Charles University

Faculty of Social Sciences
Institute of Economic Studies

MASTER'S THESIS

Effect of minimum wages: do regional data tell a different story?

Author: **Bc. Tereza Májková**

Supervisor: **PhDr. Jaromír Baxa, Ph.D.**

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Declaration of Authorship

The author hereby declares that he compiled this thesis independently; using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

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Prague, June 14, 2017

Signature

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Abstract

This thesis examines the effects of an increase of minimum wage level on unemployment, employment, disposable income and risk of poverty. We contribute to the existing literature by directly comparing results resulting from two similar datasets, one working with national, one with regional data. We use different sets of explanatory variables to see whether they affect the results of the estimation. On national level, our results confirm positive effect of minimum wages on employment of adults and on disposable income – but these findings were not confirmed on regional level. With respect to the regional perspective, the results are however subject to substantial uncertainty and are prone to substantial sensitivity to empirical specification. We attribute this uncertainty mainly to the quality of the data – small number of observations together with large heterogeneity.

JEL Classification	E02, E24, J08, J30
Keywords	minimum wages, employment effect, disposable income, risk of poverty, panel data, NUTS 2 regions, comparison

Author's e-mail	majkovat@gmail.com
Supervisor's e-mail	jaromir.baxa@fsv.cuni.cz

Abstrakt

Tato práce zkoumá efekt zvýšení minimální mzdy na nezaměstnanost, zaměstnanost, disponibilní příjmy a riziko chudoby. K dosavadní literatuře práce přispívá především přímým porovnáním výsledků plynoucích z použití dvou podobných datasetů, které se zaměřují jak na národní, tak na regionální data. Také jsme použili různé sady vysvětlujících proměnných za účelem zjištění jejich efektu na výše zmíněné závislé proměnné. Výsledky na národní úrovni potvrzují pozitivní vliv růstu minimální mzdy na zaměstnanost dospělých a na disponibilní důchod – tyto výsledky ale nebyly potvrzeny na úrovni regionů. Regionální data se zdají více citlivá na výběr proměnných. Výsledky plynoucí z regionální regrese mají ale mnoho úskalí, která plynou zejména z nízkého počtu pozorování a jejich heterogenity.

Klasifikace	E02, E24, J08, J30
Klíčová slova	minimální mzdy, zaměstnanost, disponibilní příjmy, riziko chudoby, panelová data, NUTS2, porovnání

E-mail autora	majkovat@gmail.com
E-mail vedoucího práce	jaromir.baxa@fsv.cuni.cz

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Acronyms

AIC	Akaike information criterion
BIC	Bayesian information criterion
MWSC	Minimum Wage Study Commission
OECD	Organization for economic cooperation and development

Master's Thesis Proposal

Institute of Economic Studies
Faculty of Social Sciences
Charles University in Prague

Author:	**Bc. Tereza Májková**	Supervisor:	PhDr. Jaromír Baxa PhD.
E-mail:	majkovat@gmail.com	E-mail:	jaromir.baxa@fsv.cuni.cz
Phone:	+420 739 233 860	Phone:	
Specialization:	FFM&B	Defense Planned:	June 2017

Proposed Topic:

Effects of minimum wages: do regional data tell a different story?

Motivation:

The minimum wages change over time and their levels also differ across the European countries. At the moment, minimum wage levels are set in 22 EU countries: in 16 of those, minimum wages are set on a national level, in 5 they are based on collective agreements for specific sectors and in Cyprus, they are set for specific occupations (Eurostat, 2016). There are a lot of aspects that affect the minimum wage levels and that are affected by them: for example GDP, employment and price levels. But those aspects are specific not only on a country level but also on a smaller, regional level.

The effect of the introduction or change in minimum wages on other macroeconomic variables, especially on unemployment has been quite popular in the economic literature (for example Boockman, 2010; Fialová, 2006; Dolado et al., 2006). But the authors are focused mainly on the country-level data, not considering the effect of price levels within the countries. The explanation for that may simple be the lack of the information about regional price levels – they have been so far estimated only in six European countries: Austria, Germany, Italy, Slovakia, UK and Czech Republic.

I would like to use the estimated the price levels of NUTS 2 regions of the EU from last year's paper of Janský and Kolcunová (2015) to re-estimate the socio-economic indicators (or use the ones already re-estimated – there is a paper about this topic that is going to be published very soon) and see if the effect of change or introduction of minimum wages on the adjusted variables (such as GDP, employment or income) differs from the effects estimated with non-adjusted variables. I am mainly interested in answering following questions:

- Do the specific regional data change the known relationship between minimum wages and macroeconomic variables? Or in other words, is it necessary to include region-specific data in the estimation of the relationship?
- Is there any effect of the minimum wages on the creation of new job positions?
- Are there some other significant effects between regional levels of minimum wages and different macroeconomic variables?

Hypotheses:

1. Hypothesis #1: Low price levels imply high minimum wages.
2. Hypothesis #2: An increase of the minimum wage level does not have a significant impact on employment.
3. Hypothesis #3: An increase of the minimum wage level in EU regions is strongly correlated to GDP adjusted for price levels.

Methodology:

Even though the effect of the introduction or change in minimum wages on other macroeconomic variables has been quite popular in the economic literature, there is not a unique view on this relationship. One group of the authors believe that increase in minimum wage level affect the unemployment negatively, especially when talking about the youngest, nonqualified teenage workers (for example Deere et al., 1995; Fialová, 2006; Baker et al. 1997). Authors in the second group have proven that the employment is not affected by the growth of minimum wages, moreover when considering particular age groups, the effect can even be positive (e.g. Card & Krueger, 1995, 1998; Machin & Manning, 1994; Dolado et al., 1996). Many people feel that the negative impact of minimum wage increase on unemployment is given – this phenomenon is called a "publication bias". That is why findings of Boockman (2010) are quite interesting – in his meta analysis we can see that the economists can be divided almost evenly among these two groups, only 66.7% of the 55 examined studies support the negative impact of increase of minimum wages on unemployment.

There has also been a lot of criticism of the models created by both groups – mainly because of possible endogeneity in the data (Maloney, 1995; Neumark & Wascher, 1992) or unobserved individual or state characteristics (Dolado et al., 1996; Neumark & Wascher, 1995).

But there is one thing that almost all authors have in common: working with data on a state level. It is important to realize that, based for example on a work of Janský & Kolcunová (2015), the regional differences in price levels may change the size of different macroeconomic variables such as disposable income or GDP per capita. Hence I think it will be interesting to see to what extent the impact of minimum wages on these re-estimated socio-economic indicators differs from the effects we are familiar with now.

For the data I will use different European databases, mainly EUROSTAT and OECD ones. I will also use the re-estimated data from Janský and Kolcunová (2015) and hopefully other relevant sources as well. I am going to follow similar framework as Meer & West (2015), using panel data from the NUTS 2 region of the EU and estimate the relationships between the above mentioned variables.

Expected Contribution:

This thesis will contribute to the current literature mainly by showing whether the computationally and data demanding adjustment of regional macroeconomic data bring additional insight in our understanding of the mutual relation between labor market dynamics and minimum wages or the nowadays used indicators are sufficient for creating macroeconomic policies.

Outline:

1. Introduction and motivation
2. Literature review
3. Previous results and their explanation
4. Data and methodology
5. Results
6. Conclusion

Core Bibliography:

Aaronson, D., French, E., Sorkin, I. (2015). *Firm dynamics and the minimum wage: A putty-clay approach.* Working Paper 2013-26, Federal Reserve Bank of Chicago

Baker, M. et al. (1997). *The Highs and Lows of the Minimum Wage Effect: A Time Series-Cross Section Study of the Canadian Law.* Mimeo, Toronto University.

Boockmann, B. (2010). *The combined employment effects of minimum wages and labor market regulation: A meta-analysis.* IZA Discussion Paper No. 4983.

Card, D. (1992). *Using regional variation in wages to measure the effects of the federal minimum wage.* Industrial & Labor Relations Review, 46(1), 22-37.

Card, D. and Krueger, A.B. (1995). *Myth and Measurement: The New Economics of the Minimum Wage.* Princeton University Press, Princeton, N.J.

Card, D. and Kueger, A.B. (1998). *A Reanalysis of the Effect of the New Jersey Minimum Wage Increase on the Fast-Food Industry with Representative Payroll Data. Industrial Relations Section.* Princeton University, Working Paper No. 293.

Deere, D. et al. (1995). Reexamining *Methods of Estimating Minimum Wage Effects: Employment and the 1990-91 Minimum Wage Hike.* American Economic Review Papers and Proceedings, May, pp. 232-37.

Dolado, J. et al. (1996). *The economic impact of minimum wages in Europe.* Economic Policy, October 1996, 23, 319-372.

Eurostat (2016). *Minimum wage statistics*. Available at http://ec.europa.eu/eurostat/statistics-explained/index.php/Minimum_wage_statistics; retrieved on October 10, 2016.

Ferragina, A. M., & Pastore, F. (2008). *Mind the gap: unemployment in the new EU regions.* Journal of Economic Surveys, 22(1), 73-113.

Janský, P., Kolcunová, D. (2015). *Regional differences in price levels across the European Union and their implications for its regional policy.* Mimeo.

Machin, S., Manning, A. (1994). *The Effects of Minimum Wages on Wage Dispersion and Employment: Evidence from the U.K. Wage Councils.* Industrial and Labor Relations Review, January, pp. 319-329.

Maloney, T. (1995). *Does the Adult Minimum Wage Affect Employment and Unemployment in New Zealand?* New Zealand Economic Papers, No. 1, pp. 1-19.

Meer, J., West, J. (2015). *Effects of the Minimum Wage on Employment Dynamics.* Journal of Human Resources, early publication online.

Neumark, D. and Wascher, W. (1992), *Employment Effects of Minimum and Sub-minimum Wages: Panel Data in State Minimum Wage Laws.* Industrial and Labor Relations Review, October, pp. 55-81.

Neumark, D. and Wascher, W. (1995), *Minimum Wage Effects on Employment and Enrolment: Evidence from Matched CPS Surveys.* National Bureau of Economic Research, Working Paper No. 5092.

Sorkin, I. (2015). *Are there long-run effects of the minimum wage?* Review of Economic Dynamics 18, 306–333.

The Economist (2015). *Destination unknown.* The Economist.

Visser, J. (2013). *ICTWSS: Database on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts in 34 countries between 1960 and 2012*, Version 4. Amsterdam: Amsterdam Institute for Advanced Labour Studies AIAS.

1 Introduction

The problem of minimum wages and its effects on other macroeconomic variables has been one of the most controversial topics in macroeconomics. Papers written before 1992 show strictly positive effects of minimum wages on unemployment (i.e. the studies conducted by the Minimum Wage Study Commission in 1977), not much attention was devoted to the impact of minimum wage levels on other variables. Later analyses of the papers written before year 1992 showed strong presence of publication bias – tendency of economical journals to publish only results that were expected by the large majority. The first breakthrough analysis was conducted by Katz and Krueger (1992). This paper came up with the positive employment effect of minimum wage in the fast food industry. This finding encouraged the other researchers to reexamine the effect of minimum wages, evaluating the previously published conclusions critically. We can consider this the beginning of the New minimum wage research, which went against the previously published conclusions, suggesting no or small employment effect of minimum wages.

The most recent studies and meta-analyses, do not provide a single point of view on the effects of minimum wages. The evidence for this can be found for example in Boockmann (2010) or in the summary provided by Neumark (2014). On one hand, we can see insignificant effects of minimum wages on unemployment or disposable income; on the other hand some studies suggest their significant negative or even positive impact (for example Litwin, 2015 or Card and Krueger, 1995). Moreover, the suggested relationships might differ on national and regional levels, as there are large differences in the macroeconomic indicators even within countries, as we can see when looking at the variables retrieved. The importance of the regional differences was highlighted by for example Majchrowska and Žólkiewski (2012) or Janský and Kolcunová (2015). The meta-analyses and regional studies suggest that this is probably driven by specific features of individual labor markets, but also by the datasets used by the authors. According to the literature (e.g. Chletsos and Giotis, 2015), there are three sets of the most problematic variables: minimum and average wage levels versus Kaitz index, density versus degree of urbanization and employment versus unemployment rates. The magnitude and size of the estimated effects differs based on their choice.

The objective of this thesis is to determine the effect of minimum wages and other explanatory variables on unemployment, employment, disposable income and risk of poverty on both national and regional level. Together, national-level data for 21 European countries were used. Unfortunately only four countries were used for retrieving regional data, as the indicators we were interested in were not available on NUTS 2 level elsewhere. To the best of our knowledge, there has not been any study directly comparing countries and regions in terms of minimum wage effects. Hence we presume that the use of very similar datasets operating with national and regional level macroeconomic indicators should provide valuable comparison of the estimated relationships.

This thesis follows mainly the approach used by Fialová (2007). In her work, she used regional data for Czech Republic 1991 and 2003, estimating the impact of minimum wages and other explanatory variables on unemployment and disposable income of poor households. One of the main reasons why we decided to follow this methodology is that the dataset used is very similar to the one we are working with – including problems with heteroskedasticity, stationarity and autocorrelation. Also even though the author was working with small number of observations and controversial variables (Kaitz index and unemployment), her estimation provided statistically significant results and valuable conclusions.

This work is structured in following manner. First chapter provides brief description of the current situation in Europe, focusing mainly on minimum wage levels and other variables that might impact its effects. This chapter is followed by literature review, which is divided into two subchapters: the first one presents traditional theories explaining the effects of minimum wage, used mainly in 1970s and 1980s; the second one provides an overview of the most recent empirical research regarding the impact on unemployment, disposable income and regional research. Then we get to the empirical part of this thesis. Firstly, the used datasets are described on both national and regional level. This chapter is followed by an overview of the methodology used. Chapter presenting the results is divided into five sections based on the dependent variables – unemployment, employment of the youngest workers, employment of adults, disposable income and risk of poverty. In each of the sections, national and regional results are

presented together with the overall summary. The final chapter summarizes and concludes all the findings.

