Minimum wage policy and its effect on employment in European countries

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Abstract

Minimum wage policy is very controversial topic for policy makers to reduce income inequality and ensure decent living conditions for low-wage workers. In recent years, the minimum wage has an increasing pattern in most European countries and the debate centers on whether this increase affects employment and causes job loss. The evidence, apart from the theory suggest no or very small effect on total employment, but in some cases, significant effect on youth employment. The purpose of this thesis is to estimate the effect of the minimum wage on total employment, employment for three groups divided by age and also gender across the countries of the European Union, taking into account potential non-linearity. The effect on employment for workers from oldest group is expected to be negative as the impact of employment affects not only low-skilled but also less productive workers. The analysis considers 16 European OECD countries with different level of economy. Model includes productivity and hiring costs index, and controls for unemployment rate, business cycle and secondary school enrolment. Thesis brings together theoretical and empirical aspects of the effect of the minimum wage legislation on employment.

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Introduction

Many countries around the world have minimum wage legislation, according to The World Bank already 160 economies out of 198 around the world had single or multiple minimum wage rate by mid-2015, either statutory or collectively determined. Eurostat states that within the Europe, 22 out of 28 countries had statutory minimum wage. However, the level of monthly minimum wages varies significantly. The lowest level as of January 2017 is 235 \in in Bulgaria, whereas in Luxemburg it's 1,999 \in (Eurostat).

The primary objective of the wage regulation is to protect low wage earners against unduly low wages. In this respect the legislation can reduce and prevent poverty and decrease wage inequality in the country. (Kuddo, Robalino, Weber, 2015)

International Labour Organization (ILO) stresses the importance of the monitoring the effect of the legislation and data availability for governments and social partners to ensure the effectiveness of labour market policies. Findings and results from the assessment need to be in awareness for policy makers to be able to adjust or change if necessary. Studies are usually focused on the effect of minimum wage on wage level in the country, gender pay gaps, total employment, especially employment of the young, or income inequality and poverty.

The most controversial debate and the most important one is about the effect on employment, because the effect varies not only across the countries, but between the studies. Some studies show negative impact, but some of them positive. Christ and team (2015) argue for non-linear effect, negative effect is on the demand side, and positive on the supply side. Moreover, positive effect as long as wages are low, but with the minimum wage increase the negative effect dominates the positive one. This paper analyzes the effect of the wage policy not only for youth, but it looks at the relationship of minimum wage and employment for three different groups based on age plus gender groups. I argue, that in the context of European countries minimum wage can benefit for young workers and old workers who earn the minimum wage or even for those who earn somehow more. The effect should be stronger on young because of their level of skills and experiences, but also for older people and their productivity. The effect of the employment across the European countries is non-linear, when the minimum wage level is low the effect is very small and already high level of the minimum wage and employment (Gorry, 2013).

Therefore, the hypothesis is, that assuming non-linearity, the minimum wage is expected to affect young workers' employment and employment of 56-64 years old workers. This paper specifically focuses on this group as well as other, because the minimum wage from various empirical studies has impact on employment of vulnerable, low-skilled workers, low wage earners, workers with low productivity. Which can be argued that not only young workers belong to this group. Moreover, considering wide research controlling for various variables which has potential influence on employment, this paper assumes that the level of minimum wage in countries in sample is effective, so the effect on the employment should be small.

1. Minimum Wage Policy – Theoretical Background

The first theoretical prediction is that imposing the binding minimum wage law will destroy job market. Card and Krueger (1995, p. 4) claim that this hypothesis is one of the most widely acknowledged among economists. However, if the legislation doesn't result in employment reduction, the theory is posed by more questions. With every minimum wage increase, the debate is renewed and the effect on the disadvantaged is discussed. The focus is on whether the labor market follows the theory from economic textbooks.

This chapter describes the basic Competitive Labor Market theory, followed by the theory of Two-sector model, Heterogenous Labor Market model and finally the Monopsonistic Labour Market theory.

1.1 Competitive Labour Market

The simplest model of minimum wage, standard neoclassical theory, is one assuming competitive labor market, homogenous labor and complete coverage. In competitive labor market model, labor demand D(w) equals to labor supply S(w) at equilibrium wage w^* and employment E^* . In other words, employment and wages are determined by the intersection of labor demand D(w) and labor supply S(w). After imposing the minimum wage law or increasing the level of minimum wage, the new minimum wage $w_m > w^*$ will determine new level of employment $E(m) = D(w_m)$ and create excess supply of labor $S(w_m) - D(w_m)$.

This standard model also assumes perfect information of wages, so the workers can readily move to different, better paid job. Another assumption is that employers can hire as many labor as they want and pay them market wage rate. This is called "the law of one price", and it is reason why this theory has been abolished by many economists, because this theory assumes that workers at the same level of skills receive the same wage rate. As example given by Card & Krueger (1995), that would mean that workers in IBM and McDonalds with the same skills would receive the same wage rate. Additionally, this model rules out other important assumptions. Speaking of the assumption of no effect of the higher wage on productivity, moreover productivity and turnover is unexpected to be influenced by interpersonal wage comparison or wage fairness. Employers are supposed to operate at the higher level of efficiency and do not share the profit with employees in any form of bonuses.

The assumption here is, that we are moving along the demand curve, which results in the employment loss defined by $ln(E_m) - ln(E^*)$. Employment loss depends only on the demand elasticity and the difference between competitive and minimum wage $ln(w_m) - ln(w^*)$.

The assumption here is that labor participation of workers depends on their probability to be employed and if wage level equals to the level of wage expectations. Figure 1 illustrates situation on labor market after imposing minimum wage legislation for both long or short run, assuming that the effect is more elastic in long run. The employment level after imposing the minimum wage policy is E_m (Brown, 1999).





(Source: Brown, 1999, p.2104)

Stigler in his paper (1946) implored economists to singularly agree on the assumption that minimum wage legislation results in employment reduction. He explains that in the environment where wage determination is competitive, workers receive as a wage the value of his/her marginal product. Therefore, the minimum wage law affects labor allocation for lowefficiency workers. If the minimum wage is effective, inefficient workers are being discharged unless their productivity is increased. How many workers are being discharged depends on product demand elasticity and substitution. If inefficient workers' productivity raises, the aggregate output will be reduced by the minimum wage. Cost of production will rise, but less than in the case where other resources are not substitutable for labor. This effect is most significant for low-wage industries where the environment is highly competitive and ration of wages total profit is higher compared to high wage industries.¹

¹ Sitgler (1946) defines more specifically the total profit as total-processing-cost-plus-profit.

Wage determination by employer describes U-shaped relationship between minimum wage and employment. Stigler (1946) gives an example that the employment, wage rate and even aggregate output might be increased by higher minimum wage level if minimum wage is closer to marginal product value. The example comes from the hypothetical data illustrated by the table below. If the employer is currently employing 40 workers with the set wage of \$18 the higher minimum wage of \$24 would employ 30 more workers. At this level, the marginal product equals to wage rate. However, Stigler stresses that national minimum wage level is not relevant to this hypothetical example.

Number of Workers	Wage Rate	Marginal Cost of a Worker	Value of the Marginal Product*
10	\$12		\$36
20	14	\$16	34
30	16	20	32
40	18	24	30
50	20	28	28
60	22	32	26
70	24	36	24

Figure 2. Wage determination

(Source: Stigler, 1946, p. 361)

If the wage level is higher than \$24, assuming still the hypothetical example above, the effect on employment will be negative. Optimum wage level can be set only if all demand and supply information are available for considerable range, taking into account variation among different occupations, firms and time. According to previously mentioned arguments, Stigler summarizes uniform national wage level infrequently changed as a cause of aggregate employment reduction.

