ERASMUS UNIVERSITY ROTTERDAM

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Bachelor Thesis Economics of Markets and Organizations

Minimum Wage Effect on Unemployment:

The effect of an increase in minimum wage on the unemployment rate in Europe

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ABSTRACT

The effect of the minimum wage is a heavily debated topic in labour economics. It is a very efficient tool to correct labour market failures. This thesis analyses the effects of the minimum wage on the unemployment rate in Europe. The research question is *What is the effect of the minimum wage on the unemployment rate in Europe?* This research composes a data sample of 14 European countries for the period 2000-2020. A fixed effects with an Arellano-Bond estimation is used, to measure the short run effects as well as the long-term effects. The empirical result does not show a significant effect of the minimum wage on the unemployment rate.

1.INTRODUCTION

Since the minimum wage has been implemented, there is a discussion about the effects it has on the economy. More specifically, the effects of minimum wage on unemployment, especially for workers near the minimum wage. Over a decade ago, in the United Kingdom, the Wage Council system was established. This provided many workers collective bargaining (Metcalf, 1999). Germany however only introduced a minimum wage in 2015. The discussion of the effect of the minimum wage is still undecided. One of the reasons for the introduction of the minimum wage was to improve the living conditions of the low-paid workers and keep employers from having too much market power (Machin & Manning, 1996). The theory explains that when a minimum wage is set above the market-clearing wage in a competitive market, this leads to a decrease in demand for labour and an increase in supply. In other words, lower employment, and higher unemployment. In a monopolistic labour market, firms set the wage and then hire workers. This theory leads to discussions on the negative effect a minimum wage has on employment. Some studies conclude that a rise in the minimum wage leads to lower employment (Maloney and Mendez, 2004). However, several studies have found different results, and there is no common ground on how the minimum wage reduces employment.

As research has advanced and become more empirical, there is an increase in evidence in developed countries that have suggested that a minimum wage has little to no effect on overall employment levels (Neumark and Wascher 1995; Slonimczyk and Skott, 2012). Studies from developed countries do not show a common conclusion about the adverse effect on employment (Baek and Park, 2016; Okudaira and Takizawa, 2019).

Since scientists keep conducting new research on the effects of minimum wage on unemployment, this subject remains scientifically relevant. This research will analyse the effect of the minimum wage on the total unemployment, while other studies focus on the effect of minimum wage on a particular group of workers. Brown et al. (1982) found a significant effect of the minimum wage on youth employment but could not find a significant effect on the total unemployment. This leads to the following research question:

What is the effect of the minimum wage on the unemployment rate in Europe?

This thesis examines whether this effect exists. To do this, a panel data of fourteen countries from 2000-2020 will be used, and a fixed effects model with an Arellano-Bond estimation will be done. Not every country has a minimum wage, so only the countries which implemented a minimum wage will be considered. The aim of this research is to clearly show different observed effects of the minimum wage on unemployment.

In the first section, the existing literature on this topic will be reviewed, and the theory of a minimum wage in competitive labour markets and monopsony will be explained. Also, empirical studies will be discussed. The second section presents the data and methodology, where the fixed effects test with an Arellano-Bond estimation and the models will be discussed. The third section will consist of the results, followed by a conclusion and discussion, with limitations and suggestions for further research.

2.THEORETICAL FRAMEWORK

The minimum wage was implemented to prevent employers from having too much market power. Market power gives the possibility to depress wages. This negatively affects workers. The minimum wage is an anti-poverty tool to protect lower-paid workers and the younger people. Implementing a minimum wage is a form of social protection. There are varied reasons why a minimum wage is a preferred tool for this social protection (Dolado et al., 2000). First, it does not have budgetary consequences for the government. A minimum wage does not directly lead to more borrowing in the public sector or higher taxes, except in countries where the minimum wage is linked to the unemployment allowance. Secondly, it creates a greater incentive to work as the reward has increased. On the contrary, implementing a minimum wage might negatively affect human brain capital development, as people might drop out of school to work for a minimum wage pay. A third reason a minimum wage can be preferred, is because it is administratively simple. A minimum wage is easy to control. Lastly, it establishes the right social cost of labour. There is a need for a minimum wage, as it rewards the people who work. This way, many people agree with this policy, making it easier and not as controversial.