2 Situation in Europe

2.1 Minimum wage

There are different ways of setting the minimum wage level – it can be done nationally for the whole country, for specific professions, industries or by collective bargaining for given sectors only. For the purposes of this thesis we would like to focus on countries which are operating with national minimum wage – thus to the majority of the EU countries.

As of January 2016, national minimum wage was in use in 22 of 28 European Union member states and five candidate countries (Albania, Montenegro, Macedonia, Serbia and Turkey). In Denmark, Italy, Austria, Finland, Sweden and also Iceland, Norway and Switzerland, minimum wages are set by collective agreements for specific sectors only. In Cyprus, they are given only for specific occupations. Germany decided to set up a national minimum wage quite recently, in January 2015 so it will not be included in this thesis. Minimum wage systems of the remaining 21 countries will be discussed in following paragraphs.

In most of the countries, minimum wage is set by government on the national level. It covers all full time-employees, all sectors. Usually the government needs to negotiate with different social partners and check the national budget before changing the minimum wage level. Minimum wage is considered to be the least gross amount of money a person receives on a monthly basis when working standard working hours (40 hours a week). This methodology is used in most of the European countries: Belgium, Bulgaria, Czech Republic, Estonia, France, Germany, Spain, France, Croatia, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Poland, Portugal, Romania, Slovenia, Slovakia or United Kingdom. But there are also differences and exceptions among those countries.

First of all, the date of acceptance the minimum wage policy is different. Some countries such as Spain are working with minimum wage since 1963, but for example Germany introduced this policy on a national level very recently.

Secondly, there are exceptions in the way minimum wages are set. In some countries, for example France, Ireland or UK, minimum wage is set hourly. This is not

such a big issue because hourly wage rates can be easily recalculated to comparable monthly salaries. In some countries, people receiving minimum wage are free of paying income taxes (e. g. in Portugal, Slovenia or Slovakia).

Another thing we would like to point out is that in some countries, the minimum wage does not cover employees under certain age threshold and years of experience. This lower level of wages is called "sub-minimum wage". We can see this for example in Netherlands, Belgium, Luxembourg or Czech Republic (OECD, 1998). When considering UK, the threshold is set to 21 years – younger employees have even lower wage rates. In Netherlands, minimum wages cover full-time employees aged 23-64. Malta, Latvia, France, Ireland, Germany, Belgium and Luxembourg have the lower bound equal to 18 years (the same applied to Spain before 1998). In Greece, minimum wage level applies only to employees more than 25 years old.

Because of the lack of detailed data in terms described above, this thesis will be working with basic minimum wage levels published for each of the 21 European countries. We presume sure that examination of more detailed dataset considering the subminimum wage levels could give better insight into the examined relationships, but we still think focusing on minimum wage levels can provide a valuable insight.

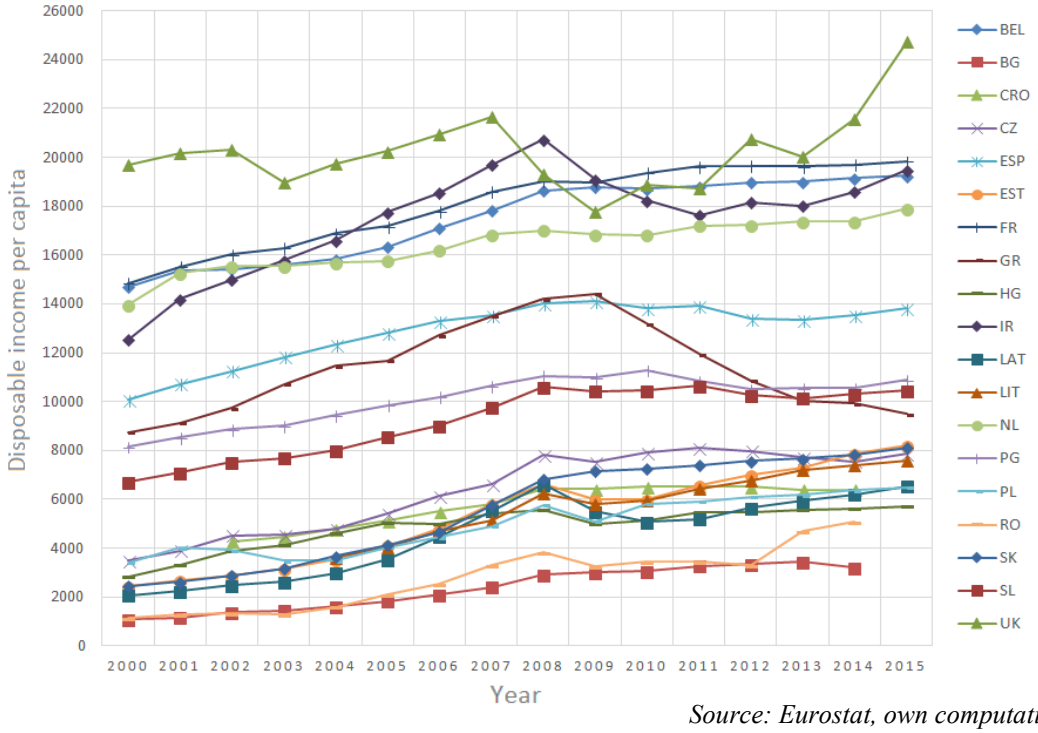
2.2 Other characteristic variables

When we take a look at the characteristics of different European countries, they are usually reported on the national level. However some authors such as Fialová (2007), Kolcunová (2015) or Majchrowska and Žólkiewski (2012) have emphasized that the regional differences in the variables such as minimum and average wage or unemployment may have significant impact on the policies applied by the governments. Luckily some of the main macroeconomic variables in most of the European countries are available on the NUTS 2 level in the Eurostat databases, which we will mainly use for retrieving the data.

The disposable income of private households (defined as a balance of primary income and the redistribution of income in cash) varies significantly among different countries and among its regions. As you can see in Figure 3, the differences in disposable income between Croatia and Slovakia in year 2013 are larger than 16 000

Euro annually. Moreover disposable income levels differ significantly even within one country. Ideally, minimum wage increase should also have a positive effect on the disposable income of households, especially in regions with a lot of people working at the minimum wage level. Fialová (2007) in her paper focused on Czech regions found evidence not supporting this relationship, but to the best of our knowledge this relationship has not been examined elsewhere on regional level.

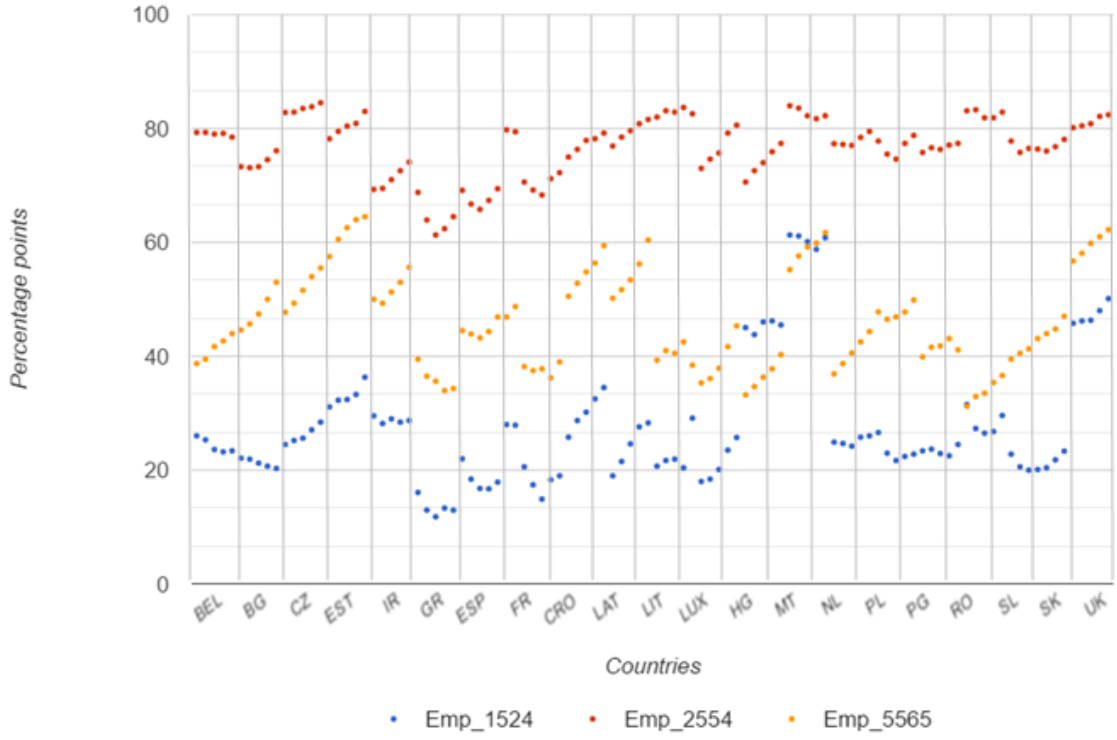
Figure 1: Disposable income of European households (2000-2015)



Source: Eurostat, own computations

Another important variable mentioned already in the previous chapter is employment, as it tends to provide more accurate results than unemployment. The middle age group (25 – 54) has the highest employment rate among all, as demonstrated in Figure 4 on the next page. The lowest rate can be seen among young workers, 15 – 24 years old. The theory suggests that minimum wage has the largest effect in this group – it significantly reduces the employment of the youngest workers. The countries selected for regional regression have the same relationship between the employment rates of different groups, but the examined time period is smaller.

Figure 2: Employment rates in examined countries, 2011 – 2015



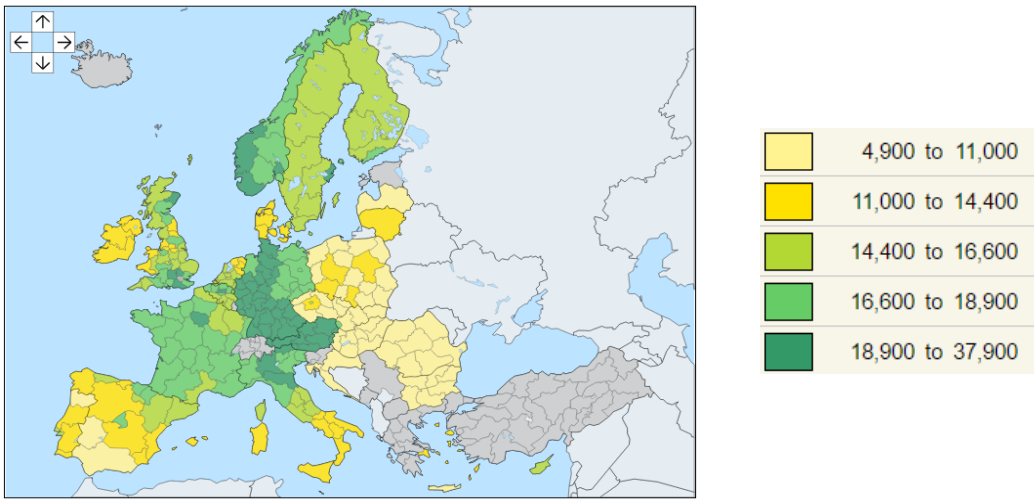
Source: Eurostat, own computations

Note: Emp_1524 – employment rate of the youngest workers (15 – 24 years old); Emp_2554 – employment rate of the middle-aged workers (25 – 54 years old); Emp_5564 – employment of the oldest workers (55 – 64 years old).

When focusing on the regional dimension of other important variables, we can see significant differences even within one country. That is why we (and also other authors) think that examining the effect of minimum wages on selected variables, for example employment or disposable income on regional level might bring different insights into this problematic.

In Figure 5 on the next page we can see that there are large differences in disposable income even within countries. The biggest differences of more than 10 000 Euro can be seen in Spain or UK.

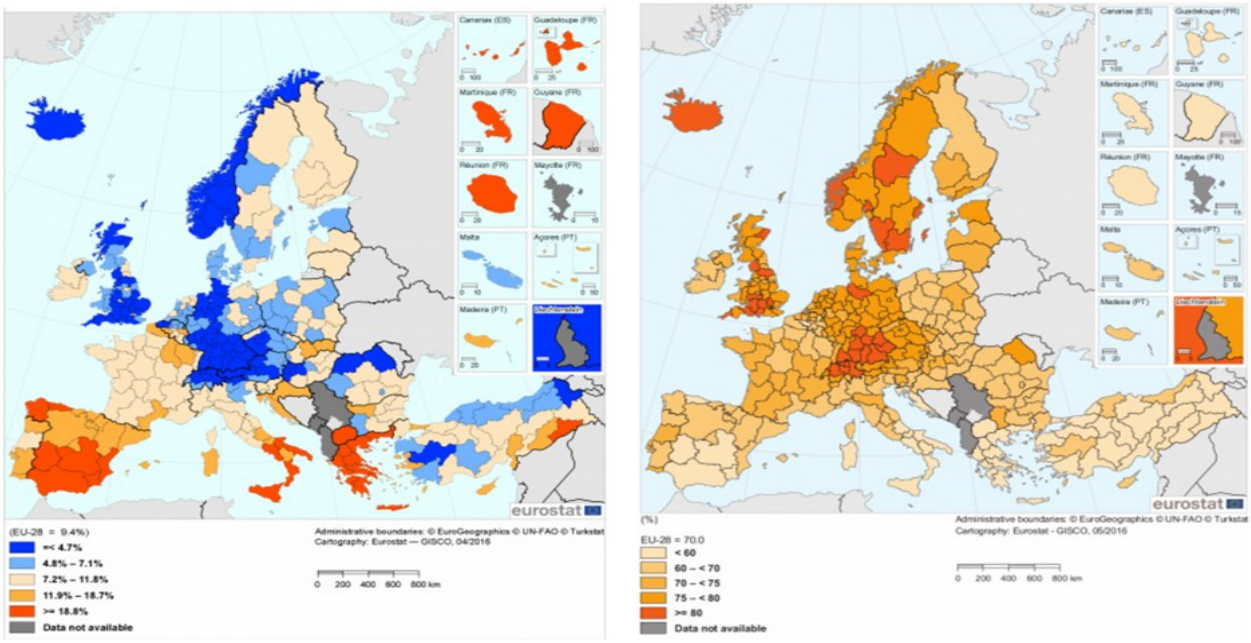
Figure 3: Disposable income of households (2013)



Source: Eurostat, 2013 (retrieved on Dec 10, 2016)

The differences on regional level can be seen also when considering employment and unemployment levels. As you can see in Figure 6 which shows the data from 2015, these rates differ significantly among European regions, especially in Italy or Greece. Also the magnitudes of employment and unemployment rates differ – that suggests different results of estimation based on the rate used.