1.2 Two-sector Models

When the minimum wage is applied with certain exceptions based on size or industry, the uncovered sector may not eliminate the negative effects on employment. According to Brown (1999), this results from the fact that labor demand in covered sector depends on level of the minimum wage $D^c(w_m)$, whereas the labor demand in uncovered sector depends on the market determined wage $D^u(w^*)$. Without the legislation, wages in both sectors would equal to equilibrium wages, so the labor supply would be $S(w^*) = D^c(w^*) + D^u(w^*)$.

For further purposes let's define the labor demand of uncovered sector $D_u(w^*)$ equal to the difference between total employment $E^*=1$ and the labor demand in covered sector $D_c(w^*)$, so $D^u(w^*) = 1 - D^c(w^*)$. Labor supply is much more difficult to be modelled after introducing the minimum wage, because on the one side more people would be willing to work at higher wage level, but we need to note that not all of them would be able to find work (Brown, C., 1999).

The situation with minimum wage in uncovered sector is illustrated on the picture below. In the equilibrium wage w_u^* and employment E_u^* , as a consequence of excess supply due to the fact that $D^{c(w_m)} < D^{c}(w^*)$, the wage in uncovered sector must fall to w_u^{1} . Total employment is smaller compared to its level in absence of minimum wage, despite the fact that employment in uncovered sector raises.



Figure 3. Minimum wage with an uncovered sector

(Source : Brown, 1999, p. 2105)

1.3 Heterogenous Labor

In the competitive model, it is assumed homogenous labor, let's now assume heterogenous labor where the expected effect of minimum wage is, as Brown (1999) describes, more significant for low-skilled workers with low wages and affects indirectly better paid workers from uncovered sector. The increase of their payment will make them more expensive and their potential substitutes more attractive. Potential substitutes are likely to be workers who earn more than minimum wage but they often do exactly same tasks or very similar as their low-paid colleagues, especially young workers, high school dropouts or fast food employees.

Further assumption implies, that the effect on total employment will be structural and characterized by the balance of loses and gains from certain group of workers as long as the minimum wage earners are good substitutes. In this case, the total employment will negatively reflect the minimum wage increase. Furthermore, the size of the change of the minimum wage need to be considered as well, because proportionally, just small effect on total employment is more likely as long as the level of minimum wage is set low. The effect on low-wage workers

is higher and therefore it is reasonable to focus on this group, because the proportion of affected workers is higher. Therefore, studies focused specially on this group dominates in the minimum wage literature (Brown, 1999).

1.4 Monopsonistic Labour Market

The monopsonistic labour market, model assumes that firm faces labor supply curve, where the wage level *w* relates to the employment level *N*, therefore labor supply is denoted by N(w)or the inverse relationship w(N). This approach is more natural and less forced. Model takes into account the involuntary unemployment and employing as less than infinite phenomenon, moreover employers have market power over the employees.

However, Manning (2003) explains that are similarities with competitive model.² The increase of marginal revenue product of labor will lead as in the competitive model to increase of employment and wages. But the increase of labor supply, keeps the elasticity the same, so the employment will rise, but wages will fall. Monopsonistic model is more complicated with the minimum wage impact as it raises the average costs of labor, but on the other hand it lowers w'(N). So, the binding minimum wage in static partial equilibrium model of monopsony must increase the employment There is also simple model of dynamic monopsony where, the difference lies on short-run and long-run labor supply elasticities. Short-run elasticity holds

 N_{t-1} fixed and it is less elastic than long-run elasticity. (Manning, 2003).

Under the assumption that labor markets are monopsonistic, I already explained that it is not surprising that the minimum wage introduction or increase will not necessarily reduce employment. Therefore, monopsonistic theory is often called as a contrary prediction to

² See more: Manning, A., 1993, p. 31

minimum wage effect on employment. In a model of single monopsonist, the employment is maximized at market clearing level of minimum wage with the elasticity of supply curve $1/\epsilon$ and marginal revenue product elasticity $1/\eta$. This implies an log wage increase of $\epsilon \ln(1+\epsilon)/(\epsilon + \eta)$ and log employment raise $\ln(1+\epsilon)/(\epsilon + \eta)$ (Manning, 2003 p. 338-9).

Monopsonistic market always offers certain level of chosen minimum wage determined by employers' monopsony power where the effect on employment is positive. The positive effect results from partial equilibrium model of single monopsonist. However, because the minimum wage does not affect only a single employer, must be considered to which extent this assumption holds in general equilibrium model of oligopsony. (Manning, 2003, p.339).



(Source: Manning, 2003, p. 339)

The equilibrium with no minimum wage, each firm had determined employment by intersection of log marginal revenue product of labour (further denoted by MRPL) and log marginal costs of labour. Given that Manning (1993) can express mathematically

$$mcl_i = ln(1 + \varepsilon) + w_i = ln(1 + \varepsilon) + \theta w + \varepsilon n_i + b_i$$

where θ w is average wage, n_i is log employment and b_i is n₀ log employment for whole market. Considering that, the employment for firm *i* is given by

$$n_i = \frac{-\theta w - \ln(1+\varepsilon) + ai - bi}{\eta + \varepsilon} \equiv n(w, a_i, b_i)$$

and mathematically expressed function for wages

$$w_i = \frac{n \, \theta w - \varepsilon \ln(1 + \varepsilon) + \varepsilon a i - \varepsilon b i}{\eta + \varepsilon}$$

Both revenue shocks a_i and supply shocks b_i are positively related to wages, but revenue shock has negative effect and supply shock has positive effect on employment. In single monopsonistic model, the level of free wages and employment is below the perfectly competitive one. In model with assumed interactions between the companies, wages are below the competitive level but the employment effect does not have to be, because employment effect is wage effect multiplied by aggregate labor supply elasticity. (Manning, 1993, p. 338-342).

When the minimum wage is introduced, let's denote it w_m than Manning is explaining three possible stages firm can face. First, unconstrained level of employment will lie on supply curve and the wage paid will be above the minimum wage. Second, the supply-constrained firm has employment at the supply curve, the point where MRLP equals the minimum wage. The third and last one, demand-constrained firm pays also the minimum wage as well as the supply-constrained and the employment is on MRLP curve. This is illustrated on the picture below.



Figure 5. The three regimes for the impact of the minimum wage

(Source: Manning, 1993, p.343)

Manning (1993, p.345) concludes that in a case where deviations of employment from free market with high standard deviations of log wages may be desirable to have different minimum wages for different jobs. Brown (1999, p. 2108) explains that the employment for low-skilled workers, specifically undergraduate students can be increased with skillfully set minimum wage increase. Also, the minimum wage impact is more beneficial in a case where monopsonist has more power on the market as a whole. This is in contrast to theoretical explanations in textbooks which states that increase of the minimum wage always decreases employment. Moreover, when the minimum wage level is low enough does not increase employment in oligopolistic labor market. The most important conclusion is that, the minimum wage level is an empirical issue and findings should inform policy makers (Manning, 1993, p. 345-347).