2.1 Standard economics model

From a standard economic view, minimum wage policies are associated with negative outcomes. The effect of the minimum wage on employment depends on the competitive structure of the labour market.

2.1.1 Competitive model

In the competitive model, labour demand and labour supply cannot affect the wage. The market outcome is therefore an equilibrium wage, as seen in point *A* in figure 1. Here, there is no unemployment. Workers with a desired wage, the lowest wage to the wage in the equilibrium, can work, while others choose to not participate in the labour market. An introduction of a minimum wage (*w*) increases the participation of workers in the labour market as seen in point *C* in the figure. Yet, there will be a decrease in the number of workers demanded. This is point *B* in the figure. This results in a rise of unemployment (*U*), while the employment has decreased from *L** to *Ld(w)*. Here, a welfare loss is created. The standard model of competitive labour markets thus indicates that a higher minimum wage increases the unemployment of low-skilled workers (Neumark, 2015).

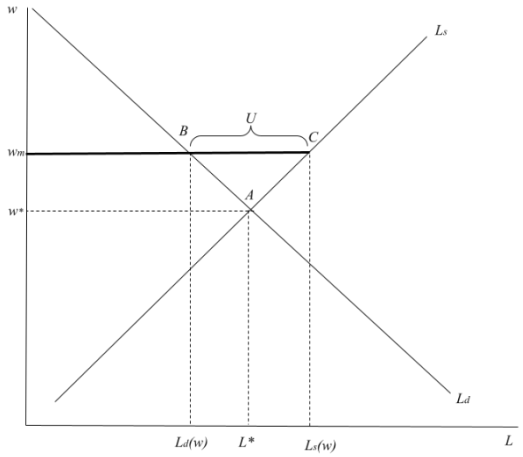

Figure 1 Perfectly competitive market with and without a minimum wage.

In this scenario, the low-skilled workers might be more expensive now than the minimum wage. This is not efficient. These workers do not generate more than the minimum wage, so the firm does not make any profit from these workers. One way for a firm to deal with the reduced profit of the minimum wage increase is to implement a rise in the price. By implementing a higher price, the demand will decrease (Lee and O'Roark, 1999). Less people are needed for the production, so people will get fired. A low-skilled worker will get fired sooner than a high-skilled worker, as their productivity is lower. Implementing a higher minimum wage, may either improve the productivity of a low-skilled worker, as they are afraid, they might lose their job, or they do not increase their productivity and face the chance of getting fired (MaCurdy and McIntyre, 2001). Low-skilled workers could be substituted for equipment or capital sometimes. Both of these scenarios bring back the company to the equilibrium where the marginal revenue is equal to the marginal costs. When a low-skilled worker increases productivity and the demand stays the same, fewer people are needed in a firm, so unemployment increases (Lechthaler & Snower, 2008). Now, high-skilled workers will be even more desirable than before and there will be a substitution effect (Neumark, 2015). In this case, there will be a labour-labour substitution, as a high-skilled worker will replace the low-skilled worker. The effects for employees differ. First, the highly skilled group. These employees generate more revenue for the firms than they earn, which means the revenue they generate is at least the minimum wage. A high-skilled worker will not notice any big effects when a minimum wage is introduced, as the firm would want to keep them. Only the low-skilled workers will be fired. From a policy perspective, this is not ideal. Minimum wages are intended to help the low-skilled workers. Yet, employers will hire more high-skilled workers and fewer low-skilled workers, having an undesired effect. One more consequence of implementing a minimum wage is that firms will choose to take their labour to other countries where the wages are lower (Machin & Manning, 1996). This is to cut down the costs, but it will also affect the employment in a country negatively. When a firm decides to stay in a country, a solution might be reducing the number of hours worked by employees. This leads to more unemployment, as production will decrease and less workers will be needed (Pindyck & Rubinfeld, 2009).