Figure 4: Employment and unemployment rates in European regions (2015, respectively)



Source: Eurostat, 4/2016 (retrieved on Dec 10, 2016)

3 Literature review

3.1 Traditional theories of minimum wage effects

Minimum wage system is setting a lowest boundary for wages that can be obtained by the workers. There are many reasons for those boundaries to be set, for example poverty or income inequality reduction, improvement of motivation of the least paid workers or even putting pressure on firms to increase their productivity. Those goals the states are trying to achieve are quite compelling, but the question is whether they are actually achieved.

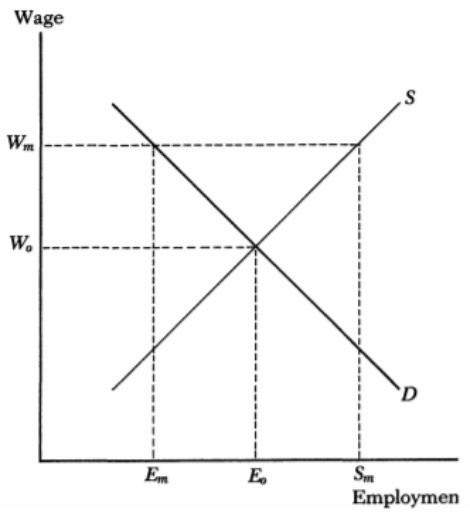
When talking about minimum wage, the main focus is given on both poverty reduction and improvement of the working conditions of the least paid workers – minimum wage should cover the main needs of the least paid workers and increase their purchase power. However the problem is that a lot of members of the low-income families are not employed so they are not affected by the minimum wage system at all. Let us now take a closer look on another controversial goal of minimum wage – trying to motivate the least paid (least skilled) workers. Success of this strongly depends on the social benefits and unemployment compensation that differ among countries. Fialová (2007) states that the difference between minimum wage (as a minimum salary resulting from a paid job) and an income based on benefits and compensations (independent on whether the person works or not) is the most important when considering motivation of an individual to work.

3.1.1 Supply-demand model

A lot of different theoretical approaches are used for explaining the effect of minimum wage on the economy. Only the two main ones will be discussed in this thesis, as the others are focusing only on given industries and they are not relevant for this work. The first model ever used was simple supply-demand relationship, based on perfectly competitive labor market and homogeneous labor force (used for example in Stigler, 1946 or Brown et al., 1982). As illustrated in Figure 1, introduction of minimum wage (increase of wage to W_m) causes the fall in employment (from E_0 to E_m), the changes being proportionally equal. The supply of labor is larger than demand and the

unemployment rate increases. Of course this model has many shortcomings – for example very strong and unrealistic assumptions. We can see that labor force is strongly heterogeneous and we can expect growing unemployment after the introduction of minimum wage especially in certain groups with lower productivity, such as young, less educated or part time workers. In some countries, this issue is solved by using lower "sub minimum wage" for those selected groups. Another effect minimum wage in this model may have is the incentive of companies to increase productivity of the employees by investing into their employees, into new procedures or equipment (also called "shock effects"). This is partially eliminating rapidly growing unemployment, motivating employees to get higher education or different certificates (partially paid by the company) and earn higher salaries.

Figure 5: Classical supply-demand model



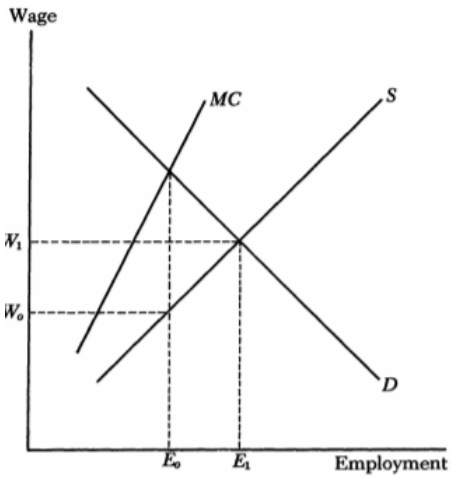
Source: Brown et al., 1982

3.1.2 Monopsony model

Another frequently used model is the monopsony, again discussed in Stigler (1946), Brown et al. (1982) or in Fialová (2007). In this model we are working with only one employer. He faces the labor supply alone so he is able to set the wage to whatever level he desires, the marginal costs of labor are above the supply price in all cases. In this model, introduction of the minimum wage may increase employment, because the employer is able to hire new employees without increasing the wage to the ones he already has. The maximum employment rate in this model is achieved in a situation

with perfect competition equilibrium (as you can see in Figure 2, employment on E_1 level, wages on W_1 level). This situation is demonstrated in Ehrenberg and Smith (1994): the authors say that we have two types of compensations that are offered to the employees, wage (salary) and non-wage (other benefits such as car, phone, education bonuses etc.). After the introduction of minimum wage, employers do not have to lay off their employees and increase the unemployment rate in order to keep their costs on the same level, they can just reduce the amount of non-wage compensations.

Figure 6: Monopsony model



Source: Brown et al., 1982

We can see that there is not a single point of view on the theoretical explanations of the effect of minimum wage on the economy. So now we would like to move to the empirical evidence captured in the last four decades.

3.1.3 Historical background

To get a better idea of the development of the minimum wage research, we will start with a little bit of history. Even though the institute of minimum wage was established on New Zealand and in Australia in the late 1890s for the purpose of protection of the low-paid workers, one of the first meta-analyses was written in the US by the Minimum Wage Study Commission (MWSC) in 1977. They focused mainly on the indexing of minimum wages to inflation and on the way of setting the subminimum wage for the youngest workers. After four years, MWSC published another analysis focused on the effect of minimum wage on employment particularly in the United States

and Canada. Using only simple time-series data, their analysis suggested that minimum wages increase the unemployment of teenage and young workers under the age of 24. This view dominated for more than 10 years.

The above mentioned approach was strongly criticized in 1982 by Brown, Gilroy and Kohen. In the landmark survey, they criticize that only the youngest workers are considered in the previous studies, they also present the limitation of the use of time-series data without taking into consideration different regions or industries.

In the early 1990s, the "New minimum wage research" wave came. Some economists, for example Card (1992) or Katz and Krueger (1992) came up with different methodologies and different datasets, refuting the original conclusions. The latest empirical results published especially after 1995 are at odds with the original, theoretical conclusions. The authors use more complex datasets, coming up with more precise estimation methods. Since then, there was a divergence between the opinions of different economists and the influence of minimum wage increase on unemployment become one of the most frequently discussed topics in all of economics. The most recent findings are summarized in following section.

3.2 Empirical literature review: New minimum wage research

The purpose of this chapter is to provide the reader an overview of the existing empirical research conducted after 1992 connected to the topic of minimum wage and its effects. There have been a lot of studies and papers written with regards to minimum wage, especially its effect on unemployment, but most of those papers focus either on the United States of America or on the OECD countries. Even though this thesis is focused on European countries only, we would like to present an overview of the most popular papers written on the topic of minimum wages, using the worldwide data – focusing on the most controversial and most frequently used methodologies.

Despite the enormous amount of papers connected to our topic, this chapter will highlight papers written year 1991, so called "The new minimum wage research" (Belman & Wolfson, 2014a). We will be mainly working with the meta-analyses focusing on the relationship between minimum wages and unemployment (or employment) – they gather the information from many studies and evaluate them critically. This thesis works with 8 meta-analyses, however only six of them will be included. Their main findings are described in following paragraphs. When working with the relationship between minimum wages and distribution of income or with the effects of minimum wage on the regional level, not any coherent analysis could be found, hence a summary of the most popular and influential papers is provided instead.

3.2.1 Minimum wage and (un)employment

To the best of our knowledge, there has been eight meta-analyses related to the relationship between employment and minimum wage, but only six of them are included in this chapter. The reasons for that are: the very first analysis (Brown et al., 1982) was included and extended by Card and Krueger in 1995a and the second excluded meta-analysis conducted by Natraj et al. (2014) was focused on low-income countries only, which we do not find relevant for this thesis.

The meta-analysis written by Card and Krueger in 1995a can be considered a first milestone in the minimum wage research. This meta-analysis is focused on the presence of publication bias – the tendency of journals to publish only "statistically significant" results, even if the t-ratio of one of the main explanatory variables exceeds the bottom

line of 2 by only a hundredth (a lot of people assumed that there is negative effect between minimum wage increase and unemployment, which may have influenced both authors and publishers). It combines 15 different papers with time-series data focused on the United States, 12 of which were included already included in the survey from Brown et al. (1982). The authors were investigating the presence of publication bias in these studies based on the relationship between sample sizes and reported t-statistics. Even though the t-statistics were expected to decrease with growing amount of data available in the later studies, Card and Krueger proved that the t-statistics of the employment effects of minimum wages reported by the authors of the examined studies are all just a little above two, regardless of the sample size. The authors conclude that this inverse relationship can be explained by the presence of publication bias in the early studies and that we have to be very careful when working with the studies written before 1995.

Similar approach was used in the meta-analysis of Doucouliagos and Stanley (2009) focused again on the United States only. The authors examined 64 American studies with the emphasis on the existence of publication bias, using the elasticity of employment with respect to minimum wage as the best measure of the effect. Only 25 of those studies refer to specific regions within US, the rest is focused on different age groups, especially teenagers. Doucouliagos and Stanley claim that most of the authors are working with panel data including fixed year effects and the Kaitz index, defined as a ratio between legal minimum and average wage. However, including those variables into the regression was criticized by many; for example Burkhauser et al. (2000) says that the employment effect of minimum wage is insignificant, when fixed year effects are included in the model. He claims that this variable eliminates the variation in the minimum wage, because it is usually changed only once a year. Card and Krueger (1995a) are against including the Kaitz index into the regression, using two arguments to support their opinion. First, they say that the index should be positively correlated with wages of teens (considering minimum wage as a relative price of teen labor), showing that it is actually negative. They also considered measuring the amount of teenagers very difficult and imprecise, hence they used nominal minimum wage in their models instead.[1] When we get back to the original analysis, we can say that the main conclusion is again the proved existence of publication bias, but also the claim that there

[1] For more details please see Card and Krueger (2005).

is just a little or no effect of minimum wages on employment. This analysis was broadened by the same authors three years later, adding more specific meta-regression methods and robustness to their initial results.

Then we have to mention Boockmann and his analysis from 2010. He was working with 55 studies from 15 main industrial countries[2] published after the year 1995. Even though the dependent variables, independent variables and also the estimation methods differed among those studies, the authors found a high significance of country fixed effects – concluding that the minimum wage effects are heterogeneous in different countries. The results have shown that negative employment effects of minimum wages are stronger in countries with stronger employment protection. Another interesting finding is that employment is more negatively affected by minimum wage compared to unemployment, regardless of the estimation method. Moreover because the author did not find any signs of publication bias in the examined studies, we can work with their results and consider them robust.

Analysis from Leonard et al. (2014) is working with 16 studies examining the employment effect exclusively in the United Kingdom. It is interesting to see that only 42% of the considered studies were working with regional data, the rest was focused on different industries or age groups. The authors were working with 236 estimated minimum wage elasticities and 710 partial correlation coefficients. Even though they did not find any evidence for the presence of publication bias in the UK, they found no evidence for any significant employment effect of minimum wage. The authors also pointed out that we should rather work with employment than unemployment because unemployment rate is not an exogenous variable (saying that unemployment is just a function of employment and labor force). This is supported by the fact that only the study from Neumark and Wascher (2004) among all included in this analysis is working with unemployment as with an exogenous variable.

Belman and Wolfson (2014b) examined more than 200 papers and international studies written between 2000 and 2013, but they were able to include only 23 of them into their research; the studies were focused mainly for the developed countries such as US, Canada, Australia and Western Europe. The authors followed similar approach as

[2] US, UK, France, Australia, Canada, New Zealand, Austria, Czech Republic, Slovak Republic, Sweden, Finland, Germany, Ireland, Portugal and Spain.

the previously mentioned Doucouliagos and Stanley (2012), calculating employment elasticities with respect to minimum wages. Based on the 439 estimates, they claim that there are only small negative effects of minimum wage increase on unemployment – saying that on average, 10% minimum wage increase causes reduction in employment of between -0.1% and -0.3%.

The last meta-analysis we would like to mention in this section was conducted by Chletsos and Giotis (2015). In this analysis the authors have used 77 studies from 18 countries, focused again on the employment effect of minimum wages and the existence of publication bias. Chletsos and Giotis claim that only 8.94% of the employment elasticities referred to specific region of a country. The heterogeneity among examined studies was explained by 27 moderator variables – the authors shown that the selection of variables determines the magnitude of the effect of minimum wage on employment and we have to be careful which variables to include in our model. The authors claim that for example lagged values of minimum wages and employment, panel data, fixed time effects or Kaitz index suggest positive effect of minimum wage on employment measures. On the other hand, fixed region effects, youth, unemployment rate or specific regions suggest negative effect of minimum wages on employment measures. Especially the significant, negative effect of region specific variables on employment is in contrast with the most recent research. We can overall say that in this analysis, the authors have found evidence for the presence of publication bias, but no significant effect of minimum wage on employment.