2 Literature Review

The above-mentioned theory of minimum wage and its impact on the employment has simple and compelling prediction but there is no singularly agreed evidence that minimum wage reduces employment. Moreover, the analysis of minimum wages and its impact shows no or very little support of this negative effect. And opponents claim that it prevents exploitation and brings certain level of living standard.

Minimum wage in Europe is also seen as labor market institution which causes high and persistent unemployment. The role of minimum wage and the settings differs not only among countries, but also through the years. Freeman (1994) states that while in 1990, United States was maintained fixed nominal minimum and lowered the real wage floor effectively and with further increase consideration, The United Kingdom in 1993 abolished minimum wage for industries, European OECD countries fought unemployment with labor costs decreasing and East-Asian countries posed negligible minimum wage laws.

Most of the studies of impact of the minimum wage on employment are from United States or United Kingdom. Minimum wage opponents, for example Neumark and Wascher (2004) in their cross-national analysis for the period 1975-2000 found disemployment effects of minimum wage. But in many empirical studies, the negative effect of the increase of the increase of the minimum wage on total employment as suggested by theory has not been found. This is shown by results from Card (1992), who estimated the effect of minimum wage on young workers. According to his findings, there is no empirical support regarding to the employment effect on minimum wages. Moreover, he suggests that low-wage employers have certain degree of monopsony power, despite the fact that the markets contain large number of small businesses. One of the most influential cross-sectional time series studies, done by Katz and Krueger (1994) also shows no evidence that minimum wage increase reduces employment. From the latest meta-analyses studies, Boockmann (2010) concluded that minimum wage effect on employment is heterogeneous between countries. Even after controlling for country specific characteristics no significant results are found except negative effect on low-skilled workers.

Doucouliagos and Stanley (2009) re-evalute the empirical evidence of employment effect caused by minimum wage. The article confirms strong significant negative elasticities for employment, although they analysis doesn't support the evidence about adverse employment effect. Paper implies that the theory of competitive labor market is not adequate for US labour markets, especially for youth employment. Nataraj et. al. (2014) found strong negative effect on formal employment of women compared to men. But the article states that the results might not be generalizable between countries because of different labor market regulations.

Chletsos and Giotis (2015) in their meta-analysis analyzed 77 studies since 1992 and did not find the evidence on the employment measures. Manning (2016) also confirms that employment effect is ambiguous. Broecke, Forti and Vandeweyer (2015) found no or very small negative impact.

3 Minimum Wage Policy

This chapter describes first attempt for introducing the minimum wage policy in the world. History of the first implementation of the law and also current legislations across the European countries, specifically focused on countries used in the analysis.

3.1 The History of Minimum Wage Policy

The very first attempt to create a legislation for poor, a long time before the minimum wage law was in The United Kingdom, so called poor laws. Poor laws began with the Statute of Laborers in 1349 -1350 and preceded the reform of 1934. The reform was necessary for working and non-working people after the feudalism. During the feudalism, with state of slavery as almost two-thirds of the population, there was just a little need for regulations considering labourers or poor, because they were responsibility of their lord. However, with Industrial Revolution wages rose, freedom of workers increased and security for workers disappeared. (Quigley, 1996).

As a first government response to economic situation in the country and very first poor law was the Statues of Laborers in 1350. This law describes interconnection between the nonworking poor and workers. Regulation prohibits idleness, as well as paying high wages or quitting work. Wage regulation was a significant part of the Statue of Laborers. Within a year, the law was enhanced by an additional act, which strengthened the wages limitation specifically based on category and workers' mobility. The authority of employers was enhanced considerably as well as a balance of power against worker, furthermore beggars and vagrants were obliged to work if their health condition allows so. The wages considered the most were excessive wages and it was prohibited to accept them, because it could result in imprisonment. However, the Statue doesn't mention the punishment for masters who refuse to pay minimum wages. Employment and wages were set annually. Later on, with creation of workhouses, workers were often forced to agree with any wage workhouse offered (Quigley, W., 1996).

Quigley (1996) describes another successful reform, which was Speenhamland from 1975 which provided the supplementation of wages from so called local poor relief. Money was collected as a form of taxes. The reform provided new wage formula based on and tied to wheat price and number of family members. This was not literally the minimum wage as a binding minimum amount of payment workers must receive from employers, but it acted as a minimum wage since workers were authorized to receive minimum amount of payment which if they did not get from employers, they were substituted. This approach, as it turned out later, was not the best approach because employers kept the wages low and public funds costs increased a lot. Later on, in Speenhamland comes also suggestion of the minimum wage. But the only change in legislation was that poor relief became less attractive and taxation and subsidies centralized (Quigley, 1996, p.115).

The first statutory minimum wage legislation as such was introduced in 1980s in New Zealand as a part of the economic reform of 1984-95. This economic reform which has been implemented in July 1984, after the foreign exchange and constitutional crisis, and it has evolved to a one of the most comprehensive economic reforms of any OECD countries. Wage determination became centralized, introduction of statutory minimum wage for adults of 41 percent of the average ordinary-time wage and 24 percent for youth (Evans, et. al. 1996). In 1896 the legal minimum wage and wage boards for men and women in the Colony of Victoria in Australia were introduced. The Factory act was the crucial in the solving problem of labor competition of Chinese immigrant workers who generally earned lower wages and worked longer hours in expanding industries, such as laundry work, restaurants, market gardens, etc. The original legislation considered just women and children and later was extended to the adult

men as well (Lake, 2014). Both legislations introduced in New Zealand and Australia can be understood as a response to anti-slavery movements.

English law responded in 1909 by Trade Board to low level of wages for women in all industries (Douglas, 1919). The United Kingdom tried to introduce a statutory national minimum wage first time in mid 1960s to decrease rising inequalities between workers with different skill groups what could lead to highly unequal wage structure in the country. But the legislation came into effect after almost three decades after the proposal, in April 1999. However, there were introduced already minimum rates for workers' payments in some industries (Nijhuis, 2016). These earlier mentioned first legislations from New Zealand, Australia and England had been followed by the first serious consideration of implementing the minimum wage policy in United States, Massachusetts in 1911. (Douglas, 1919). And the United States first federal minimum wage law was passed in 1938 (OECD Observer, 2017). However, the minimum wage system in United States has two national and federal level and those doesn't have to be necessarily the same.

3.2 Minimum Wage Policies in European Countries

Minimum wages in the European countries were established along with other elements of labour market and industrial regulations in the wake of struggles and compromises resulting from historical process. There are various international and European agreements prescribing and discussing the fair and equitable wage and all of them are related to a decent standard of living and sort of adequate participation in a society. Schulten (2008) mentions in his paper United Nations Declaration of Human Rights from 1948, also European Social Charter of the Council of Europe from 1961, or EU Community Charter of Fundamental Social Rights for Workers from 1989. Council of Europe found a tool which could guarantee a decent wage its citizens and in 1970s proposed that the level of decent minimum wage should not be less than 68 percent of the national level of average gross wage with tax and benefits taken in to the account. Unfortunately, this framework never assessed because of missing framework which could assess the weight of compensatory factors, so Council of Europe was forced to abandon the benchmark and in the 1990s developed new threshold not considering gross wage but net. The new benchmark was set up at the level of at least 60 percent of the national level of average net wage (Schulten, 2008).

In first half of 1990s was created the first concept or a European minimum wage policy as a response to the fears that the adoption of European Single market might bring wage dumping and reduce workers' rights. However, the legislation was never introduced and legally binding and it could not mean introducing the same statutory minimum wage for all European countries, although this legislation might become open method of coordination where European Union creates a framework which is applied independently by national institutions.