2.1.2 Monopsony model

Another extreme situation is the situation in a monopsony. In this case, firms do have market power. An assumption made is that there only is one buyer of labour and there are several sellers of labour. This way, the single buyer has the power to set the wages to a certain limit. When a monopsony situation exists, there will only be one firm in the labour market. The firm only hires workers below the competitive level. This is shown as point *C* in figure 2. Monopolistic firms earn non-competitive rents in this situation. This creates an incentive for other firms to enter the market, but this does not happen due to high entry fixed costs. Here, the monopoly firms set the employment level below the competitive equilibrium, so they can pay lower wages.

When a minimum wage is introduced, the minimum wages will become ambiguous (Neumark, 2015). The firm will have to increase the wages for all workers, as all of the workers are employed in the firm. The employment of the firm will increase until the marginal costs match with the marginal value of workers, to reach the optimal level of employment. This will lead to an improvement in market efficiency, until point *A*. At this point, the minimum wage has led to the most efficient level possible. Beyond this competitive wage, a minimum wage will increase unemployment like it would in a competitive model. When looking at the efficiency of setting or increasing a minimum wage, it might be desirable for firms to have some monopoly power over the workers, as this increases employment.

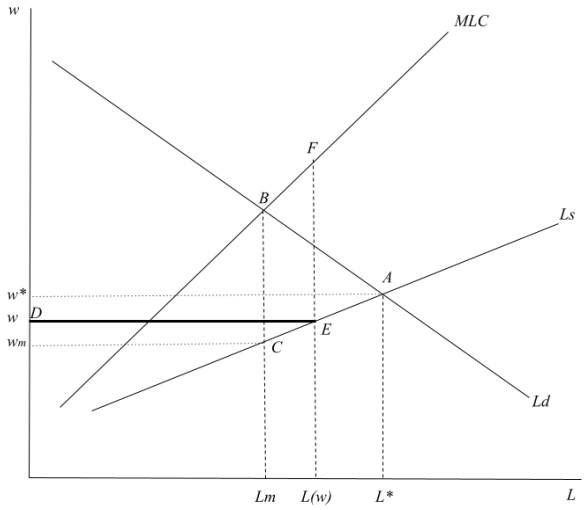

Figure 2 Monopolistic market with and without minimum wage.

An effect of the implementation of a minimum wage is that the firm is forced to set a higher wage. The level of employment will increase, and this brings it closer to the competitive model. This results in positive effects on the supply side of the market (Flinn, 2010). It is possible for a monopolistic firm to

still earn positive profits when the minimum wage is not set too high. Yet, there can also be a negative consequence, while some companies might exit due to the reduction in profits.

Both models conclude different outcomes of an increase in the minimum wage. But as both might end up with an increasing unemployment rate when the minimum wage increases, the following hypothesis is formed:

A minimum wage increase leads to an increase in unemployment

When a firm does not have market power over the workers, like in the competitive model, one would assume that the hypotheses will not be rejected and there will be a significant increase in the unemployment rate. On the other hand, when in a monopolistic market, a firm has power over its workers and the effect of the minimum wage will be negative. This will lead to a rejection of the hypothesis and indicates that the European labour market is more aligned with a monopolistic model, where there is a certain market power.

2.2 Factors of unemployment

According to Bartolucci et al. (2017), the GDP growth has a significant effect on the unemployment rate. The theory behind this, is stated in Okun's law (Prachowny, 1993). This law states that there is a negative correlation between the GDP growth and unemployment. When there is an increase in GDP growth, the economy is improving, with a higher demand for products. With the increasing demand for products, the production will increase. Therefore, more workers are needed, which will decrease unemployment. Schubert and Kroll (2016) also investigated this relationship and assumed an autocorrelation between the unemployment rate and the GDP growth. The people who are unemployed, do not produce goods nor services, so they do not increase the GDP growth. When unemployment increases and thus employment decreases, less people contribute to GDP growth. Therefore, both variables affect each other.