Based on this section we can say that there has always been a large heterogeneity among studies examining the effect of minimum wages on employment and unemployment, even though the results suggests that there is no significant adverse employment effect of minimum wage. One possible explanation of the heterogeneity is the publication bias, which was present in the academic journals especially before 1991, but we can still see it nowadays – hence we have to carefully draw conclusions from those papers. Another possible explanation is the selection of variables in different models. Some of the variables, such as different measures of employment or minimum wage are affecting the magnitude and the size of the effect. The use of unemployment, Kaitz index and fixed year or country effects is the most controversial among all. Based on the analyses above, we can say that the most frequently used estimation methods are

Ordinary Least Squares (OLS), Fixed and Random Effect estimation or Difference-in-Differences, all of them providing similar results.

3.2.2 Minimum wage and income distribution

One of the goals of minimum wages is to reduce poverty and to increase the living standards of the least paid workers. In the last three decades we can say that the income inequality significantly grew, even though minimum wage in lot of the countries increased as well. To the best of my knowledge, there has not been any complex meta-analysis examining the effect of minimum wage on the distribution of income. However, there are different papers and studies examining this effect, written mainly after the year 1991, most of them providing similar conclusions (at least when considering studies related to developed countries). In this section we would like to present some of the most recently published papers empirically examining this relationship and their results.

One of the first studies examining the relationship between minimum wage and income distribution was conducted in mid 1990s´ by Card and Krueger (1995b), working with the data from US. In the study, they proved that when increasing the minimum wage level, the income inequality is temporarily reduced. But because minimum wage modifies only the income of the least paid workers, the reduction of income inequality is very small.

Koeniger et al. (2007) focused on eleven OECD countries in the period between 1973 and 1999, examining their policies and different effects on income distribution. Using feasible fixed effect GLS estimator, the authors claim because a lot of the examined countries are linked with each other, the changes in income distribution could be explained by country-fixed variables, for example the minimum wage – which has shown significantly negative relationship with the income inequality. The authors have also mentioned other variables with significantly negative effect on the income distribution in the examined countries, for example employment protection, unemployment benefits or the union density. Moreover when they dropped dummy variables for year effects, the tax wedges became significant, having a positive effect on

the distribution. On the other hand dropping dummy variables for countries caused minimum wage being less significant.

Last paper mentioned in this section was written by Litwin (2015). He examined data from seventeen OECD countries, focusing on the period between 1980 and 2010 including the transnational effects into his mode. Using four different estimation methods (OLS, FE, RE, feasible GLS), the author get to the single conclusion: minimum wage does reduce income inequality, but the effect we can see is again temporary and it diminishes with increasing minimum wage. He also shows that increasing minimum wage is efficient until we get the minimum wage to certain point so called the maximum effectiveness value (hourly minimum wage equal to 11.77 USD) – then the effect is reversed. The author claims that based on the results, the income inequality may be lowered by lowering minimum wage, he even suggests when getting to the point of maximum effectiveness of the minimum wage, keeping the minimum wage level still may be the best solution for the economy.

This section is easier to summarize than the previous one because the most of the authors using the data from developed, OECD countries come with the same results – minimum wage reduces the income inequalities, but this effect is rather small and temporary. We still have to keep in mind that minimum wage is not the only variable (or policy) influencing the income distribution, there are other policies such as the employment protection or unemployment benefits that have demonstrated their effects on this issue.

3.2.3 Regional-level studies

This chapter is focused on the studies examining the effect of minimum wage on employment and on the income distribution on the regional level. Because minimum wages are usually set on a national level, the most of the studies focused on that dimension as well. But we have to keep in mind that there are huge differences between regions within one country, considering for example the average wage level or employment rate, which might play a crucial role when determining the effects of minimum wage.

There have been authors focusing on the regional dimension of the minimum wage effects. Even though there is not much papers and studies investigating the above mentioned relationships using the regional data, this section summarizes some of the most recent ones that inspired our research. Three papers will be discussed, concerning Czech Republic, Poland and Russia.

Fialová (2007) focused her attention on minimum wage in Czech Republic. There has been a few studies focused on the Czech Republic earlier, but they did not provide any reliable or significant results. Fialová examined the effects of minimum wage on both employment and income distribution in all 77 Czech regions between 1991 and 2003. Besides minimum wage level, the author is working with unemployment, average wage, Kaitz index or school enrollment rate as the explanatory variables. The results of her study suggest that neither working nor total income of poor families grew since 1999 in Czech Republic. She has also shown that minimum wage increases significantly raise unemployment, especially in regions with low wage levels – 1% increase in minimum wage is reflected in 0.42% increase in unemployment in given region.

The second paper is focused on Poland and its regions, conducted by Majchrowska and Žólkiewski (2012). The authors were working with the data from sixteen NUTS2 regions in Poland in the period between 1999 and 2010, examining the effect of minimum wage on employment. Interesting is that in the model, they used both employment rate and male unemployment rate (which are undoubtedly linked with each other) or Kaitz index – the most controversial variables. The authors found significant employment adverse effect of minimum wage in Poland with the largest and most negative effects in the period between 2005 and 2010 on working teenagers. Majchrowska and Žólkiewski have also shown that the poorest regions suffer the most from adverse employment effects.

In this section we would like to mention one more study by Muravyev, Oshchepkov (2013) focused on Russian regions. Even though Russia is not the most representative European country, we have two main reasons for including this study into our review. Firstly, the authors are working with very recent quarterly data from period between 2001 and 2010, considering all 89 Russian regions. Secondly, there is large variation in the data – the authors have also used interesting approaches and methods when dealing missing values in their panel dataset. Using the fixed effect regression and Neumark and

Wascher (1992) approach, the authors again claim that there are adverse employment effects of minimum wage especially on teenage and young workers. They also found evidence for increase in informal employment after a minimum wage hike.

Based on the research performed on regional level we can say that there are no or really small adverse employment effects of minimum wages. There effects are the strongest when considering employment of the youngest workers. Moreover we can say that there is no proven effect of minimum wages on the distribution of income.

Compared to the traditional explanations of minimum wage effects, we can say that the most recent research suggests only small overall effect of minimum wages, in some cases even significantly positive. One of the main reasons for the difference between the older and current approach might be the choice of explanatory variables.

4 Data

We were working with Eurostat database, OECD database and with individual statistics of each country. The datasets were almost the same on both regional and national level. In total, information regarding 16 different variables was retrieved. 15 of them entered the regression on both national and regional level: when working with NUTS 2 regions, variable *Dist* (Distance) was included and the three variables regarding employment were merged into two. Fialova (2007) also included variable capturing the distance of given region from the capital city into her regression. In the end, fixed effect estimation was suggested for the used model so this variable was omitted, but it had significantly positive impact on unemployment when using the random effects. The main features of variables are described in following paragraphs, detailed description can be found in the Appendix 1.

Average wages, *minimum wages*, *Kaitz index* (ratio between minimum and average wage), *disposable income* and the *risk of poverty* capture the information connected to the wealth of individuals. The risk of poverty measures the percentage of total population whose disposable income is lower than 60% of income median, the definition other variables is straightforward and can be found in the Appendix 1. On national level, the data were available during the whole examined period for most of the countries. On regional level, selected indicators were available only in limited time frame, especially when considering the average wage levels.

Following the recent literature, we included both *employment* and *unemployment* rates into the regression. There variables act as dependent and explanatory, when estimating the effects on risk of poverty. The recent literature provides a complementary evidence that employment provides more significant results than unemployment, as unemployment rate could be a function of employment and labor force, hence we could not consider it as an exogenous variable (Leonard, 2014). The differences resulting from the use of employment and unemployment rate will be tested in the following section. The employment rates were divided into three subgroups on national level and into two subgroups on regional level based on the age of workers. This will help to see if the effect of minimum wages is the most significant when considering the youngest workers. Also *employment protection index* is included in the regressions: this index, measured by OECD includes various factors regarding employment protection

regulations in most of the European countries. Last variable connected to labor markets is the *vacancy rate*, defined as the number of newly open roles in given region or country.

The remaining variables are connected to the education (participation in *tertiary education* system) economic situation in given country (*GDP growth*) or they have purely descriptive character (population *density*, *distance* from capital city or degree of *urbanization*).

On the national level, we were working with data from 21 countries in the time period between 2000 and 2015, together with up to 33, as the data were in the form of an unbalanced panel. The data summary can be found in the Appendix 2 in the very end of this thesis. Maximum number of observations was available for the most descriptive variables: density, GDP growth and urbanization. The smallest number of observations was available for *vacancy rate* and *employment protection index*, as they are not measured in every country (in France or Ireland, vacancy rates are not measured at all; employment protection index is not available for Bulgaria, Malta or Romania, as they are not member states of OECD).

Most of the European countries is not monitoring levels of development of the average wages on regional level (NUTS 2) – we have been able to find information about regional average wages only in four European countries: Bulgaria (with 6 regions), Czech Republic (with 8 regions), Poland (with 16 regions) and Slovakia (with 4 regions) in a limited time frame between 2011 and 2015, together with up to 170 observations, as the data were also in the form of an unbalanced panel. In the rest of Europe, average wages are available on national or NUTS 1 levels, which are often whole states. This is the reason behind using only the four selected countries for the purposes of our regional research. Most of the information was available from the time period between years 2011 and 2015 with the exception of *Disposable income*, *Primary income* and *Employment protection*, which were able only between 2011 and 2013 (moreover we have not been able to retrieve the data regarding *Employment protection* for Bulgaria). Same as Fialova (2007), we have included one more variable – *Distance* into our regional research.

The smaller number of observations on regional level needs to be taken into consideration when interpreting the results of the estimations, but we presume that even the smaller dataset can provide valuable insight into the relationship between examined variables.

5 Methodology

For the purposes of estimation, panel regression methods were used. The correctness of the models used was tested by two main tests. First one used was Breusch Pagan Lagrangian multiplier test for random effects, to help us decide whether pooled OLS regression is enough. In all the cases, this test suggested we should use either fixed or random effect models. The other test performed was the test of overidentifying restrictions, because the original Hausman test was not appropriate for our datasets. In all cases, fixed effect estimation resulted as more efficient.

Then we tested for heteroskedasticity, autocorrelation and stationarity. The tests used are described in following paragraphs.

First thing tested was heteroskedasticity in our data by using Breusch-Pagan test. Based on the results of this test we can say that heteroskedasticity is present in both of our datasets. To deal with this issue, we will be using estimation with robust errors.

We also tested for stationarity using Fisher-type unit-root test and for autocorrelation using the Wooldridge test. On national level, the results shown that almost all the variables contain unit-root, with the exception of *Urbanization*, *Risk of Poverty* and *GDP growth*. On regional level, all variables except of the *Risk of Poverty and GDP growth* contained unit-root. Because different levels of unit-root are present in lot of variables, we are not able to differentiate them on the same level. This issue is solved by using the same approach as Fialova (2007) – variables which include the currency levels will be differentiated one time. This concerns average wages, minimum wages and disposable income. The results will then describe change in our variables in given period. Autocorrelation is also present in the dataset, its effect should be lowered or eliminated by using the first differencing.

In order to decide which of the models is the best fit for explaining the variability of given dependent variable, Akaike (AIC) and Bayesian (BIC) information criterions were obtained after running each set of regressions. These criterions provide measure of relative quality of used models (Akaike, 1992). We decided to include these criterions into the thesis because we wanted to avoid possible problems with overfitting when having too many variables in the models. The important thing here is that we can compare only the models who work on the same datasets, in other words with the same

number of observations. That is why adjusting our dataset will be needed when omitting variables for which small number of observations is available, for example the employment protection index, as the number of observation usually dramatically increases after doing so. The criterions are specified in each explanatory variable in the following section.

There has been a discussion which variables are optimal to use and which give the best estimation results. In this context, the most frequently discussed variables are employment rate versus unemployment rate, minimum and average wage level versus Kaitz index and density versus degree of urbanization. That is why we decided to run more regressions for each explanatory variable, using different sets of dependent variables. Together, 28 regressions were performed, using unemployment, employment of all three age groups, disposable income and risk of poverty as explanatory variables. The results of all estimations are summarized in following chapter.

6 Results

6.1 Minimum wages and unemployment

Very often economists argue what are the effect of minimum wage on unemployment, many of the older studies say that minimum wages raise the unemployment levels. We chose variables *minimum wage*, *average wage*, *tertiary education*, *employment protection*, *vacancy rate*, *urbanization* and *GDP growth* for the purpose of testing this relationship, as all of them may have impact on unemployment.

Including GDP growth into the regressions is important especially on a national level. In that case, the models are working with large time period including financial crisis in 2007-2008. GDP growth is included mainly because we wanted to see whether the stage of the business cycle and the whole economy have any impact on the dependent variable.

6.1.1 Unemployment: results on national level

The main model we used when working with data on national level is stated below:

$$U_{it} = \propto + \beta_1 lnMW_{it} + \beta_2 lnAW_{it} + \beta_3 X_{it} + \varepsilon_{it} \quad \textbf{(1)}$$

X represents the set of control variables. The first model includes tertiary education, employment protection index, vacancy rate, degree of urbanization and GDP growth (1a). This model has been modified three times when working with national level data: degree of urbanization was replaced by density (model 1b), then employment protection index was omitted from the regression (model 1c) and finally, Kaitz index was included instead of individual minimum and average wages (model 1d). All of the models were estimated with the fixed effect model, based on the results of Lagrangian multiplier test and test of overidentifying restrictions. Detailed description of the models used and results can be found in Table 1 below.

The AIC and BIC were used to measure the quality of our models. Both criterions suggest that first two models (1a) and (1b) are the best predictors of the variability of unemployment, the first one being slightly better. That means there is no difference when using the degree of urbanization or density in this regression. Also note that there

are two models (1c1) and (1c2) – that is because after dropping the employment protection index, the number of observations dramatically increases, so the number of observations needed to be adjusted to have the same dataset for all the models (because when using Akaike and Bayesian criterions, we need to have the same amount observations for each of the compared models).