The idea with setting up the minimum for payment come along with a launching a job search website in Germany. The website helped the employers to find workers willing to work at low pay rates, some of them well below the German average. Next outcome was exploitation of high unemployment.

In January 2017, twenty-two European Union countries have binding statutory minimum wage. The level of minimum wage varies considerably and also the proportion of employees earning the minimum wage vary across the countries. Germany, Scandinavian countries, Italy and Austria don't have binding national minimum wage, large part of work force is ensured by collective agreements and negotiated wage floors (OECD Observer, 2017).

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4 Data Analysis and Methodology

This study examines the effect of minimum wage level change on employment across European Countries. For this purpose, I use panel data and estimate regression with fixed effects, where the real minimum wage is a key explanatory variable and it is regressed on total employment rate as well as on the employment rate by three age groups, and lastly employment rate considering gender differences. Moreover, paper includes control variables as, unemployment rate in the country, recession dummy, measured by negative GDP growth as a business cycle variable and secondary school enrolment.

4.1 Data Description

The analysis covers 16 OECD countries, mostly countries of European Union. The countries covered are Belgium, Czech Republic, Estonia, France, Greece, Hungary, Ireland, Latvia, Luxemburg, Netherlands, Poland, Portugal, Slovak Republic, Slovenia, Spain and The United Kingdom. All countries comprised in dataset have statutory minimum wage and period observed in this sample is 2000-2015. Years 2016 and 2017 are not included in the sample, because there are missing latest data for some countries. The sample is an unbalanced panel with 256 observations. When it comes to countries, just 22 out of 28 EU member states have national minimum wage. Therefore, excluded countries are Austria, Cyprus, Denmark, Finland, Italy and Sweden because there is minimum wage on the national level. For example, in Cyprus, minimum wages theare set for specific occupations. In Austria, Denmark, Finland, Italy, Iceland as well as Norway, Switzerland and Sweden, the minimum wage are based on collective agreements for certain sectors. Furthermore, my dataset does not contain data for Germany, which was prominent representative of countries where wage is negotiated with industrial partners, but they introduced state minimum wage only in 2015. However, Italy have

not introduced the legislation despite of all the efforts in 2015, and even though they are one of the countries with grave problem with low earning workers.

Current level of national minimum wage in countries considered in my sample is enforced by law and usually applies to all employees in the country or at least the large majority of them. Minimum wages generally refer to monthly gross earnings, so earnings before the tax and social contribution is deducted. As I mentioned earlier, the level of the minimum wage varies widely across the European Union countries. The minimum wage changed considerably over the years across the countries of the European Union. Compared to 2008, the only country where the nominal level of minimum wage is now lower is Greece, the minimum wage decreased by 14%. Although, for some countries minimum wage raised significantly. For example, the minimum wage (expressed in euros) in some countries doubled, the rate increased by 109% in Bulgaria and by 99% in Romania. Additionally, some other countries recorded recognizable minimum wage increases, country such as Slovakia with 80% increase, Estonia has compared to 2008 now minimum wages higher by 69%, Latvia by 65% and minimum wages increase also in Lithuania by 64% (Eurostat, 2017).

Based on minimum wage in terms of their national gross monthly payments for The European Union countries, there are three main groups of countries. Eurostat (2017) divides countries to groups where gross national minimum wage at the beginning of 2017 is:

- less than 500 euros per month those are countries as Bulgaria, Czech Republic, Croatia, Estonia, Hungary, Latvia, Lithuania, Romania, Slovakia, and Poland. Where the lowest level has Bulgaria with minimum wage of 235 euros per month and the highest minimum wage has Estonia, 470 euros per month.
- in the range of more than 500 euros but less than 1,000 euros in this group are included EU member states as Greece, Malta, Portugal, Slovenia and Spain. The lowest level of

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the minimum wage in this group is 650 euros per month in Portugal and the highest gross minimum wage, 826 euros per month is in Spain.

3. the highest level of gross minimum wage in European Union member states, with the minimum wage more than 1000 euros per month – countries in this group are Belgium, Germany, France, Ireland, Netherland, Luxemburg and United Kingdom. The lowest level in this group is in United Kingdom, where the gross minimum wage is 1,397 euros and the highest level is in Luxemburg, where the gross minimum wage is almost 1,999 euros.

Countries included in my database are from each group considering the gross level in the minimum wage, but the higher ratio is in the first group with the lowest minimum wage. Another important view of the minimum wage when comparing countries is minimum wage expressed in purchasing power, the adjustment for price level differences reduces the variations across the countries and allows better comparison, because the gap between the countries is considerably smaller when PPP is taken into the account.

Based on division by Eurostat (2017), there are three groups of European Union member states comparing the gross minimum wage levels adjusted for purchasing power standards (PPS). This division differs from the previous one considerably. While in first division, the group with lowest level of the minimum wage included the most countries, when considering PPS, more countries fall into the middle group. Although, the country with the lowest and highest level of gross minimum wage is the same in both groups. Countries are divided to three groups where the national gross level of minimum wage at the beginning of the year 2017 adjusted for PPS is:

 lower than PPS 560 – Bulgaria, Latvia and Romania. The level ranges from the lowest PPS 501 in Bulgaria to the highest PPS 553 in Latvia.

- more than PPS 560 but less than PPS 1,050 countries in this group are Czech Republic, Croatia, Estonia, Greece, Hungary, Malta, Poland, Spain and Slovenia. The lowest level is PPS 625 in Lithuania and highest minimum wage is PPS 1,012 in Slovenia.
- higher than PPS 1,050 this group includes countries as Belgium, Germany, France, Ireland, Luxemburg, Netherland and United Kingdom. Their national wage levels range from PPS 1,236 in United Kingdom to the highest level of gross minimum wage adjusted of PPPs 1,659 in Luxemburg.

Relatively low minimum wage level countries tend to have relatively higher minimum wages when considering the PPS, because of their price level in the country is also low. The same holds for countries with relatively high level of minimum wage. The level of real minimum wages adjusted of PPS for each country for years 2000 – 2015 which is used in the model is illustrated below.



Figure 6. Real minimum wage level

(Source: OECD statistics)

As this paper focuses on employment by age groups, it is necessary to see the distribution of the low-wage workers for age groups. Unfortunately, the data sources in this area does not provide required level of information for this paper. But from the latest sources available (2014), the table below shows proportion of low-wage earners as a percentage off all employees divided by age. Statistics are from Eurostat and table below includes age group of low-wage workers aged 50 years old and more compared to low-wage workers as a percentage off all workers aged 30 years old and less.



Figure 7. Low-wage earners by age



For simplicity, let's call the age group < 30 young, and age group >50 older. The distribution of low-wage earners in countries in my sample vary significantly. In 2014, almost all countries have more young low-wage earners, only Estonia and Latvia have more older low-wage earners. There are also recognizable differences in ratios as well. While in Belgium just 1.12 percent of all employees are older low-wage earners, in Estonia it is more than 30 percent. The highest gaps among the age groups are in Greece, Netherlands and United Kingdom, where the proportion of young low-paid workers is much higher.