An increase in the GDP growth does not only decrease the unemployment, but the vacancy rate will also increase (Romer, 1990). Due to the increase in demand for goods, firms will expand, and new firms will entry the market. In both scenarios there will be an increase in demand for labour. The competition between employers will increase, as both firms want to attract qualified workers. To attract workers and to keep them, the wages for the workers in the firm will increase (Card & Krueger, 1994). Firms might also consider investing in the skills of workers (Acemoglu & Autor, 2011). This leads to more training. People can be hired and trained to fit the role which is needed in the firm. When labour demand is increasing, people with different skills or background will also be hired more easily (Challier, 2016). As more people can get work, as well as the underprivileged people, this can result into a more equal division of income and chances.

The GDP growth is affected by the implementation of the minimum wage. When a minimum wage is implemented, workers have a higher income which they can spend more freely. There is a greater demand for products and people put more money into the economy, which increases the GDP growth (Sitompul & Simangusong, 2019). It is therefore important to take this factor into account in this analysis.

Not only does an increase in demand for goods lead to an increase in GDP growth, but it also leads to an increase in inflation. Because of the increase in minimum wage, and therefore the increase in income, workers can spend more. This increase in demand leads to inflation. The minimum wage thus influences the inflation in a country. Inflation also influences the unemployment rate, according to the Phillips-curve (Fuhrer, 1995). An improvement of the economy leads to more demand from consumers. Because of this greater demand in products, the production increases to keep up with the demand. More workers are needed, leading to a decrease in the unemployment rate.

Inflation thus increases the employment a lot through the extra demand, but sectors will also have to deal with higher prices. Not only might they also increase their prices, some firms will go bankrupt as they can not bear the higher costs (Card & Krueger, 1995). It is not always possible to include the extra costs in the price. This leads to more unemployment and a decrease in growth in this sector. However, as most of the firms can use the inflation to ask higher prices when the demand increases, this effect will not compensate fully for the extra demand, and inflation will still have a negative effect on the unemployment.

Inflation does not only influence the unemployment rate. As the prices increase and inflation occurs, employees will demand higher wages to keep up with these prices. When they do not get a raise, their purchasing power will decrease. An increase in wages, also results into inflation and these two variables might keep on rising each other (Katz & Dickens, 1987) . Inflation will be the first variable to increase, and the wages will follow. This might take some time as this is a lagged effect. As inflation increases first, the purchasing power will stay behind (Fischer, 1981). This decreases the standard of living, having negative effects on the goods consumed as the demand to goods decreases.

Sometimes, the inflation goes up too fast. To tackle that problem, an instrument is necessary to decrease the spendings of consumers. The interest rate can be used to flatten the curve. When there is an increase in the interest rate, people start saving instead of consuming and lending. When the demand decreases, this leads to a decrease in the inflation rate. Hence, there is a negative relationship between the interest rate and the inflation rate. This also means there is an indirect effect of the minimum wage on the interest rate, as an increase in the minimum wage results in more spending and higher prices. The reaction to the higher prices results in an increase in the interest rate (Glover and Mustre-del-Rio, 2021). When people consume less due to a higher interest rate, the demand decreases. This leads to a reduction in

production, where less people are necessary. This leads to an increase in the unemployment rate (Bartolucci et al., 2017). Interest thus has a positive effect on unemployment.

The interest rate does not only affect the consumer, but firms might depend their decision to invest on the interest rate (Chirinko & Schaller, 2009). When the interest rate is low, loans are less expensive for firms. This gives better opportunities to invest in new projects, like innovations or expansions. This will also lead to more employees and decreases the unemployment. So, the interest rate affects the labour market with an decrease in investment when the interest rate increases.