Employment protection index was statistically significant on 1% level in both models (1a) and (1b), so when left out from the regression, there was significant decrease of the R^2 within the examined groups. Both of these models were rated worse compared to the first ones when using AIC and BIC. The effect of employment protection is negative, which is in line with the intuition behind this variable: the higher the index, the lower the unemployment in given country. In all of the regressions, vacancy rate has also significant, negative effect.

The effect of minimum wages is negative, but not significant. It is significant only when the employment protection index was omitted from the regression (model 1c), but this model was rated as the worst of all four we used by Akaike and Bayesian criterions. Moreover when minimum and average wages are replaced by the Kaitz index in the model with significant minimum wages, Kaitz index does not have significant effect unemployment – that suggests the ability of the minimum to average wage ratio to suppress the effect of minimum wage on unemployment. Also the phase of the economy does not have any significant impact on unemployment.

These results are is in line with the theory, following findings suggested by Katz and Kruger (1992). Authors who are working with unemployment also did not find any evidence supporting negative effect of minimum wages.

Table 1: National analysis: dependent variable Unemployment (U)

Dependent variable:					**UNEMPLOYMENT**
Explanatory Variables	**(1a)**	**(1b)**	**(1c1)**	**(1c2)**	**(1d)**
lnMW	-1.999 (0.082)	-2.089 (1.574)	-3.252*** (1.638)	-2.272 (1.087)	
lnAW	0.083 (0.089)	0.082 (0.09)	0.062 (0.09)	0.077 (0.102)	
lnMWAW					0.143

					(0.186)
Tertiary Education	-0.026 (0.165)	-0.016 (0.215)	0.175* (0.091)	0.302 (0.254)	0.335 (0.233)
Employment Protection	-4.077*** (0.906)	-4.109*** (1.046)			
Vacancy rate	-0.868*** (0.0296)	-0.872*** (0.269)	-1.172*** (0.362)	-0.87** (0.364)	-0.961** (0.425)
Urbanization	0.0004 (0.0003)				
Density		0.012 (0.049)	-0.011 (0.025)	-0.057 (0.068)	-0.063 (0.064)
GDP growth	0.059 (0.038)	0.056 (0.036)	-0.025 (0.03)	0.064* (0.036)	0.058 (0.037)
Intercept	15.561*** (3.858)	15.837*** (4.99)	6.264** (2.748)	11.736 (8.518)	12.284 (8.069)
R^2 overall	0.008	0.059	0.207	0.272	0.269
R^2 within	0.441	0.439	0.337	0.272	0.26
R^2 between	0.07	0.222	0.198	0.392	0.388
Model	FE	FE	FE	FE	FE
Observations	97	97	169	97	97

*Note: Robust standard errors are in brackets below each coefficient. Significance levels are demonstrated by stars - * significant at 10% level, ** significant at 5% level, *** significant at 1% level. The models with the highest quality based on AIC/BIC measures are highlighted.*

6.1.2 Unemployment: results on regional level

One important thing when working with regional dataset is that smaller number of observations was available, especially when considering the employment protection index. This fact needs to be taken into consideration when interpreting the results. However I still think that we can get a valuable insight into the minimum wage – unemployment relationship.

On regional level, we have used the same model, but we also included variable considering the distance of given region from the capital city. The model used is defined as:

$$U_{it} = \propto + \beta_1 lnMW_{it} + \beta_2 lnAW_{it} + \beta_3 X_{it} + \varepsilon_{it} \quad \textbf{(2)}$$

Because the employment protection index was available only for three out of four examined countries, we were interested in seeing to what extent this variable influences the estimation results. We use the same set of control variables as when working with national level data (model 2a). Moreover we included variable distance into the model, as it has positive effect on unemployment in study conducted by Fialová (2007). This model was modified four times: firstly, the same model was used, just employment protection index was excluded from the regression (model 2b), then the degree of urbanization was replaced by density (model 2c) and employment protection index was omitted (model 2d) and finally, Kaitz index was used instead of minimum and average wage levels (model 2e). Based on the tests, fixed effect regression was used for the estimation of all of the models. Detailed estimation results and the description of the models can be found in Table 2 below.

Akaike and Bayesian criterions evaluated models (2d) and (2e) respectively as the best quality ones. We can see that excluding statistically insignificant employment protection index from our regression increases the quality of the model. The criterions for the other three models were significantly higher so we will not consider them as relevant for explaining the variability of unemployment.

Unfortunately in both of the relevant models, only density resulted as statistically significant, at least on 5% level. This result suggests that in larger cities or generally in places with larger population density, the unemployment is higher. This may be connected to more working opportunities and higher competition in larger cities. Distance of selected region from given city did not show any impact on unemployment, not even when the relationship was estimated by using the random effect approach.

In the table below we can also notice very big standard errors. This may be caused by the small number of observations in examined dataset and by heteroskedasticity.

In this case, using minimum to average wage ratio instead of the minimum and average wages rates suggests insignificant positive effect on unemployment. We can also say that the choice of the explanatory variables influences the magnitude of the effects a lot – the magnitude depends both on urbanization versus density and minimum and average wages versus Kaitz index.

Table 2: Regional analysis: dependent variable Unemployment (U)

Dependent variable:					**UNEMPLOYMENT**
Explanatory Variables	**(2a)**	**(2b)**	**(2c)**	**(2d)**	**(2e)**
lnMW	0.303 (16.845)	8.141 (18.117)	12.824 (17.31)	16.926 (15.957)	
lnAW	-2.072 (5.474)	1.524 (5.529)	0.89 (6.794)	2.569 (5.443)	
lnMWAW					1.791 (1.904)
Tertiary Education	-0.033 (0.197)	0.005 (0.183)	-0.09 (0.173)	-0.08 (0.16)	0.018 (0.146)
Employment Protection	3.236 (2.769)		1.425 (4.237)		
Vacancy rate	0.801 (1.627)	0.911 (1.624)	-0.221 (1.417)	-0.276 (1.392)	0.217 (1.254)
Urbanization	0.00007 (0.000)	0.00002 (0.000)			
Density			0.156 (0.117)	0.18*** (0.064)	0.173** (0.076)
GDP growth	0.158 (2.205)	-1.283 (2.239)	-1.304 (2.723)	-2.004 (2.112)	-0.105 (0.757)
Intercept	-3.343 (8.888)	3.861 (8.125)	-24.744 (18.71)	-26.309 (15.88)	-28.548* (16.652)
R^2 overall	0.03	0.086	0.189	0.19	0.185
R^2 within	0.216	0.198	0.217	0.214	0.195
R^2 between	0.031	0.087	0.19	0.191	0.186
Model	FE	FE	FE	FE	FE
Observations	56				

*Note: Robust standard errors are in brackets below each coefficient. Significance levels are demonstrated by stars - * significant at 10% level, ** significant at 5% level, *** significant at 1% level. The models with the highest quality based on AIC/BIC measures are highlighted.*

6.1.3 Unemployment: summary

On national level, employment protection index proved its significant positive impact on the unemployment rate – that is why models including this variable were evaluated as the highest quality ones. Employment protection was not significant on

regional level, so it could be excluded from the regression (moreover, omitting employment protection raised the coefficient of determination on regional level).

Working with Kaitz index did not influence our results in both cases, as the individual wage levels did not have any significant impact on the dependent variable. Density was preferred over the degree of urbanization on the regional level, as it was the only significant variable in our regional model.

Our estimation results are in line with papers and studies conducted after 1992 – no significant relationship between minimum wage levels and unemployment was demonstrated. We can also conclude that the variables influencing unemployment on national and regional level differ. This may be in general influenced by the small number of observations in our regional dataset (and their heterogeneity); further research may provide better insight into the above described relationships.

6.2 Minimum wages and employment of the youngest workers

The older papers suggest negative relationship between minimum wage levels and employment, especially when considering the youngest workers or teenagers. Most of the economists who belong into the time period of New minimum wage research claim that there is no significant effect of minimum wages on employment, but there have been some suggesting even positive effects (for example Machin and Manning, 1994).

In this section, the same set of explanatory variables is used as when talking about unemployment rates. We are interested to see whether the magnitudes and significance of the results changes when working with slightly different (and by many authors even better) dependent variable.

6.2.1 Employment of the youngest workers: results on national level

The models used are the same as in previous case. The main formula is stated below:

$$E1524_{it} = \propto + \beta_1 lnMW_{it} + \beta_2 lnAW_{it} + \beta_3 X_{it} + \varepsilon_{it} \quad \textbf{(3)}$$

Tertiary education, employment protection, vacancy rate, urbanization and GDP growth are represented by X variable above (model 3a). This model has been again modified three times: degree of urbanization was replaced by density (model 3b), employment protection index was excluded from the regression (model 3c) and finally, Kaitz index was used instead of individual levels of minimum and average wages (model 3d). Detailed information can be found in the Table 3 below.

Based on the AIC and BIC measures, all models have very similar quality with the exception of moth modifications of model (3c). This is probably caused by omitting highly significant variable, employment protection index. The results suggests that there is no difference in using degree of urbanization or density in our models; moreover there is no difference in using wage levels and Kaitz index, while the effects of the individual wage levels are not statistically significant.

We can see that in all cases, employment protection index and vacancy rate have significant, positive effect on the employment of the youngest workers. This is the absolute opposite of what was suggested when working with unemployment. The effect of tertiary education is negative in all relevant models. This can be explained by the school enrollment of the youngest workers and not enough time for them to go to work because of their education.

The effect of minimum wages is not significant in any of the relevant models – the statistical significance is suggested only in model (3c) after excluding the employment protection index. Moreover when working with Kaitz index, its effect on employment of the youngest workers is again not significant.

Based on this section we can say that minimum wages have no significant effect on employment of the youngest workers – this result is in line with the most recent studies and papers.

Table 3: National analysis: dependent variable Employment of 15-24 year old (E1524)

Dependent variable:					**EMPLOYMENT, 15-24**
Explanatory Variables	**(3a)**	**(3b)**	**(3c1)**	**(3c2)**	**(3d)**
lnMW	2.555 (2.77)	3.114 (2.717)	6.081* (3.59)	3.524 (3.322)	
lnAW	-0.199	-0.177	-0.12	-0.168	

	(0.139)	(0.132)	(0.106)	(0.163)	
lnMWAW					-0.329 (0.255)
Tertiary Education	-0.685** (0.313)	-0.491* (0.401)	-0.364 (0.352)	-1.204** (0.52)	-0.531* (0.414)
Employment Protection	8.426*** (2.097)	9.224*** (2.449)			9.274*** (2.374)
Vacancy rate	1.268* (0.72)	1.131** (0.519)	1.838** (0.774)	1.126 (0.961)	1.252*** (0.055)
Urbanization	0.0003 (0.001)				
Density		-0.112 (0.106)	-0.016 (0.212)	0.043 (1.17)	-0.106 (0.105)
GDP Growth	0.011 (0.081)	0.016 (0.074)	-0.013 (0.05)	-0.002 (0.059)	0.022 (0.075)
Intercept	15.624* (7.825)	31.483** (12.262)	34.934** (14.065)	40.687 (23.525)	30.844** (11.884)
R^2 overall	0.009	0.527	0.233	0.183	0.52
R^2 within	0.599	0.608	0.241	0.455	0.603
R^2 between	0.006	0.479	0.338	0.105	0.479
Model	FE	FE	FE	FE	FE
Observations:	97	97	169	97	97

*Note: Robust standard errors are in brackets below each coefficient. Significance levels are demonstrated by stars - * significant at 10% level, ** significant at 5% level, *** significant at 1% level. The models with the highest quality based on AIC/BIC measures are highlighted.*

6.2.2 Employment of the youngest workers: results on regional level

The basic model used in this section can be defined by following equation:

$$E1524_{it} = \propto + \beta_1 lnMW_{it} + \beta_2 lnAW_{it} + \beta_3 X_{it} + \varepsilon_{it} \quad \textbf{(4)}$$

The first model uses the same set of explanatory variables as on national level plus the distance (model 4a). It was modified four times, but the modifications were a little different than when working with unemployment. Firstly, some of the insignificant variables were omitted (model 4b). Then density was used instead of the degree of urbanization (model 4c) and employment protection index was excluded (model 4d).

Finally, Kaitz index was included into the regression (model 4e). Details can be found in the Table 4 below.

We need to be careful when applying AIC and BIS measures, as we can compare only models working "on the same dataset" – or in other words, with the same number of observations. When we exclude variable employment protection, the number of observations tends to increase. Based on the AIC and BIC measures used on different models with the same number of observations, models (4c) and (4d) were evaluated as the best ones. However these criterions are inconclusive when working with random effects model. Excluding the employment protection index slightly increased the overall R^2.

The results suggest positive effect of regional average wages on employment of the youngest workers. This can be explained by higher motivation of the youngest to work even part-time jobs when the salaries are higher. It may be also connected to the costs of living: young people studying in big cities with higher costs of living need extra money to keep their living standards. The results suggested negative impact of tertiary education, which was observed also on national level. Degree of urbanization also has significant, positive effect on the employment.

There is no evidence for effect of minimum wages. We can also say that the choice of the variables strongly influences the magnitude of the estimated effects. As can be seen in the table below, almost all variables have different signs.