Main source of data for analysis is OECD database. To capture the effect of minimum wage change, I use statutory real annual minimum wages from OECD Earnings database.³ Wages are converted into a common annual pay period for which they are available. Furthermore,

³ See more: OECDstat, Real minimum wages.

estimates are deflated by national Consumer Price Indices (CPI) and converted into common currency unit (US) using Purchasing Power Parities (PPPs). All employment data, total employment rate and employment rate for various groups are from OECD Labor market statistics⁴. Model includes EFW index, representing hiring costs measured by labor market regulation and its level of strictness. The index represents Economic freedom based on 5 indicators such as Size of Government, Legal System & Property Rights, Sound Money, Freedom to Trade Internationally and Regulation. Economic Freedom rankings data are taken from Fraser institute's database⁵. Total unemployment rate data, as a percentage of total labour force are from OECD Labor market statistics, as employment statistics. Secondary school enrolment data are from Unesco Institute for Statistics (UIS.Stat), Education Statistics⁶. And lastly, recession dummy is based on negative annual percentage of GDP at market prices, using constant \$ 2010. GDP growth data are taken from World Bank⁷.

4.2 Model

The baseline of the model is inspired by one used by Christl, M., Köppl Turyna, M., & Kucsera, D. (2015). Model in this paper analyses the effect of the relationship between the minimum wage level and difference groups of employment rate. Model further estimates the relationship with workers' productivity and hiring costs. In order to contribute to the literature and to see more specific effect of the legislation, this thesis observes employment from various perspectives and sample data cover more years.

⁴See more: OECD (2017), Employment rate by age group (indicator). OECD (2017), Employment rate (indicator).

⁵See more: The Fraser Institute, Economic Freedom Rankings.

⁶See more: UIS.stat, Education: Gross enrolment ratio by level of education

⁷ See more: The World Bank, Data Bank – World development Indicators, GDP growth (annual %).

The effect of minimum wage is going to be observed for:

- 1. Total employment rate as a percentage of working age population.
- 2. Employment rate by age group as a number of people employed of a given age as percentage of total number of the people in the same age group.
 - 15-24 year olds
 - 25-54 year olds
 - 55-64 year olds
- 3. Employment rate for women and men as a percentage of people employed of a given group of total number of the people in the same group.

Additionally, model differ from one used by Christl, et. al. (2015) by not controlling for GRR gross replacement rate of unemployment benefits because of lack of data. The last difference is in the vector X of control variables, where model in this paper control for GDP growth instead of output gap also as a consequence of data availability. So as a business cycle control variable used in this paper is recession dummy, which reflects negative GDP growth of the country.

The model is following:

 $E_{i,t} = \alpha + \beta * MW_{i,t-1} + \gamma * MW^{2}_{i,t-1} + \delta * H_{i,t} + \zeta * AWP_{i,t} + \eta * X_{i,t} + \theta * S_{i,t} + \varphi * T$

Where

- $E_{i,t}$ denotes the employment rate in country *i* and at time *t*.
- MW lagged minimum wage at time *t*-1 for country *i*.
- H states for hiring costs measured by Index of Economic Freedom (EFW 5B index), based on strictness of labor market regulations.
- AWP is average productivity measured by GDP per hour worked for country *i* at the time *t*.

 variable X is vector or other control variables, such as secondary school enrolment and recession dummy. S and T are fixed effects for states and time.

For the analysis is used fixed effect panel regression which is often used by many empirical studies that focus on the effect of the minimum wage on employment. In this paper there is a multi-period panel and these methods allows for different intercepts for all units. Fixed effects is good for analyzing the impact of variables which vary over time, because of assumption that time-invariant characteristics for one country are not correlated with other country.

The table below summarizes descriptive statistics for all variables used for analysis in this study. Variables are defined later in this paper with the model description. The first part are dependent variables, total employment (TE), employment for three age groups (E1, E2 and E3), employment rate for men (EM) and employment rate for women (EW). In the second part is the key explanatory variable real minimum wage to average minimum wage ratio, so called Kaitz index. Minimum wages are lagged, because from the theoretical perspective employees need some time to adjust. Model includes also hiring costs (H) and average wage productivity (AWP). The last group represents control variables as unemployment rate (UR), recession dummy (REC) and secondary school enrolment (SSE).

Table 1. Descriptive Statistics

. summarize

Max	Min	Std. Dev.	Mean	Obs	Variable
77.18	48.8	5.526166	63.41288	248	TE
70.4	11.85	12.32099	32.35264	248	E1
86.78	61.33	4.859489	77.97452	248	E2
64.55	21.35	10.08351	42.96813	248	E3
71.53	39.9	6.575507	57.05784	248	EW
83.18	56.48	5.826011	69.80107	248	EM
23401.49	2055.43	6091.513	12680.26	256	RMW
60369	10173	12921.43	31469.01	256	AVW
.515	.202	.0646499	.3906094	256	MWAW
8.5	6.14	.4198884	7.390083	240	Н
134.07	61.72	10.06244	95.09446	256	AWP
27.47	2.25	4.887222	9.485249	248	UR
1	0	.3786	.172549	255	REC
164.81	85.88	13.01138	106.0032	238	SSE
5.48e+08	4224792	1.66e+08	1.98e+08	256	RMW2

5 Results

This section presents main findings concerning the effect of the minimum wage on employment for countries included in the sample. Before the analysis, I looked at the relationship between real hourly minimum wage and average hourly wage for all countries in the sample. The relationship between the variables showing quite strong and positive relationship as expected. It can suggest that the minimum wage have been adjusted in all countries trying to reach the effective level.



Figure 8. Relationship between real minimum wage and average wage

If we take a look at every country independently, we can see that average minimum wage in Netherland increased while the real minimum wage remained quite constant. Average minimum wage is steeper also for Ireland, Slovenia and Slovakia. See Annex 1.



Figure 9. Minimum wage to average wage ratio at the country level

The biggest relative increases between 2000 and 2015 occurred in Estonia, Slovenia, Poland and Latvia. The ratios are illustrated on the table above.

The table below shows estimations of the impact of the minimum wage on lagged employment, taking into consideration fixed effect for years and countries. Employment is considered for five employment groups, total employment, three age groups I mentioned above, and women and men. Using panel regression for the period 2000-2015 and results estimated for 16 European counties. The results for each employment group will be discussed independently. The results of the base model do not show significant relationship for total employment as predicted. See Annex 2. However, average workers' productivity and hiring costs have significant impact on employment. One unit increase in hiring costs' index decreases employment by 1.36 percentage point. Also, increase in average workers' productivity by one unit increases the total employment by 0.85 percentage points.

Variable	TE	El	E2	E3	EW	EM
RMW L1.	.00019635	.0018575	00025003	00172258	0003491	.00062305
RMW2 L1.	-6.949e-09	-9.055e-08	1.772e-08	6.688e-08	2.077e-08	-3.147e-08
Н	-1.3644082	-1.6630239	9167775	-3.1705399	-2.1178948	72399583
AWP	.08533756	21090832	.0704011	.47675729	.14540517	.02827456
REC	.28578373	34951854	.27144042	1.6616657	.704057	13805988
UR	66321164	-1.0102277	68223036	52010602	36148858	96706805
SSE	.00803251	02509131	00697638	.03373065	.01766757	0010745
_cons	69.632 4 13	71.377177	84.9645	30.50765	60.705379	79.970263

Table 2. Estimated results

Results based on this sample did not confirm the empirical evidence, according to which the young population is more vulnerable for job loss caused by minimum wage policy. See Annex 3. Estimations for young employment are statistically significant. For simplicity, let's assume that minimum wage increase annually by \$1000, then the employment for young people, according to data in my sample will increase by 1.8 percentage points. Although, hiring costs increase by one unit leads to employment decrease by 1.66 percentage points, and average workers' productivity increase by one unit leads to employment decrease by 0.21 percentage points.