When the government wants to reduce unemployment, an instrument which they can use is public labour market policies (Jackman et al., 1990). Here, the government spends money on the labour market with the aim to decrease unemployment in forms of training programmes. Countries which implemented these policies seem to have less unemployment and experience a bigger reduction in unemployment when the number of vacancies rises compared to countries which do not spend money in the active labour force. These policies speed up to the adjustment to the equilibrium. By training workers, it is possible to retrain them into a career where many people are needed. This way, the public labour market policies reduce unemployment. It also gives them the opportunity to change sectors within the economy more easily and have better career prospects (Filomena, 2023). For disadvantaged groups, the effect might even be bigger. Through redistribution measures, all kinds of people have the same chances (Light & Munk, 2018). As all kinds of people have access to these trainings, the inequality on the labour market will decrease and people will get the same chances. An introduction of the minimum wage, however, might discourage taking training (Lechthaler & Snower, 2008). For many low-skilled workers who lack skills and experience, a minimum wage set by the government is higher than the wage they would earn otherwise. Workers are more likely to take a job, instead of taking a training, as the benefits of the work are now higher. This makes them less encouraged to take training.

For job policies, the vacancy rate is considered through which it has an indirect effect. However, the vacancy rate affects the unemployment rate directly as well. Lang & Khan (1998) found that the higher level of vacancies in the labour market, leads to a higher likelihood of finding a fitted job to the unemployed person. This leads to a reduction in the unemployment rate. The vacancy rate is also correlated with the public labour market policies, as these trainings ensure a person is more fit for the job vacancy. When a minimum wage is implemented, more and better workers will apply, also for a low-wage job with a high vacancy rate (Drazen, 1986). On the other hand, a minimum wage makes workers more costly, leading to more production costs (Hall & Kudlyak, 2022). As explained earlier, a possibility for a firm to deal with these increased costs, is to reduce the number of working hours. A firm is less likely to want more people to work in the firm and may decide to not put out a vacancy. This leads to a decline in the number of vacancies.

When the vacancy rate is relatively high, there are only a few employees available who are fitted for a particular job. To get the best candidates for a job, a firm might offer higher wages to get the best workers (Blanchard & Katz, 1997). This also means there will be an increase in competition between different firms, as all firms want the few high-skilled workers. This leads not only to a higher wage, but also to better working conditions. If firms have difficulties with finding the right workers, a firm might decide to innovate and improve the productivity, to reduce the number of workers needed (Syverson, 2011). Workers with ambition might see an increase in vacancies as an opportunity to start their own business, as this gives them more freedom and often a higher wage, resulting in more economic growth (Audretsch et al., 2006).

What also leads to a decline in the number of vacancies, is the strictness employment protection. Various research has been done to the direction of the effect of employment protection on the unemployment, but results show wide variation. This can also be because employment protection is tested in different countries and different time periods (Heimberger, 2020). The purpose of the employment protection is to protect existing jobs (OECD, 1999). It limits the firms' ability to fire workers, consisting of the costs which are related to hiring and firing workers (Venn, 2009). But it also reduces the re-employment chances of unemployed workers, leading to long-term unemployment. When hiring an employee, the likelihood of the occurrence of firing costs will be considered. With an increasing strictness employment protection, this leads to more pressure. So, the strictness employment protection results in a reduction of the inflows to unemployment, but it also makes it more difficult for people who are looking for a job to find one.