Table 4: Regional analysis: dependent variable Employment of 15-24 year old (E1524)

Dependent variable:					**EMPLOYMENT, 15-24**
Explanatory Variables	**(4a)**	**(4b)**	**(4c)**	**(4d)**	**(4e)**
lnMW	-5.674 (20.624)	-5.925 (20.742)	80.034 (71.491)	67.877 (65.32)	
lnAW	3.419* (7.125)	2.852* (6.311)	33.805* (19.504)	28.83** (13.728)	
lnMWAW					-6.257** (3.063)
Tertiary Education	0.023 (0.094)		-0.291* (0.804)	-0.32* (0.757)	0.096 (0.088)
Employment	8.979		-4.223		

Protection	(6.934)		(11.053)		
Vacancy rate	-0.24 (1.429)	-0.225 (1.157)	-6.601 (4.8)	-6.439 (4.678)	-1.349 (1.481)
Urbanization	0.000002* (0.000)	0.0004** (0.000)			0.0002** (0.000)
Density			0.238 (0.334)	0.166 (0.201)	
Dist	-0.007 (0.005)	-0.008 (0.004)	omitted		-0.005 (0.004)
GDP Growth	0.502 (1.975)	0.715 (1.673)	-12.697 (8.806)	-10.625 (6.978)	-1.139** (0.521)
Intercept	0.616 (16.518)	-0.81 (15.299)	0.927 (52.975)	5.474 (44.1)	22.664** (2.026)
R^2 overall	0.329	0.333	0.008	0.009	0.218
R^2 within	0.094	0.087	0.195	0.192	0.109
R^2 between	0.343	0.349	0.009	0.01	0.225
Model	RE	RE	FE	FE	RE
Observations	56				

*Note: Robust standard errors are in brackets below each coefficient. Significance levels are demonstrated by stars - * significant at 10% level, ** significant at 5% level, *** significant at 1% level. The models with the highest quality based on AIC/BIC measures are highlighted.*

6.2.3 Employment of the youngest workers: summary

As when working with unemployment, employment protection index resulted as strongly significant on national level, but insignificant on regional level, together with the vacancy rate. Based on the results on regional level, we can say that average wage level has significantly positive effect on employment of the youngest workers. Models on both levels suggest negative effect of tertiary education – this may be explained by the fact that 15-24 old are in most cases still enrolled in schools, especially universities so they do not have enough time for working. Minimum wages did not prove any significant effect on employment of the youngest workers.

The selection of dependent variables (assuming all none of the significant variables is excluded) does not seem to impact the estimation results on national level. On regional level, density and individual wage levels are preferred over the degree of urbanization or Kaitz index.

Overall we can say that the results are in line with the most recent papers written after 1992 and with our expectations.

6.3 Minimum wages and employment of adults

Most of the older papers written before year 1992 claim that there is none or negative employment effect of minimum wages in this age group. That goes strongly against findings of the New minimum wage research, which say that there is none or slightly positive effect of minimum wages on employment of adults.

In this section, the exact same set of explanatory variables is used, together with the same models. Two age groups are examined on national level, 25-54 years old workers and 55-64 years old. On regional level, only the employment rate of the whole group was retrieved.

6.3.1 Employment of the 25 – 64 years old workers: results on national level

On national level, this age group was divided into two subgroups – employment of the middle-aged workers (25-54 years old) and the employment of the older ones (between 55 and 64 years). Both of the models used are the same as in previous chapter, it can be described by following equation when working with the employment of 25-54 years old:

$$E2554_{it} = \propto + \beta_1 \ln MW_{it} + \beta_2 \ln AW_{it} + \beta_3 X_{it} + \varepsilon_{it} \qquad \textbf{(5)}$$

In model (5a), tertiary education, employment protection, vacancy rate and urbanization are included. This model has been modified three times: density was used instead of the degree of urbanization (model 5b), employment protection index was omitted from the regression (model 5c) and Kaitz index was used instead of individual wage levels (model 5d). Fixed effect estimation was used on all of the models.

Again, model (5c) was evaluated as the worst among all by Akaike and Bayesian information criterions, as this model excluded highly significant variable, similar quality was suggested for all the other models. This suggests there is no significant

difference when using density instead of urbanization or Kaitz index instead of wage levels when considering the quality of estimated relationships.

We can see significant, positive effects of tertiary education, employment protection index, vacancy rate and the degree of urbanization on employment of the middle-aged workers. These effects were expected and can be explained easily. One surprising effect the models suggest is positive impact of minimum wages on employment, significant on 10% level. One possible explanation of this effect may be increased motivation of the people in this age group to work when minimum wages increase rather than receive social benefit payments – either because the new minimum wage level is higher than the level of social benefits, or because of the "psychological" effect of increase of minimum wage (people thinking received salary will be larger).

When Kaitz index is included instead on the minimum and average wage levels, its effect is not statistically significant. This again supports the claim that Kaitz index is not an appropriate variable for capturing the effect of minimum wages. Except of that, all the models provide similar results of the estimation.

Table 5: National analysis: dependent variable Employment of 25-54 year old (E2554)

Dependent variable:				**EMPLOYMENT, 25-54**
Explanatory Variables	**(5a)**	**(5b)**	**(5c)**	**(5d)**
lnMW	3.643* (1.956)	3.339* (1.82)	3.62 (2.235)	
lnAW	-0.05 (0.104)	-0.053 (0.109)	-0.046 (0.12)	
lnMWAW				-0.092 (0.189)
Tertiary Education	0.327** (0.138)	0.367** (0.153)	-0.121 (0.3)	0.32* (0.159)
Employment Protection	6.425*** (0.996)	6.323*** (1.054)		6.362*** (1.007)
Vacancy rate	1.082*** (0.307)	1.064*** (0.337)	1.061* (0.577)	1.202*** (0.404)
Urbanization	0.001*** (0.0004)			
Density		0.041	0.148	0.05

		(0.035)	(0.091)	(0.036)
GDP Growth	-0.059 (0.041)	-0.074 (0.037)	-0.086* (0.034)	-0.066 (0.042)
Intercept	47.393*** (3.656)	48.647*** (5.199)	54.957*** (11.828)	47.683*** (5.198)
R^2overall	0.011	0.324	0.242	0.312
R^2 within	0.474	0.453	0.189	0.436
R^2 between	0.011	0.276	0.242	0.263
Model	FE	FE	FE	FE
Observations	97			

*Note: Robust standard errors are in brackets below each coefficient. Significance levels are demonstrated by stars - * significant at 10% level, ** significant at 5% level, *** significant at 1% level. The models with the highest quality based on AIC/BIC measures are highlighted.*

When considering the last employment group of 55-64 years old, the same model and the same initial set of explanatory variables is used:

$$E5564_{it} = \propto + \beta_1 lnMW_{it} + \beta_2 lnAW_{it} + \beta_3 X_{it} + \varepsilon_{it} \quad \textbf{(6)}$$

And the same modifications are applied: using density instead of degree of urbanization (model 6b), excluding employment protection index (model 6c) and using Kaitz index (model 6d). All of them were estimated by the fixed effect approach.

AIC and BIC evaluated model (6c) as the worst, the rest of the models were evaluated on the similar level. This suggests no difference in the quality of the models based on the use of selected variables.

All of the models suggest significant, positive employment effects of tertiary education and employment protection. Minimum wages also have significant, positive effect on employment of the 55-64 years old workers, which can be explained using the same arguments as when working with employment of the middle-aged group. Moreover in this estimation, GDP growth has highly significantly negative impact on the employment. One of the possible explanations of this effect is the loss of "old jobs" in declining industries and creation of new roles in expanding sectors (Landmann, 2004). The expanding sectors are usually very technical and modern so people from the age group between 55 and 64 years are not able to learn and adapt to the new requirements.

Again, we can see that the Kaitz index did not capture the effect of minimum wages on employment.

Table 6: National analysis: dependent variable Employment of 55-64 year old

Dependent variable:				**EMPLOYMENT, 55-64**
Explanatory Variables	**(6a)**	**(6b)**	**(6c)**	**(6d)**
lnMW	8.595** (4.004)	7.654** (2.753)	7.942** (3.074)	
lnAW	0.016 (0.132)	-0.006 (0.16)	0.001 (0.168)	
lnMWAW				0.033 (0.261)
Tertiary Education	1.672*** (0.512)	1.591** (0.585)	1.09* (0.624)	1.59*** (0.479)
Employment Protection	7.272** (2.951)	6.49** (3.215)		7.553*** (2.591)
Vacancy rate	0.098 (0.877)	0.175 (0.778)	0.171 (0.751)	0.432 (0.888)
Urbanization	0.002 (0.002)			0.002 (0.002)
Density		0.156 (0.263)	0.265 (0.237)	
GDP Growth	-0.192** (0.082)	-0.221** (0.083)	-0.233*** (0.078)	-0.168* (0.087)
Intercept	-12.956 (13.571)	-23.003 (39.871)	-16.527 (35.613)	-12.216 (13.124)
R^2 overall	0.143	0.064	0.045	0.148
R^2 within	0.557	0.558	0.492	0.529
R^2 between	0.099	0.003	0.000	0.099
Model	FE	FE	FE	FE
Observations	97			

*Note: Robust standard errors are in brackets below each coefficient. Significance levels are demonstrated by stars - * significant at 10% level, ** significant at 5% level, *** significant at 1% level. The models with the highest quality based on AIC/BIC measures are highlighted.*

6.3.2 Employment of the 25 – 64 years old workers: results on regional level

On regional level, we have been able to retrieve data only for the whole age group of workers aged between 25 and 64. The model used is stated below:

$$E2564_{it} = \propto + \beta_1 lnMW_{it} + \beta_2 lnAW_{it} + \beta_3 X_{it} + \varepsilon_{it} \quad \textbf{(7)}$$

The initial model is the same as on national level, but it also includes density as an explanatory variable (model 7a). Four modifications has been made: firstly, urbanization was replaced by density (model 7b); then Kaitz index was used (model 7c); employment protection was omitted when working with minimum and average wage levels (model 7d) and then with Kaitz index (model 7e). For all of the modifications, fixed effect estimation was suggested by Lagrangian multiplier and overidentification tests. Details of the estimation can be found in Table 7 below.

When working with employment of 25 – 64 year old workers, models (7e) and (7d) were evaluated as the best ones using Akaike and Bayesian information criterions. Both of these models work with density and excluded variable employment protection.

In both of the models we can see significant, negative effect of population density on the employment. The reason behind might be an enormous competition in places with larger concentration of skilled people, when applying for a job. The effect of GDP growth is positive and significant in last estimated model.

In this section, working with density appeared to be better than working with the degree of urbanization. The magnitudes of the effect depend on the choice of explanatory variables. Omitting employment protection index also has positive impact on the model, as the variable is not statistically significant.

Table 7: Regional analysis: dependent variable Employment of 25-64 year old

Dependent variable:					**EMPLOYMENT, 25-64**
Explanatory Variables	**(7a)**	**(7b)**	**(7c)**	**(7d)**	**(7e)**
lnMW	32.373 (26.19)	12.203 (28.859)		9.961 (29.089)	
lnAW	7.191 (7.663)	0.763 (8.964)		-0.154 (7.849)	
lnMWAW			2.479		2.348

			(3.292)		(2.463)
Tertiary Education	-0.024 (0.37)	0.014 (0.37)	0.044* (0.319)	0.008* (0.357)	0.057* (0.229)
Employment Protection	-5.419 (5.818)	-0.779 (5.149)	0.487 (5.35)		
Vacancy rate	-0.835 (2.064)	0.389 (1.863)	0.635 (1.678)	0.419 (1.815)	0.667 (1.729)
Urbanization	0.00001 (0.000)				
Density		-0.311 (0.19)	-0.335** (0.165)	-0.324** (0.146)	-0.328** (0.132)
GDP Growth	-1.486 (3.006)	1.44 (3.689)	2.827* (1.156)	1.825 (3.125)	2.781** (1.155)
Intercept	88.711*** (15.934)	137.955*** (33.087)	138.419*** (31.381)	138.793*** (30.646)	137.667*** (28.482)
R^2 overall	0.005	0.207	0.209	0.208	0.21
R^2 within	0.398	0.431	0.432	0.431	0.429
R^2 between	0.006	0.209	0.211	0.21	0.21
Model	FE	FE	FE	FE	FE
Observations	56				

*Note: Robust standard errors are in brackets below each coefficient. Significance levels are demonstrated by stars - * significant at 10% level, ** significant at 5% level, *** significant at 1% level. The models with the highest quality based on AIC/BIC measures are highlighted.*

6.3.3 Employment of adults: summary

Both dimensions of the data suggest positive effect of tertiary education on employment. This is in line with our expectations, as more educated people have more working opportunities. On national level, the employment protection index is highly significant in both examined age groups. In contrast to that, on regional level, omitting this variable actually results in higher coefficient of determination.

Results on national level also suggest significant, positive employment effect of minimum wages. The possible explanations may be either minimum wage exceeding the social benefit payments, or "psychological" effect of the increase of minimum wage level (people may think they will receive higher income). However the effect of minimum wage levels was not confirmed on regional level. This effect is surprising, but it was already proved in some studies. Immervoll (2007) for example claims that

minimum wage increase tends to increase consumption, which positively affects the demand for work and hence also employment. Cahuc et al. (1999) also suggested possible positive employment effect of minimum wage based on the complementarities of skilled and unskilled workers.

We can also say that the choice of dependent variables influences the results, the biggest difference can be seen when using the Kaitz index. When the effect of minimum wages is significant and we replace the individual wage levels by the Kaitz index, the impact of minimum wages is suppressed. On regional level, density is preferred over the degree of urbanization.

6.4 Minimum wages and disposable income

The theory suggests that increasing minimum wage should also raise disposable income of households, especially of the poorest ones. Unfortunately we have not been able to find data regarding the income of the poorest households, so disposable income will be used instead.

Different sets of explanatory variables were examined in this section. Variables were divided into 6 general groups: *minimum wages*, *average wages* / *Kaitz index*; *tertiary education*; *employment* (divided into three groups on national level, two on regional level, based on age) / *unemployment*; *vacancy rate*; degree of *urbanization*/*density* and *GDP growth*. We were again interested to see if the selection of the dependent variables affects the model.

6.4.1 Disposable income: results on national level

On national level, we were working with following model:

$$lnDI_{it} = \propto + \beta_1 lnMW_{it} + \beta_2 lnAW_{it} + \beta_3 X_{it} + \varepsilon_{it} \quad \textbf{(8)}$$

First model is using tertiary education, employment levels of all age groups, vacancy rate, urbanization and GDP as the set of explanatory variables (model 8a). This model was modified four times: firstly, employment rates and density were included

(model 8b); then the model was working with unemployment rate and degree of urbanization (model 8c); urbanization was replaced by density (model 8d) and finally, Kaitz index replaced minimum and average wage levels (model 8e). The results are presented in Table 8 below.