When looking at employment effect for age group 25-54, only hiring costs and productivity is significant as well. For more details see Annex 4. After one unit increase of hiring costs, employment will decrease by 0.91 percentage points and one unit higher productivity will

increase employment. The employment group which this paper is focused more on, workers aged 55-64 years old is affected by minimum wage increase. If the minimum wage is increased by \$1000, the employment for older workers will decrease by 1.7 percentage points. This proves the hypothesis that minimum wage has negative impact on older workers. The results can be found in Annex 5. Moreover, with one unit increase of hiring costs employment for this group will decrease by 3.17 percentage points and with one unit higher productivity will raise employment by 0.47 percentage points.

Considering the effect of minimum wage on employment groups divided by gender, employment for men is positively affected by minimum wage increase, but model does not show any significant relationship for women employment. See Annex 6 and Annex 7. Hiring costs have in both cases negative effect, although the impact for men is stronger compared to women. Productivity has comparable positive effect on both employment groups.

Those results suggest that countries of my sample have the effective statutory minimum wage level, so the policy implication can ensure one of its equity goals, to ensure fair wages to workers.

Variable	KTE	KE1	KE2	KE3	KEW	KEM
MWAW						
L1.	19.541653	65.043694	7.1078028	-31.480485	32.952418	4.099607
MWAW2						
L1.	-24.738943	-71.914382	-5.6319859	13.08616	-47.903229	2523789
Н	-1.3272828	.20807165	-1.365847	-4.3652113	-2.7591862	0063112
AWP	.08752762	21472121	.07170239	.45949265	.14541253	.0281913
REC	.34319353	31292838	.37008207	1.5006083	.8360947	17741523
UR	67070093	-1.0164128	68928834	51947298	3810072	96136321
SSE	.00796642	03595776	0035783	.04052661	.02218957	0056008
cons	66.564918	50.704354	86.257987	41.889341	59.390006	75.260135

Table 3. Estimated results Kaitz index

Table above shows the same model, but the impact is analyzed on Kaitz index, so the impact is estimated on the minimum wage to average wage ratio, instead of on real minimum wage. The relationship between the minimum wage and average wage in countries of my sample is linear and positive (Figure 7.), therefore paper looks at these estimates as well. Even thought, the real minimum wage is adjusted for PPP and converted to the same currency, Kaitz index allow us to better cross-countries comparison. Although, Kaitz index can be endogenous, because as Card, et. al. (1993) suggest, high average wage can be associated with high employment.

Total employment is positively affected by Kaitz index, the minimum wage has impact also on younger workers and much higher compared to total employment. However, there is no significant effect on employment of middle aged, or older workers or men. There is significant and positive effect on women. For more detailed results see Annex 8. – Annex 13.

Hiring costs have negative impact on total employment, middle aged worker, older workers and women. Productivity is affecting positively the total employment, middle aged workers, older workers, men and women. The negative effect is on the employment of young workers.

Conclusion

The main purpose of this thesis was to estimate the impact of the minimum wage on different employment groups in European countries. First, the effect is estimated for total employment, then employment for three different age groups, workers aged 15-24, 25-54, 55-64 years old. The preliminary assumption was that the effect of the minimum wage is non-linear, so if the minimum wage is efficient, the results should show no effect on employment. Based on empirical findings from different studies, the assumption is that employment for young workers should be affected. Considering that impact on employment is found for low-skilled workers with low productivity, this paper assumes that minimum wage has impact on employment of the older workers at age 55-64, as well as on younger employees. For testing this hypothesis, paper includes 16 European countries for the period 2000-2015 using fixed effects regression. Furthermore, the impact is analyzed also for women and men independently. Assuming, that employment for women increases with minimum wage increase. The reason behind can be, that with higher wage more women are willing to work instead of staying at home.

The estimations resulting from the analysis the following policy recommendation could be proposed:

1. The minimum wage to average wage did not change significantly for some countries included in my sample. From these countries, Spain had traditionally low minimum wage level compared to other European countries with similar economy. Considering one of the purpose of the minimum wage, which is to decrease wage inequalities, and taking into account results from the estimations, this paper suggests also to increase minimum wage in countries with highest gap between real minimum wage and average wage, namely Luxemburg, United Kingdom, Belgium and Ireland.

- 2. The minimum wage rate recommended by European Union is 60% of the national average wage. France and Portugal have already minimum wage at the recommended level. Estonia, Czech Republic and Spain has the minimum wage currently around 40% of the median national wage, based on the results it can be recommended to increase the level of the national level of the minimum wage.
- 3. Despite considering the minimum wage adjusted to PPP, there are still big wage differences between the countries. National level of the minimum wage in each country should be set at the level which ensure that lower end of the earning distribution earns living wage, avoid exploitation of low-skilled workers and create incentives to work. At the same time, downward pressures cause by globalization and economic transformation in countries without significant negative effect on economy or employment. As paper mentioned earlier, the employment effect is ambiguous, each country must analyze their own labor market to find the effective level of minimum wage.

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Annexes:



Annex 1: Minimum wage and average wage, country level

Annex 2: Minimum wage effect on total employment

. xtreg TE 1.RMW 1.RMW2 H AWP UR REC SSE, fe vce(robust)

Fixed-effects (within) regression	Number of obs =	213
Group variable: Country1	Number of groups =	- 16
R-sq: within = 0.8018	Obs per group: min =	11
between = 0.4506	avg =	13.3
overall = 0.5011	max =	- 14
	F(7,15) =	34.96
corr(u_i, Xb) = 0.1943	Prob > F =	0.0000

TE	Coef.	Robust Std. Err.	t	P> t	[95% Conf.	. Interval]
RMW						
L1.	.0001964	.0004736	0.41	0.684	0008132	.0012059
RMW2						
L1.	-6.95e-09	1.65e-08	-0.42	0.680	-4.22e-08	2.83e-08
н	-1.364408	.6397577	-2.13	0.050	-2.72802	0007969
AWP	.0853376	.0396239	2.15	0.048	.0008812	.1697939
UR	6632116	.0535321	-12.39	0.000	7773126	5491106
REC	.2857837	.200511	1.43	0.175	1415955	.7131629
SSE	.0080325	.0151565	0.53	0.604	0242727	.0403377
_cons	69.63241	5.147896	13.53	0.000	58.65993	80.60489
sigma u	3.896253					
sigma e	1.1526043					
rho	.91953033	(fraction	of varia	nce due t	o u_i)	

Annex 3: Minimum wage effect on employment for worker aged 15-24

. xtreg E1 1.RMW 1.RMW2 H AWP UR REC SSE, fe vce(robust)

Fixed-effects (within) regression	Number of obs	=	213
Group variable: Country1	Number of groups	=	16
R-sq: within = 0.7995	Obs per group: min	=	11
between = 0.0068	avg	=	13.3
overall = 0.0276	max	=	14
	F(7,15)	=	99.46
corr(u_i, Xb) = -0.2983	Prob > F	=	0.0000