Strict employment protection is a policy implemented by the government to improve the work circumstances of employees (Young, 2003). This has its similarities with a minimum wage. Both policies will not be fully implemented at the same time, but a payoff will be made between the two measurements. Therefore, more strictness employment protection is less policies regarding minimum wage, meaning a negative relationship between the two. A stricter employment protection will weaken the unemployment effect of the minimum wage (Neumark & Wascher, 2004). The strictness employment protection also leads to an overall improvement of the conditions near the minimum wage as it increases bargaining power (Belot et al, 2007). Strictness employment protection increases the unemployment, but it also improves the job security (Lindbeck & Snower, 2001). As firms need to put in more effect and need to pay higher costs when someone gets fired, it is harder to fire someone. People who already have a job, might also be tempted to stay at the place they work, while it is harder to find another job, leading to more unhappy workers (Boeri & Jimeno, 2005). This however leads to less flexibility on the labour market (Acemoglu & Shimer, 2000). It makes it harder for employers to change their staff when different circumstances occur, like technical improvements.

2.2.3 Putty-clay model

Aaronson et al. (2018) used the putty-clay model to study the effect of minimum wage policies on employment levels, leading to both a scale and substitution effect. The model looks at how the minimum wage affects the employment by replacing labour with capital. In this model, an assumption holds that there is free entry, and the expected profits are zero. Employers strive to have maximum profit, while the employees want to have the highest wage possible. Putty are the factors which can be easily replaced, while clay are factors that are harder and more expensive to implement. When there is an increase in minimum wage, this leads to higher labour costs. This will be passed on to the customers in the form of a price increase. This leads to less sales and the firms needing less input, which causes a fall in the employment of minimum wage workers. This phenomenon is also known as the scale effect. A minimum wage makes companies lose out on low-skilled workers. This causes firms to substitute workers for cheaper factors of production and more capital-intensive firms will occur. New technologies and machines are implemented to replace the labour. This substitution effect can also have a negative effect on employment, as fewer employees are needed (Aaronson and French, 2007). As some jobs are taken out, it increases unemployment. This effect is even bigger in sectors which are very labour-intensive and sectors where it is relatively easy to replace labour with capital. Here, the labour costs are a greater part of the total costs. This model is built to help decisions made by policymakers for the long run.

2.2.4 Partial equilibrium model

The partial equilibrium model of the labour markets looks at the relationship between wages, employment and the incentives for employers and employees (Neumark and Schweitzer, 2004). This model examines the effect of minimum wage changes on employment levels, taking the supply and demand dynamics into account. It assumes that both groups make rational decisions, where employers want to maximize profits and workers want to get the highest wage possible. When the minimum wage increases, workers who used to get the minimum wage, now get a higher wage. This may lead to different decisions in labour supply. On the one hand, people might choose to work more as their income has increased. This is also known as the income-effect. Working more now also pays more. Other people might decide to cut down in working hours, as they now have the same wage with less hours. This is known as the substitution-effect. When people decide to work more hours, less people are needed in the firm, leading to more unemployment. But when people work less hours, a firm might need to increase the workers in the firm. Which effect weighs the most, depends on the sector and the industry a firm is in. Sectors that are most sensitive to minimum wage changes will be affected the most. Using these two effects by analysing the effect of minimum wage, a more complete picture of the reaction in the labour market can be analysed.

2.4 Empirical studies

The first empirical study was by when Brown et al. (1982) in the 1980s. He stated that a minimum wage increase reduces employment. It was a small but a significant negative effect of the minimum wage on unemployment in the US.

Then, Card and Krueger (1994) came with an extraordinary result for that time. Their article was related to the impact of the minimum wage increase on employment for fast food restaurants in New Jersey in 1992. The results were not consistent with the competitive models. There were no signs of negative employment effects. The research was based on a Difference-in-Difference approach, where the constant minimum wage from New Jersey and Pennsylvania were analysed. Different research (Card 1992; Katz and Krueger 1992; Card, Katz and Krueger 1994) has all found that a minimum wage has positive effects on employment or no effect at all.

Neumark and Wascher (2000) replicated the study of Card and Krueger. They decided to use payroll data instead of time-series analysis and panel data analysis. The results are the opposite of the study Card and Krueger did. They found a significant decrease in employment in New Jersey and a reduction of hours worked. An advantage of panel data analysis is the different wages which are considered. Neumark and Wascher claimed these differences in results between them and Card and Krueger could be errors in estimating the time-series analysis. In 2007, Neumark and Wascher brought up that it can take some time for a minimum wage to influence employment, which might lead to different results.