Based on AIC and BIC measures, the last model is evaluated as the least explicit of all. The rest of the models have very similar quality levels. Based on these measures we can say that there is not much difference when using different sets of explanatory variables in terms of quality of the models used.

Minimum wages, degree of urbanization and GDP growth have significant and positive effect on the growth of disposable income; the effect of tertiary education is negative (1% increase of number of people participating in tertiary education system causes 0.006% -0.009% decrease of the growth on disposable income). This can be explained by smaller amount of people participating in the disposable income generation, while they attend school.

We can also see that the Kaitz index inhibits the effect of minimum wages. There is no evidence for the choice of the explanatory variables influencing the magnitudes of the effects.

Table 8: National analysis: dependent variable Disposable Income (lnDispInc)

Dependent variable:					**lnDISPOSABLE INCOME**
Explanatory Variables	**(8a)**	**(8b)**	**(8c)**	**(8d)**	**(8e)**
lnMW	0.393***	0.389***	0.389***	0.387***	
	(0.085)	(0.086)	(0.086)	(0.087)	
lnAW	0.004	0.004	0.005	0.005	
	(0.002)	(0.001)	(0.003)	(0.003)	
lnMWAW					0.0007
					(0.005)
Tertiary Education	-0.008**	-0.006*	-0.009***	-0.007***	-0.009***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
E1524	0.001	0.001			
	(0.002)	(0.002)			
E2554	0.003	0.002			
	(0.002)	(0.002)			

E5564	-0.001 (0.002)	-0.001 (0.001)			
Unempl.			-0.005 (0.004)	-0.005 (0.004)	-0.008* (0.005)
Vacancy rate	0.013 (0.008)	0.001 (0.002)	0.013 (0.008)	0.012 (0.002)	0.027*** (0.008)
Urbanization	0.0001* (0.000)		0.00003* (0.000)		
Density		0.002 (0.002)		0.0005 (0.002)	0.002 (0.008)
GDP Growth	0.007*** (0.001)	0.008*** (0.002)	0.007*** (0.001)	0.008*** (0.002)	-0.007*** (0.001)
Intercept	0.312* (0.177)	-0.439 (0.405)	-0.022 (0.063)	0.048 (0.212)	-0.026*** (0.214)
R^2 overall	0.042	0.01	0.043	0.28	0.0004
R^2 within	0.673	0.67	0.672	0.668	0.546
R^2 between	0.017	0.1	0.013	0.0004	0.085
Model	FE	FE	FE	FE	FE
Observations	152				

*Note: Robust standard errors are in brackets below each coefficient. Significance levels are demonstrated by stars - * significant at 10% level, ** significant at 5% level, *** significant at 1% level. The models with the highest quality based on AIC/BIC measures are highlighted.*

6.4.2 Disposable income: results on regional level

The model used on regional level is simpler than the one used on national level, as data regarding employment rates were retrieved only for two age groups. The main model can be specified by following equation:

$$lnDI_{it} = \propto + \beta_1 lnMW_{it} + \beta_2 lnAW_{it} + \beta_3 X_{it} + \varepsilon_{it} \quad \textbf{(9)}$$

The initial model is using the same explanatory variables as the one on national level (model 9a). It has been modified four times: model (9b) is working with employment and density, model (9c) with unemployment and urbanization, (9d) also with unemployment and density and finally, model (9e) is working with Kaitz index. Detailed results are listed in Table 9 in the end of this chapter.

Akaike and Bayesian criterions evaluated all of the models with the exception of the last one as equally explicit. Again, this is probably caused by the Kaitz index not capturing the effect of minimum wages on disposable income.

The effect of vacancy rate is in this case significantly negative among all models. Average wage level has significant positive effect, which is in line with our expectations. We can also say that the choice of explanatory variables (with the exception of Kaitz index) does not affect the results on regional level.

Table 9: Regional analysis: dependent variable Disposable Income (lnDispInc)

Dependent variable:					**lnDISPOSABLE INCOME**
Explanatory Variables	**(9a)**	**(9b)**	**(9c)**	**(9d)**	**(9e)**
lnMW	0.713	0.76	0.651	0.661	
	(0.671)	(0.712)	(0.693)	(0.704)	
lnAW	0.544**	0.554**	0.489*	0.489*	
	(0.257)	(0.264)	(0.242)	(0.243)	
lnMWAW					-0.253***
					(0.075)
Tertiary Education	-0.005*	-0.006*	-0.005*	-0.005*	0.001
	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)
E1524	-0.002	-0.002			-0.001
	(0.002)	(0.002)			(0.001)
E2564	0.004	0.005			0.005
	(0.003)	(0.003)			(0.003)
Unemp.			-0.001	0.001	
			(0.006)	(0.006)	
Vacancy rate	-0.141***	-0.149***	-0.131***	-0.133***	-0.112***
	(0.047)	(0.049)	(0.046)	(0.043)	(0.036)
Urbanization	0.00003		0.000		
	(0.000)		(0.000)		
Density		0.002		0.00002	0.001
		(0.003)		(0.003)	(0.003)
GDP Growth	-0.226	-0.232	-0.2	-0.201	-0.103
	(0.107)	(0.11)	(0.1)	(0.101)	(0.026)
Intercept	0.107	-0.264	0.331	0.339	-0.429
	(0.331)	(0.793)	(0.256)	(0.742)	(0.684)
R^2 overall	0.545	0.165	0.542	0.563	0.121

R^2 within	0.74	0.743	0.713	0.713	0.704
R^2 between	0.775	0.226	0.778	0.806	0.168
Model	FE	FE	FE	FE	FE
Observations	68				

*Note: Robust standard errors are in brackets below each coefficient. Significance levels are demonstrated by stars - * significant at 10% level, ** significant at 5% level, *** significant at 1% level. The models with the highest quality based on AIC/BIC measures are highlighted.*

6.4.3 Disposable income: summary

The positive effect of minimum wages on the growth of disposable income was found only on national level. On regional level, the positive effect of average wages was suggested. On both national and regional level we can see significantly negative effect of tertiary education – this can be explained by the smaller amount of people participating in the income generation while they attend school.

Kaitz index again suppressed the significant effect of minimum wages. Otherwise there is no evidence for the choice of dependent variables to influence the results.

6.5 Minimum wages and risk of poverty

The theory suggests that increase in minimum wage should not have not only positive effect on disposable income; it should also reduce the number of people living below the poverty line. We were able to find variable which measures how many people have disposable income lower than 60% of the average in given country or region and decided to test to what extent it is influenced by other explanatory variables.

We have included the same groups of variables into the models plus we also included the employment protection index, as it may have significant impact on the risk of poverty as well.

6.5.1 Risk of poverty: results on national level

The main model used when working with risk of poverty as the dependent variable is stated below:

$$ROP_{it} = \propto + \beta_1 lnMW_{it} + \beta_2 lnAW_{it} + \beta_3 X_{it} + \varepsilon_{it} \quad \textbf{(10)}$$

This model was the most complex of all. The fist one uses tertiary education, employment rates, vacancy rate, urbanization, employment protection and GDP growth (model 10a). It was modified four times: firstly, density was used instead of urbanization (model 10b), then we were working with unemployment together with urbanization (mode 10c) and density (model 10d) and finally, Kaitz index was included (model 10e). Results of the estimation are summarized in the Table 10 below.

Based on AIC and BIC measures we can say that all of the models have similar quality, models (10a) and (10c) being slightly better than the others.

In all of the models, variables tertiary education and degree of urbanization show significant, negative impact on the risk of poverty. That is again in line with our expectations, as more educated people tend to move to larger cities, obtaining higher salaries. The effect of employment protection is not significant, but this is about to change – one of the main goals of the Europe 2020 is to fight against poverty and social exclusion inter alia, by improving the social protection systems (European Commission, 2010)

The effect of minimum wages depends on other explanatory variables – the results suggest that working with employment, the effect of minimum wages is negative but when working with unemployment, the effect is positive. However in both cases, it is not statistically significant.

Table 10: National analysis: dependent variable Risk of Poverty (ROP)

Dependent variable:					**Risk of Poverty**
Explanatory Variables	**(10a)**	**(10b)**	**(10c)**	**(10d)**	**(10e)**
lnMW	-0.342 (1.439)	-0.088 (1.568)	0.279 (1.567)	0.328 (1.588)	
lnAW	-0.061 (0.048)	-0.061 (0.049)	-0.057 (0.039)	-0.057 (0.039)	
lnMWAW					-0.102 (0.091)
Tertiary Education	-0.226* (0.12)	-0.214* (0.141)	-0.339*** (0.097)	-0.304*** (0.097)	-0.219* (0.115)
E1524	0.015 (0.103)	0.022 (0.115)			0.023 (0.115)

E2554	-0.017 (0.164	-0.051 (0.139)			-0.052 (0.175)
E5564	0.088 (0.045)	0.082 (0.046)			0.081 (0.045)
Unemp.			-0.05 (0.154)	-0.058 (0.157)	
Vacancy rate	0.25 (0.254)	0.299 (0.26)	0.179 (0.251)	0.2 (0.246)	0.291 (0.268)
Urbanization	-0.001** (0.0005)		-0.001** (0.0003)		
Density		-0.022 (0.031)		-0.015 (0.025)	-0.023 (0.031)
Employment Protection	0.732 (0.96)	0.975 (1.066)	1.142 (0.553)	1.127 (0.634)	0.976 (1.04)
GDP Growth	0.054 (0.052)	0.061 (0.055)	0.043 (0.051)	0.051 (0.052)	0.06 (0.051)
Intercept	12.428 (9.059)	12.264 (8.329)	11.875*** (2.96)	10.075*** (2.978)	1.51 (8.536)
R^2 overall	0.065	0.38	0.06	0.369	0.373
R^2within	0.225	0.189	0.189	0.163	0.186
R^2 between	0.02	0.432	0.024	0.377	0.427
Model	FE	FE	FE	FE	FE
Observations	93				

*Note: Robust standard errors are in brackets below each coefficient. Significance levels are demonstrated by stars - * significant at 10% level, ** significant at 5% level, *** significant at 1% level. The models with the highest quality based on AIC/BIC measures are highlighted.*

6.5.2 Risk of poverty: results on regional level

When working with the risk of poverty on regional level, we have used very similar model as when working with the data on national level. The model can be described by following equation:

$$ROP_{it} = \propto \beta_1 lnMW_{it} + \beta_2 lnAW_{it} + \beta_3 X_{it} + \varepsilon_{it} \quad \textbf{(11)}$$

The first model is the same as on national level (model 11a). This model was modified five times in order to see whether the employment protection index has any significant impact on the results. Firstly, employment protection was omitted (model 11b); then urbanization was replaced by density (model 11c); other two models are

working with unemployment rates (11d and 11e) and the last one is using Kaitz index (model 11f).

Based on AIC and BIC, models (11a), (11b) and (11f) are the most explicit, explaining the variability of the dependent variable in the best way. This is probably caused by the insignificant effect of both minimum and average wages, so that the use of Kaitz index does not play a crucial role in the estimation.

The coefficients and robust standard errors are very large during the whole estimation, but they are especially large when using risk of poverty as an explanatory variable. This might be caused by large heterogeneity in the data and small number of observations for both the dependent variable and one of the significant explanatory variables, employment protection index. Effect of tertiary education and employment of the youngest workers have both significant, negative impact on risk of poverty. That means that working students should be able to earn higher salaries. Negative effect was also suggested for GDP growth, meaning that growing economy should have positive impact on poor households. The effect of degree of urbanization is also negative.

Table 11: Regional analysis: dependent variable Risk of Poverty (ROP)

Dependent variable:						**Risk of Poverty**
Explanatory Variables	**(11a)**	**(11b)**	**(11c)**	**(11d)**	**(11e)**	**(11f)**
lnMW	86.633 (57.433)	61.528 (52.56)	163.455* (93.423)	74.294 (77.545)	116.636 (100.014)	
lnAW	35.36 (22.49)	24.2 (19.07)	50.205 (30.556)	14.302 (19.367)	31.776 (29.617)	
lnMWAW						-5.945 (5.645)
Tertiary Education	-0.591* (0.417)	-0.706* (0.4)	-1.082* (0.611)	-0.99 (0.738)	-0.883 (0.663)	-0.228* (0.396)
E1524	-0.484** (0.235)	-0.486* (0.247)	-0.537 (0.349)			-0.423* (0.239)
E2554	0.09 (0.28)	0.137 (0.278)	0.165 (0.338)			0.164 (0.278)
Vacancy rate	-1.891 (3.942)	-2.196 (3.896)	-9.37 (6.85)	-5.101 (6.068)	-5.661 (6.198)	0.749 (3.52)

Unemp.				0.424 (0.45)	0.457 (0.476)	
Urbanization	-0.00006** (0.00002)	-0.00006** (0.00003)				-0.00007* (0.00003)
Density			0.797* (0.472)	0.299 (0.359)	0.547 (0.487)	
Employment Protection	-10.044 (9.096)		-16.393 (3.93)		-14.906 (12.611)	-1.414 (8.525)
GDP Growth	-17.041* (9.289)	-12.63* (8.128)	-24.93* (13.746)	-10.031 (9.609)	-17.279 (13.751)	-4.678** (2.114)
Intercept	19.975 (29.545)	-5.924 (26.536)	-78.122 (77.706)	-29.369 (65.679)	-44.539 (69.994)	-28.751 (29.745)
R^2overall	0.047	0.042	0.008	0.005	0.007	0.005
R^2within	0.573	0.557	0.454	0.272	0.3	0.525
R^2 between	0.047	0.043	0.008	0.006	0.008	0.005
Model	FE	FE	FE	FE	FE	FE
Observations	56					

*Note: Robust standard errors are in brackets below each coefficient. Significance levels are demonstrated by stars - * significant at 10% level, ** significant at 5% level, *** significant at 1% level. The models with the highest quality based on AIC/BIC measures are highlighted.*

6.5.3 Risk of poverty: summary

On both national and regional level, tertiary education and the degree of urbanization showed significant, negative effect on risk of poverty. Moreover on regional level, also tertiary education and GDP growth have significant, negative effect on risk of poverty – this is in line with our expectations, as both experience and economical development bring more work opportunities and possible higher salaries. Minimum wage did not show any significant impact.

