produce negative but insignificant coefficients.

The coefficient for the transition from full to part time employment is also not affected by the sample. It lies between -0.0208 and -0.0281 while the original estimation was -0.0242. The coefficient is significant for the control group which is restricted to the individuals earning up to 15% more than the minimum wage, however, as the sample is restricted to MW+10% and observations drop, the coefficient loses its significance. This issue could again be explained by the lack of observations because only 3 people from the control group switched towards part-time employment in MW+10% sample.

5.2. Changing the Treatment Group

The other potential problem in this study was the possible reporting and measurement errors. The monthly income had to be calculated given the hours worked a week and yearly income which lead to unrealistically low wages for some individuals. This issue could have been caused by the errors common in the survey-type data: individuals might not recall their actual working hours and income or the interviewers might report the wrong numbers. Alternatively, the calculation of the monthly income could produce the results different from the actual monthly income of an individual.

As the monthly income was the key determinant for the treatment and control group construction, it is important to address this potential bias. In order to do that, the treatment group was expanded to the individuals who earn from 50% of the MW and to all individuals who reported non-zero income.

Expanding the sample has increased the significance of the main disemployment results, however, the coefficient has decreased by half percent and ranges between -0.0443 and -0.0459.

Once again the coefficients for hours worked a week and months unemployed stayed negative and insignificant. The full time – part time transitions, on the other hand, increased in

significance and slightly in size. The estimated coefficient for the samples with the expanded treatment group is between -0.0267 and -0.0306. Unlike reducing the number of observations, expanding the sample has improved the significance of the latter result. In order to be certain about the robustness of this estimation even bigger sample should be used which, unfortunately, is unavailable for the period of 2012-2013. Nonetheless, the estimated effect of transitioning from full time to part time employment in all scenarios ranged around 2.5% suggesting no severe changes in size of the effect caused by the composition of the sample.

6. Conclusion and Discussion

Employment effects of minimum wages have been widely studied over the decades, yet, there is still no consensus not only on how big the impact actually is but also what direction it goes. The empirical studies have found conflicting results indicating that the effects highly depend on a context. Higher minimum wage increases would mostly produce more significant negative results, however, in the countries with more flexible labour markets, like in the UK and the US, negative employment effects would constantly fail to be detected. The theoretical implications are also ambiguous. While the neoclassical textbook explanations clearly indicate negative effects on employment, the other theories based on labour market frictions produce scenarios with weak or even positive employment effects.

Although broadly studied, the topic lacks research on Lithuanian labour market which this paper tried to address. Lithuania has experienced recent minimum wage increases which started in 2013 after the 4-year period during which the minimum wage was frozen at 800LTL. The minimum wage was raised by 17.6% and stayed fixed throughout the year which created a quasi-experiment setting perfect for the difference-in-differences estimation. Using an individual-level dataset this study estimated the probabilities of remaining employed for the minimum-wage earners and individuals who earn slightly above the minimum wage in order to estimate the effects of the minimum wage reform.

Overall, the results revealed that the reform affected the employment of the minimum-wage earners to some extent. The minimum wage increase has reduced the probability of remaining employed by around 5% for the minimum wage earners. These results were robust for different compositions of the treatment and control groups confirming the main hypothesis. The models also indicated 2% higher probability of switching from full-time to part-time employment,

but these estimates should be taken with caution due to a low variation in the sample. Other hypotheses were rejected as the models did not indicate any significant minimum wage effects on duration of unemployment and hours worked a week.

The research was limited in terms of available data. The monthly income variable which was the most important for the group formation had to be calculated based on the yearly income and the information available on the working hours of the individuals. This in turn could have biased the estimated results. Moreover, the sample could have benefited from more observations, as models for the part-time switching probability were sensitive to the size of the sample. Finally, another bias could come from a small minimum wage raise at the end of 2012. The study used 2012 as a period without a treatment and observed the employment status of the individuals who were employed by the end of the year. Possibly, some of the minimum wage earners might have already lost their jobs due to this smaller reform. However, this is unlikely as the test on the common trend assumption did not indicate any significant employment changes in that period. Alternatively, the previous reform could also have been incorporated in the estimation of 2013 policy effects.

Future studies could further examine the link between the minimum wage and hours worked of the minimum wage earners. Moreover, the studies on impact of the reform for different demographic groups could also better explain the dynamics of minimum wage effects. The use of other datasets, for example, with the company payroll data or monthly observations could also shed more light on the developments in Lithuanian labour market and the robustness of this study results.

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Appendix A: Descriptive Statistics

Table A1

Descriptive statistics of the sample

	Treatment		Control	
Family status	2012	2013	2012	2013
Single	110 *28.5 %*	115 *29.79 %*	80 *24.84%*	82 *25.47 %*
Married	276 *71.5 %*	271 *70.21 %*	242 *75.16 %*	240 *74.53 %*
Highest level of education				
Primary education	3 *0.78 %*	3 *0.78 %*	-	-
Lower secondary education	25 *6.48 %*	25 *6.48 %*	20 *6.21%*	20 *6.21%*
Upper secondary education	181 *46.89 %*	176 *45.6%*	136 *42.24%*	133 *41.3%*
Post-secondary non-tertiary education	118 *30.57 %*	120 *31.09%*	102 *31.68%*	102 *31.68%*
First stage of tertiary education	58 *15.03 %*	61 *15.8%*	63 *19.57%*	66 *20.5%*
Second stage of tertiary education	1 *0.26%*	1 *0.26%*	1 *0.31%*	1 *0.31%*