El	Coef.	Robust Std. Err.	t	P> t	[95% Conf.	Interval]
RMW						
L1.	.0018575	.0007834	2.37	0.032	.0001878	.0035272
RMW2						
L1.	-9.05e-08	2.81e-08	-3.22	0.006	-1.50e-07	-3.07e-08
н	-1.663024	1.594451	-1.04	0.313	-5.061516	1.735468
AWP	2109083	.0869921	-2.42	0.028	3963277	025489
UR	-1.010228	.1006641	-10.04	0.000	-1.224788	7956673
REC	3495185	.3396859	-1.03	0.320	-1.073542	.3745048
SSE	0250913	.0248039	-1.01	0.328	0779597	.027777
_cons	71.37718	8.866568	8.05	0.000	52.47853	90.27582
sigma u	12.78929					
sigma e	2.1744967					
rho	.97190378	(fraction	of varia	nce due t	o u_i)	

Annex 4: Minimum wage effect on employment for worker aged 25-54

. xtreg E2 1.RMW 1.RMW2 H AWP UR REC SSE, fe vce(robust)

Fixed-effects (within) regression	Number of obs	=	213
Group variable: Country1	Number of groups		16
R-sq: within = 0.8119	Obs per group: min	=	11
between = 0.5322	avg	=	13.3
overall = 0.6027	max	=	14
corr(u_i, Xb) = -0.1078	F(7,15) Prob > F	=	34.82 0.0000

E2	Coef.	Robust Std. Err.	t	P> t	[95% Conf.	Interval]
RMW						
L1.	00025	.0004353	-0.57	0.574	0011778	.0006777
RMW2						
L1.	1.77e-08	1.58e-08	1.12	0.280	-1.60e-08	5.14e-08
Н	9167775	.663063	-1.38	0.187	-2.330063	.4965077
AWP	.0704011	.0413222	1.70	0.109	0176751	.1584773
UR	6822304	.051599	-13.22	0.000	792211	5722497
REC	.2714404	.2238246	1.21	0.244	2056305	.7485113
SSE	0069764	.0132386	-0.53	0.606	0351938	.021241
_cons	84.9645	6.515909	13.04	0.000	71.07617	98.85283
sigma u	2.9682381					
sigma e	1.1482172					
rho	.86983676	(fraction	of varia	nce due 1	to u_i)	

Annex 5: Minimum wage effect on employment for worker aged 55-64

. xtreg E3 1.RMW 1.RMW2 H AWP UR REC SSE, fe vce(robust)

Fixed-effects (within) regression	Number of obs =	213
Group variable: Country1	Number of groups =	16
R-sq: within = 0.6684	Obs per group: min =	11
between = 0.0005	avg =	13.3
overall = 0.0665	max =	14
	F(7,15) =	26.34
corr(u_i, Xb) = -0.2626	Prob > F =	0.0000

E3	Coef.	Robust Std. Err.	t	P> t	[95% Conf	. Interval]
RMW						ίŋ.
L1.	0017226	.0013149	-1.31	0.210	0045253	.0010801
RMW2						
L1.	6.69e-08	4.44e-08	1.50	0.153	-2.78e-08	1.62e-07
н	-3.17054	1.892943	-1.67	0.115	-7.205253	.8641732
AWP	.4767573	.1035779	4.60	0.000	.2559862	.6975284
UR	520106	.0951012	-5.47	0.000	7228095	3174025
REC	1.661666	.7081552	2.35	0.033	.1522686	3.171063
SSE	.0337306	.0301638	1.12	0.281	0305619	.0980232
_cons	30.50765	15.00001	2.03	0.060	-1.464111	62.47941
sigma u	9.8413621					
sigma e	2.7114787					
rho	.92944532	(fraction	of varia	nce due t	:o u_i)	

Annex 6: Minimum wage effect on employment for men

. xtreg EM 1.RMW 1.RMW2 H AWP UR REC SSE, fe vce(robust)

Fixed-effects (within) regression	Number of obs	=	213
Group variable: Country1	Number of groups	=	16
R-sq: within = 0.9234	Obs per group: min	=	11
between = 0.2424	avg	=	13.3
overall = 0.4748	max	=	14
	F(7,15)	=	79.43
corr(u_i, Xb) = -0.0631	Prob > F	=	0.0000

EM	Coef.	Robust Std. Err.	t	P> t	[95% Conf	. Interval]
RMW						ŝ
L1.	.000623	.0004527	1.38	0.189	0003419	.001588
RMW2						
L1.	-3.15e-08	1.44e-08	-2.18	0.046	-6.23e-08	-6.84e-10
н	7239958	.6893506	-1.05	0.310	-2.193312	.7453203
AWP	.0282746	.0404159	0.70	0.495	0578698	.1144189
UR	9670681	.0552477	-17.50	0.000	-1.084826	8493104
REC	1380599	.1631275	-0.85	0.411	4857579	.2096382
SSE	0010745	.0079482	-0.14	0.894	0180158	.0158668
_ ^{cons}	79.97026	4.316096	18.53	0.000	70.77072	89.1698
sigma u	4.2053365					
sigma e	1.0208869					
rho	.94434739	(fraction	of varia	nce due t	o u_i)	
rho	.94434739	(fraction	of varia	nce due t	:o u_i)	

Annex 7: Minimum wage effect on employment for women

. xtreg EW 1.RMW 1.RMW2 H AWP UR REC SSE, fe vce(robust)

Fixed-effects (within) regression	Number of obs	=	213
Group variable: Country1	Number of groups		16
R-sq: within = 0.4668	Obs per group: min	=	11
between = 0.1788	avg	=	13.3
overall = 0.2190	max	=	14
corr(u_i, Xb) = 0.0211	F(7,15) Prob > F	=	9.92 0.0001

EW	Coef.	Robust Std. Err.	t	P> t	[95% Conf.	Interval]
RMW						
L1.	0003491	.0007216	-0.48	0.636	0018871	.0011889
RMW2						
L1.	2.08e-08	2.55e-08	0.82	0.428	-3.35e-08	7.51e-08
Н	-2.117895	.8959642	-2.36	0.032	-4.027597	2081923
AWP	.1454052	.0506166	2.87	0.012	.0375184	.2532919
UR	3614886	.070473	-5.13	0.000	5116981	211279
REC	.704057	.2936306	2.40	0.030	.0781981	1.329916
SSE	.0176676	.0251341	0.70	0.493	0359044	.0712396
_cons	60.70538	8.320748	7.30	0.000	42.97012	78.44063
sigma u	5.705514					
sigma e	1.6935649					
rho	.91902663	(fraction	of varia	nce due t	to u_i)	

Annex 8: Minimum wage effect on employment for total employment Kaitz index

. xtreg TE 1.MWAW 1.MWAW2 H AWP REC UR SSE, fe vce(robust)

Fixed-effects (within) regression	Number of obs	=	213
Group variable: Country1	Number of groups		16
R-sq: within = 0.8030	Obs per group: min	=	11
between = 0.4507	avg	=	13.3
overall = 0.5035	max	=	14
corr(u_i, Xb) = 0.1888	F(7,15) Prob > F	=	29.16 0.0000

TE	Coef.	Robust Std. Err.	t	P> t	[95% Conf.	Interval]
MWAW						
L1.	19.54165	13.07756	1.49	0.156	-8.332514	47.41582
MWAW2						
L1.	-24.73894	19.26101	-1.28	0.218	-65.79281	16.31493
Н	-1.327283	.6553194	-2.03	0.061	-2.724063	.0694974
AWP	.0875276	.026133	3.35	0.004	.0318265	.1432287
REC	.3431935	.1656605	2.07	0.056	0099036	.6962906
UR	6707009	.0548472	-12.23	0.000	7876051	5537968
SSE	.0079664	.0150261	0.53	0.604	0240609	.0399937
_cons	66.56492	5.375291	12.38	0.000	55.10776	78.02208
sigma u	3.8828094					