In both cases, the use of degree of urbanization is preferred over density. We can see that the size and magnitudes of the effects strongly depend on the choice of explanatory variables, especially when working with national data.

7 Conclusion

This thesis had two main goals: to see whether different sets of explanatory variables affect the estimation results and whether the results differ on national and regional level. Two very similar datasets were used in order to get the best possible comparison; the only difference was the time frame, as on the regional level, some of the core variables were not available before 2011.

The information regarding 15 variables was retrieved on both national and regional level. As dependent variables, unemployment rate, employment rate of the youngest workers, employment rate of adults, disposable income and risk of poverty were used. In total, 54 regressions were performed, out of which 28 was done on national level and 26 on regional level (in fact we performed even more regressions, but they were not stated in this thesis). In most of the cases, fixed effect regression was suggested for estimating the data. This caused omitting one of the regional explanatory variables, distance of given region from the capital city. In paper written by Fialová (2007), this variable showed significant, positive effect on unemployment – however this was not confirmed by our results.

On national level, our results suggested positive effect of minimum wages on employment of adults and on disposable income. However this effect was not confirmed when focusing on regions – we presume that this can be to some extend caused by the quality of the regional data, as we were working with small number of observations and with large heterogeneity (which can be seen also on the reported standard errors). Overall we can say that these results are in line with the minority of the most recent studies (e.g. Card and Krueger, 1994; Cahuc et al., 2001 or Immervoll, 2007).

Significance and size of the effect of explanatory variables differed based on the dataset used: only significant, negative effect of tertiary education on employment of the youngest workers and negative effect of education and degree of urbanization on risk of poverty were estimated on both levels.

Regarding the selection of variables, we can say that the Kaitz index captured the effect of average wages, but it absorbed the effect of minimum wage levels. In each model with average wages as a significant variable, the Kaitz index was also significant, but usually on lower level. On the other hand in models with minimum wages as a

significant variable, Kaitz index did not show any significant effect, not even when minimum wage level was significant on 1% level. In general we can conclude that regional data were more sensitive to the choice of the explanatory variables in all cases with the exception of estimating the effects on risk of poverty.

In this thesis we have not found any evidence supporting impact of minimum wages on risk of poverty. The theory suggests that the number of people living at the poverty line should be reduced, but the empirical research claims that if there are any reducing effects, they are only small and temporary (e.g. Koeniger et al., 2004; Litwin, 2015).

We can see authors suggesting modifications of the minimum wage system. Abrogation of the whole system is suggested: introducing additional payments to regular salaries smaller than given level, moving the costs of raising wages from companies to state (Sinn, 2006), which would be difficult to implement. Other authors suggest not connecting minimum wages and social benefit payments or differentiating the wage levels based on specific needs of given regions (OECD, 1998). These policies are implemented in some countries, but their implementation needs to be evaluated for each country individually.

Even though our findings are in line with some of the most recent papers, it would be interesting to use larger dataset on the regional level to see whether the predicted relationships will be more similar to those on national level. Despite the growing tendency of authors to focus on regional data, their utilization implies a lot of challenges, namely lack of regional-level data.

8 References

Akaike, H. (1992): *Information Theory and an Extension of the Maximum Likelihood Principle*. Pages 610-624 In: Kotz, S., and N.L. Johnson, editors. Breakthroughs in Statistics Volume 1. Foundations and Basic Theory. Springer Series in Statistics, Perspectives in Statistics. Springer-Verlag: New York.

Belman, D. & Wolfson, P. J. (2014a): *The New Minimum Wage Research.* Employment Research. 21(2): 4-5. Available at http://dx.doi.org/ 10.17848/1075-8445.21(2)-2.

Belman, D. L. & Wolfson, P. (2014b): *What Does the Minimum Wage Do?* Upjohn Institute Press

Boockman, B. (2010): *The combined employment effects of minimum wages and labor market regulation: A meta-analy*sis. IZA Discussion Paper, No. 4983.

Brown, CH.; Gilroy, C. & Kohen, A. (1982): *The Effect of The Minimum Wage on Employment and Unemployment*. Journal of Economic Literature, Vol. 20, No. 2. (Jun., 1982), pp. 487-528. Available at http://links.jstor.org/.

Cahuc, P., Saint-Martin, A., Zylberger, A. (2001): *The Consequences of the Minimum Wage When Other Wages are Bargained Over*. European Economic Review 45 (2001), pp. 337 – 352. Available at http://elsevier.com

Card, D. (1992): *Using Regional Variation in Wages to Measure the Effects of the Federal Minimum Wage*. Industrial and Labor Relations Review, October 1992, 46(1), pp. 22-37.

Card, D. & Krueger, A. (1995a): *Time-Series Minimum Wage Studies: A Meta-analysis.* The American Economic Review, Vol. 85, No. 2, Papers and Proceedings of the Hundredth and Seventh Annual Meeting of the American Economic Association Washington, DC, January 6-8, 1995. (May, 1995), pp. 238-243.

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

Chletsos, M. & Giotis, G. P. (2015): *The employment effect of minimum wage using 77 international studies since 1992: A meta-analysis*. 14th conference on research on economic Theory and Econometrics, Working Paper. Available at http://www.aueb.gr/Giotis.pdf.

Doucouliagos, C. H. & Stanley, T. D. (2009): *Publication selection bias in minimum-wage research? A meta-regression analysis*. British Journal of Industrial Relations 47: 406-28.

Ehrenberg, D. G. & Smith, R. S. (1994): *Modern Labor Economics: Theory and Public Policy*. 5th edition. Reading, Addison-Wesley.

European Comission (2010): *EUROPE 2020, A strategy for smart, sustainable and inclusive growth*. Communication from the comission. Brussels, 3.3.2010. COM(2010) 2020. Available at http://ec.europa.eu/eu2020

Fialová, K. (2007): *Minimální mzda: vývoj a ekonomické souvislosti v České republice.* IES Working Paper: 12/2007. IES FSV. Charles University.

Immervoll, I. (2007): *Minimum Wages, Minimum Labor Costsand the Tax Treatment of Low-wage Employment*. OECD Social, Employment and Migration Working Papers no. 46, 2007, 24 p.

Janský, P., Kolcunová, D. (2015). *Regional differences in price levels across the European Union and their implications for its regional policy.* Mimeo.

Katz, L. F. & Krueger, A. B. (1992): *The Effect of the Minimum Wage on the Fast Food Industry*. NBER Working Paper #3997, February 1992. Natioanl Bureau of Economic Research. Available at http://www.nber.org/papers/w3997.pdf.

Koeniger, W.; Leonardi, M. & Nunziata, L. (2004): *Labour Market Institutions and Wage Inequality*. IZA Discussion Paper No. 1291, September 2004.

Landmann, O. (2004): *Employment, productivity and output growth.* Employment strategy papers. Employment Trends Unit, Employment Strategy Department.

Leonard, M.; Stanley, T. D. & Doucouliagos, H. (2014): *Does the UK minimum wage reduce employment? A meta-regression analysis*. British Journal of Industrial Relations 52(3): 499-520.

Litwin, B. S. (2015): *Determining the Effect of the Minimum Wage on Income Inequality*. Student Publications. Paper 300. Available at http://cupola.gettysburg.edu/student_scholarship/300.

Majchrowska, A. & Žólkiewski, Z. (2012): *The impact of minimum wage on employment in Poland*. Investigaciones Regionales, 24 – Pages 211 to 239. Available at http://www.aecr.org/images/ImatgesArticles/2012/12/10_Aleksandra_Majchrowska,_Zbigniew.pdf.

Machin, S. & Manning, A. (1994): *The Effects of Minimum Wages on Wage Dispersion and Employment: Evidence from the U.K. Wages Councils.* Industrial and Labor Relations Review, January, pp. 319-329.

Minimum Wage Study Commision (1981): *Report*. Digitalized by Google, available at https://babel.hathitrust.org/cgi/pt?id=mdp.39015046807155;view=1up;seq=3.

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

OECD (1998): *Making the most of the minimum: Statutory minimum wages, employment and poverty*. In Employment Outlook, Paris, OECD.

Stigler, G. (1946): *The Economics of Minimum Wage Legislation*. American Economic Review. Vol. 36, str. 535-543.

Online data sources:

Central Statistical Office of Poland, retrieved from http://stat.gov.pl/en/regional-statistics/.

Czech Statistical Office, retrieved from https://www.czso.cz/.

Eurostat database, retrieved from http://ec.europa.eu/eurostat/data/database.

National Statistical institute of Bulgaria, retrieved from http://www.nsi.bg/en.

OECD database, retrieved from http://stats.oecd.org/.

Statistical Office of Slovakia, retrieved from www.statistics.sk/.

9 Appendix

Appendix 1: Description of variables used on both national and regional level

NAME	DESCRIPTION
Average Wage (AW)	Average monthly wage in given region. Unit of measure: Euro
Density (D)	Population density in given region. Unit of measure: number of people per square kilometer
Disposable Income (DI)	Net disposable income of households defined as balance of primary income and redistribution of income in cash. Unit of measure: million Euro
Distance (Dist)	Distance of given region from the capital city. Unit of measure: kilometers
Employment 15-24 years old (E1524)	Employment rate of people aged 15-24, Unit of measure: percentage of total population in the same age
Employment 25-54 years old (E2554)	Employment rate of people aged 25-54. Unit of measure: percentage of total population in the same age
Employment 55-65 years old (E5565)	Employment rate of people aged 54-65. Unit of measure: percentage of total population in the same age
Employment protection index (EMPP)	Indicators of strictness of labor regulations covering 21 items within 3 groups of employment protection regulations. We used EPRC_V2 index – for more details please see OECD webpage. Unit of measure: absolute index value
GDP growth (GG)	Percentage change in GDP compared to previous year. Unit of measure: percentage
Minimum to average wage ratio (MWAW)	Ratio of minimum wage and average wage; calculated as MW/AW∗100. Also called Kaitz index. Unit of measure: percentage
Minimum Wage (MW)	Monthly minimum wage set by a legislation of given country. Unit of measure: Euro
Risk of Poverty (ROP)	People with disposable income after social transfers lower than 60% of the national median equalized disposable income. Unit of measure: percentage of total population
Tertiary Education (TE)	People who graduated from university or private college. Unit of measure: percentage of total population
Unemployment (U)	Unemployment rate of people aged 15-65. Unit of measure: percentage of total population
Urbanization (Urb)	Share of population living in cities. Unit of measure: number of people
Vacancy rate (V)	Percentage of posts that are new and unoccupied (= vacant); calculated as number of vacancies/(number of occupied posts + number of job vacancies)∗100. Unit of measure: percentage

Source: Eurostat, OECD, own computations

Appendix 2: Summary statistics for national-level data

NAME	OBSERVATIONS	MEAN	STANDARD DEVIATION	MIN	MAX
Average Wage (AW)	284	1431.2 €	1081.83 €	119.1 €	4091.4 €
Density (D)	336	188.5	270.15	30.3	1369.5
Disposable Income (DI)	233	213 808.8 mil €	353 625 mil €	3305.6 mil €	1 280 673 mil €
Employment 15-24 years old (E1524)	319	31.4%	12.01%	11.8%	70.4%
Employment 25-54 years old (E2554)	319	76.72%	5.29%	61%	86.8%
Employment 55-65 years old (E5565)	319	42.13%	9.94%	20.8%	64.5%
Employment protection index (EMPP)	192	2.63	0.5	1.53	4.09
GDP growth (GG)	334	2.51%	4.15%	-14.6%	25.5%
Minimum Wage (MW)	328	640.44 €	495.4 €	34.29 €	1922.96 €
Minimum to average wage ratio (MWAW)	284	40.81%	5.57%	26.3%	56%
Risk of Poverty (ROP)	235	16.77%	3.97%	8.6%	26.4%
Tertiary Education (TE)	252	14.46%	4.5%	5.96%	25.91%
Unemployment (U)	319	5.9%	2.9%	1.5%	17.3%
Urbanization (Urb)	323	6346.4	7969.63	125.2	28984.8
Vacancy rate (V)	189	1.16%	0.67%	0.3%	3.3%

Appendix 3: Summary statistics for regional-level data

NAME	OBSERVATIONS	MEAN	STANDARD DEVIATION	MIN	MAX
Average Wage (AW)	170	895.44 €	203.5 €	545.08 €	1727 €
Density (D)	170	193.27	420.99	42.5	2604.7
Disposable Income (DI)	102	11093.61 mil €	7427.39 mil €	2045.34 mil €	38855.75 mil €
Distance (Dist)	170	194.09 km	99.49 km	0	398 km
Employment 15-24 years old (E1524)	170	23.82%	3.68%	15.4%	33.1%
Employment 25-54 years old (E2564)	170	69.58%	5.22%	60.3%	82.3%
Employment protection index (EMPP)	84	2.5	0.17	2.19	2.78
GDP growth (GG)	170	2.48	1.6	-0.9	5
Minimum Wage (MW)	170	321.56 €	82.43 €	122.71 €	417.55 €
Minimum to average wage ratio (MWAW)	170	36.53	9.68	14.45	51.49
Risk of Poverty (ROP)	154	11.24%	7.32%	0.16%	32%
Tertiary Education (TE)	170	23.04%	6.23%	9.9%	40.5%
Unemployment (U)	170	9.65%	3.31%	2.5%	19%
Urbanization (Urb)	170	672223.5	388492.5	230900	230670
Vacancy rate (V)	170	0.74%	0.47%	0.2%	2.7%