	Treatment		Control	
Current economic activity	2012	2013	2012	2013
Employee working full-time	344 *89.12%*	299 *77.46%*	301 *93.48%*	284 *88.2%*
Employee working part-time	42 *10.88%*	43 *11.14%*	21 *6.52%*	18 *5.59%*
Self-employed working full-time	-	2 *0.52%*	-	4 *1.24%*
Self-employed working part-time	-	-	-	-
Unemployed	-	24 *6.22%*	-	6 *1.86%*
Pupil, student, further training, unpaid work experience	-	3 *0.78%*	-	2 *0.62%*
In retirement or in early retirement or has given up business	-	11 *2.85%*	-	4 *1.24%*
Permanently disabled or/and unfit to work	-	2 *0.52%*	-	4 *1.24%*
Fulfilling domestic tasks and care responsibilities	-	-	-	-
Other inactive person	-	2 *0.52%*	-	-
Contract type				
Permanent job	370 *97.63%*	368 *96.84%*	306 *95.63%*	306 *96.53%*
Temporary job	9 *2.37%*	12 *3.16%*	14 *4.38%*	11 *3.47%*
Area				
Urban	236 *61.14%*	234 *60.62%*	216 *67.08%*	217 *67.39%*
Rural	150 *38.86%*	152 *39.38%*	106 *32.92%*	105 *32.61%*

Region	Treatment	Control
Alytaus	13 *3.37%*	14 *4.35%*
Kauno	73 *18.91%*	69 *21.43%*
Klaipėdos	26 *6.74%*	25 *7.76%*
Marijampolės	21 *5.44%*	28 *8.7%*
Panevėžio	54 *15.54%*	27 *8.39%*
Šiaulių	60 *15.54%*	36 *11.18%*
Tauragės	16 *4.15%*	19 *5.9%*
Telšių	13 *3.37%*	9 *2.8%*
Utenos	22 *5.7%*	31 *9.63%*
Vilniaus	88 *22.8%*	64 *19.88%*

Appendix B: Results of the Robustness Checks

Table B 1

Regression results with restricted control groups

	Control group: MW+15%		Control group: MW+10%	
	(1)	(2)	(3)	(4)
Specification	Without controls	With controls	Without controls	With controls
A. Employment status				
Coefficient	-0.0566**	-0.0562**	-0.0489*	-0.0486*
S.E.	(0.0220)	(0.0219)	(0.0250)	(0.0250)
R-squared	0.057	0.083	0.058	0.083
Observations	1,260	1,260	1,110	1,110
B. Hours worked a week				
Coefficient	-0.615	-0.650	-0.602	-0.644
S.E.	(0.715)	(0.712)	(0.811)	(0.811)
R-squared	0.006	0.054	0.002	0.064
Observations	1,207	1,207	1,060	1,060
C. Months unemployed				
Coefficient	-0.0701	-0.0707	-0.111	-0.111
S.E.	(0.150)	(0.149)	(0.168)	(0.168)
R-squared	0.006	0.028	0.005	0.026
Observations	1,260	1,260	1,110	1,110
D. Employed full-time				
Coefficient	-0.0281**	-0.0278**	-0.0212	-0.0208
S.E.	(0.0140)	(0.0139)	(0.0166)	(0.0165)
R-squared	0.022	0.043	0.021	0.045
Observations	1,042	1,042	902	902

Notes: Columns (2) and (4) include the following controls: urban/rural area, highest level of education, gender, age, age squared, and family status. Robust standard errors in parentheses. Significance levels *** 1%, ** 5%, * 10%.

Table B 2

Regression results with expanded treatment groups

	Treatment group: from 50% of the MW		Treatment group: all individuals with non-zero income	
	(1)	(2)	(3)	(4)
Specification	Without controls	With controls	Without controls	With controls
A. Employment status				
Coefficient	-0.0459***	-0.0455***	-0.0446***	-0.0443***
S.E.	(0.0175)	(0.0173)	(0.0171)	(0.0169)
R-squared	0.047	0.075	0.047	0.073
Observations	1,732	1,732	1,832	1,832
B. Hours worked a week				
Coefficient	-0.721	-0.696	-0.605	-0.580
S.E.	(0.623)	(0.617)	(0.612)	(0.606)
R-squared	0.005	0.042	0.006	0.051
Observations	1,664	1,664	1,760	1,760
C. Months unemployed				
Coefficient	-0.113	-0.114	-0.0787	-0.0797
S.E.	(0.122)	(0.122)	(0.121)	(0.120)
R-squared	0.007	0.019	0.006	0.019
Observations	1,732	1,732	1,832	1,832
D. Employed full-time				
Coefficient	-0.0306**	-0.0303**	-0.0269**	-0.0267**
S.E.	(0.0129)	(0.0128)	(0.0123)	(0.0122)
R-squared	0.025	0.047	0.023	0.045
Observations	1,436	1,436	1,508	1,508

Notes: Columns (2) and (4) include the following controls: urban/rural area, highest level of education, gender, age, age squared, and family status. Robust standard errors in parentheses. Significance levels *** 1%, ** 5%, * 10%.