Annex 9: Minimum wage effect on employment for 15-24 Kaitz index

. xtreg E1 1.MWAW 1.MWAW2 H AWP REC UR SSE, fe vce(robust)

Fixed-effects (within) regression Group variable: Country1	Number of obs Number of groups	=	213 16
R-sq: within = 0.7726 between = 0.1919 overall = 0.2730	Obs per group: min avg max	= =	11 13.3 14
corr(u_i, Xb) = 0.1053	F(7,15) Prob > F	=	51.86 0.0000

E1	Coef.	Robust Std. Err.	t	P> t	[95% Conf.	Interval]
MWAW						
L1.	65.04369	28.667	2.27	0.038	3.941422	126.146
MWAW2						
L1.	-71.91438	41.26145	-1.74	0.102	-159.8611	16.03231
Н	.2080716	1.815845	0.11	0.910	-3.662311	4.078454
AWP	2147212	.0746845	-2.88	0.012	3739074	055535
REC	3129284	.3977909	-0.79	0.444	-1.1608	.534943
UR	-1.016413	.1273088	-7.98	0.000	-1.287765	7450605
SSE	0359578	.0272307	-1.32	0.206	0939985	.022083
_cons	50.70435	9.728295	5.21	0.000	29.96898	71.43972
sigma u	10.636993					
sigma e	2.3157647					
rho	.95474779	(fraction	of varia	nce due t	to u_i)	

Annex 10: Minimum wage effect on employment for 25-54 Kaitz index

. xtreg E2 1.MWAW 1.MWAW2 H AWP REC UR SSE, fe vce(robust)

Fixed-effects (within) regression Group variable: Country1	Number of obs Number of groups	=	213 16
R-sq: within = 0.8064 between = 0.6506 overall = 0.6719	Obs per group: min avg max	= =	11 13.3 14
corr(u_i, Xb) = 0.2569	F(7,15) Prob > F	=	33.46 0.0000

E2	Coef.	Robust Std. Err.	t	P> t	[95% Conf.	Interval]
MWAW						
L1.	7.107803	19.20912	0.37	0.717	-33.83546	48.05106
MWAW2						
L1.	-5.631986	25.2418	-0.22	0.826	-59.43362	48.16965
Н	-1.365847	.7709785	-1.77	0.097	-3.009149	.2774547
AWP	.0717024	.0290837	2.47	0.026	.0097118	.1336929
REC	.3700821	.1766634	2.09	0.054	0064671	.7466313
UR	6892883	.0488434	-14.11	0.000	7933955	5851811
SSE	0035783	.0146714	-0.24	0.811	0348496	.027693
_cons	86.25799	7.219689	11.95	0.000	70.86958	101.6464
sigma u	2.7275509					
sigma e	1.1651185					
rho	.84568651	(fraction	of varia	nce due t	co u_i)	

Annex 11: Minimum wage effect on employment for 55-64 Kaitz index

. xtreg E3 1.MWAW 1.MWAW2 H AWP REC UR SSE, fe vce(robust)

Fixed-effects (within) regression	Number of obs =	213
Group variable: Country1	Number of groups =	16
R-sq: within = 0.6634	Obs per group: min =	11
between = 0.0147	avg =	13.3
overall = 0.0700	max =	14
	F(7,15) =	53.04
corr(u_i, Xb) = -0.1666	Prob > F =	0.0000

E3	Coef.	Robust Std. Err.	t	P> t	[95% Conf	. Interval]
MWAW						7
L1.	-31.48049	36.94453	-0.85	0.408	-110.2259	47.26491
MWAW2						
L1.	13.08616	58.7461	0.22	0.827	-112.1282	138.3005
н	-4.365211	2.015187	-2.17	0.047	-8.66048	0699425
AWP	.4594927	.0607895	7.56	0.000	.329923	.5890623
REC	1.500608	.51224	2.93	0.010	.4087945	2.592422
UR	519473	.0942472	-5.51	0.000	720356	3185899
SSE	.0405266	.0330543	1.23	0.239	0299269	.1109801
-cons	41.88934	13.05278	3.21	0.006	14.068	69.71069
sigma u	9.5488298					
sigma e	2.7319514					
rho	.92433822	(fraction	of varia	nce due t	ou_i)	

Annex 12: Minimum wage effect on employment for men Kaitz index

. xtreg EM 1.MWAW 1.MWAW2 H AWP REC UR SSE, fe vce(robust)

Fixed-effects (within) regression	Number of obs	= 213
Group variable: Country1	Number of groups	= 16
R-sq: within = 0.9164	Obs per group: min =	= 11
between = 0.4187	avg =	= 13.3
overall = 0.5903	max =	= 14
	F(7,15) =	= 121.78
$corr(u_i, Xb) = -0.0755$	Prob > F	= 0.0000

EM	Coef.	Robust Std. Err.	t	P> t	[95% Conf	. Interval]
MWAW						
L1.	4.099607	15.00847	0.27	0.788	-27.89018	36.0894
MWAW2						
L1.	252379	20.24915	-0.01	0.990	-43.41242	42.90767
н	0063113	.8170395	-0.01	0.994	-1.74779	1.735167
AWP	.0281914	.0318874	0.88	0.391	039775	.0961577
REC	1774152	.1530861	-1.16	0.265	5037104	.14888
UR	9613632	.0639343	-15.04	0.000	-1.097636	8250905
SSE	0056008	.008587	-0.65	0.524	0239036	.0127019
_cons	75.26013	5.076056	14.83	0.000	64.44078	86.07949
sigma u	3.6921998					
sigma e	1.0662442					
rho	.9230239	(fraction	of varia	nce due t	:o u_i)	

Annex 13: Minimum wage effect on employment for employment women Kaitz index

. xtreg EW 1.MWAW 1.MWAW2 H AWP REC UR SSE, fe vce(robust)

Fixed-effects (within) regression	Number of obs	=	213
Group variable: Country1	Number of groups	=	16
R-sq: within = 0.4645	Obs per group: min	=	11
between = 0.1309	avg	=	13.3
overall = 0.1631	max	=	14
	F(7,15)	=	16.88
corr(u_i, Xb) = 0.0974	Prob > F	=	0.0000

		Robust				
EW	Coef.	Std. Err.	t	P> t	[95% Conf.	Interval]
MWAW						
L1.	32.95242	16.71148	1.97	0.067	-2.66725	68.57209
MWAW2						
L1.	-47.90323	26.37245	-1.82	0.089	-104.1148	8.308327
н	-2.759186	.9767582	-2.82	0.013	-4.841097	6772754
AWP	.1454125	.0301671	4.82	0.000	.0811129	.2097121
REC	.8360947	.2516215	3.32	0.005	.2997761	1.372413
UR	3810072	.0668218	-5.70	0.000	5234345	2385799
SSE	.0221896	.0268596	0.83	0.422	0350604	.0794395
_cons	59.39001	8.63458	6.88	0.000	40.98583	77.79418
sigma_u	5.9266844					
sigma_e	1.6971916					
rho	.9242105	(fraction	of varia	nce due t	o u_i)	