A study done by Michel and Cahuc (1996) looks into the model of the minimum wage, economic growth and unemployment. The minimum wage can have a positive effect on the growth rate by causing human capital accumulation. A lower demand for unskilled labour caused by a minimum wage, can create an incentive for workers to gain their human capital.

In the UK research has also been done concerning this topic. Stewart (2004) used a Difference-in-Difference approach. He found out that employment is not adversely affected with an introduction or a rise of the national minimum wage. The new minimum wage is like the U.S. minimum wage. Dolton et al. (2012) also looked at these effects and took inequality into account. The effects on employment are positive or negative depending on the different methods used. The negative effects of the new minimum wage are mostly found when there is a difference between low and high skilled workers, where the new minimum wage negatively affects the low skill workers (Neumark, 2015). They stated that a higher minimum wage pushes low-skilled workers out of the labour market, as higher skilled people will be hired more. This results in fewer jobs for low-skilled workers, while the new minimum wage was implemented to help them (Neumark, 2015). According to de Linde Leonard et al. (2014), by implementing an adjustment to the minimum wage when the employment is high or the expectations are to increase, policy makers can minimize the employment effect.

In Germany, the minimum wage was introduced more recently. Bossler and Gerner (2016) used a Difference-in-Difference comparison of the affected and unaffected groups for the minimum wage, which was introduced in 2015. They found out that the establishment of the minimum wage led to an increase in unemployment.

Another significant effect was also found in France by Bazen & Cardebat (2001). In France, the inflexibility of the French labour market is blamed for the high unemployment. More recently, Aeberhardt et al. (2015) measured the spillover effect for two years, when changes occurred in the minimum wages in the French labour market. These results in an increase which cover a big part of the French wage distribution. The minimum wage is either pushing out the low productivity workers, or attracting individuals who used to be unemployed, as the minimum wage did first not meet their desired wage.

Dolado et al. (1996) did research investigating the effects of a minimum wage in four different European countries. In these countries, mixed results occurred for every country. They concluded that the effect of total employment and the effects on youth employment are not similar. In Spain, the minimum wage effect was negative on youth employment, but positive on employment for adults, which cancelled out each other. This is aligned with the findings from Brown et al. (1982), as both concluded that the minimum wage does not cause an increase in the total unemployment in Europe.

3.DATA

For testing the main hypothesis empirically whether a relationship exists between the minimum wage and the unemployment rate, a data sample is created from 14 European countries for the period from 2000 to 2020. The data used in this research is offered by the OECD and Eurostat. It contains information about the unemployment rates, minimum wages, GDP growth rates, inflation rates, interest rates, public spending on labour markets, vacancies and the strictness employment protection. Europe is chosen, as there is more data available for these countries, so more variables can be tested. Initially, the dataset included more countries, but these were dropped from the sample due to insufficient data. This gives a total of 294 observations. The counties are shown in table 1.

Table 1 European countries

Belgium (BEL)	Spain (ESP)	Greece (GRC)	Luxembourg (LUX)	Portugal (PRT)
Czech Republic (CZE)	France (FRA)	Hungary (HUN)	Netherlands (NLD)	Slovenia (SVN)
Germany (DEU)	United Kingdom (GBR)	Ireland (IRL)	Poland (POL)	

3.1 The dependent variable and independent variable

Data on minimum wages is available on the OECD website for countries where the minimum wage is set by collective agreements or agreements that cover whole sectors or activities (Stancanelli et al., 1998). In this case, the minimum wage measure is defined as the ratio of the nominal value of the minimum wage to the average wage of full-time employees. It is intended to capture the extent to which a minimum wage clashes with the wage distribution (Neumark and Wascher, 2004). By taking this variable, the variation in the relative prices is captured between the low-skilled workers and the more-skilled workers.

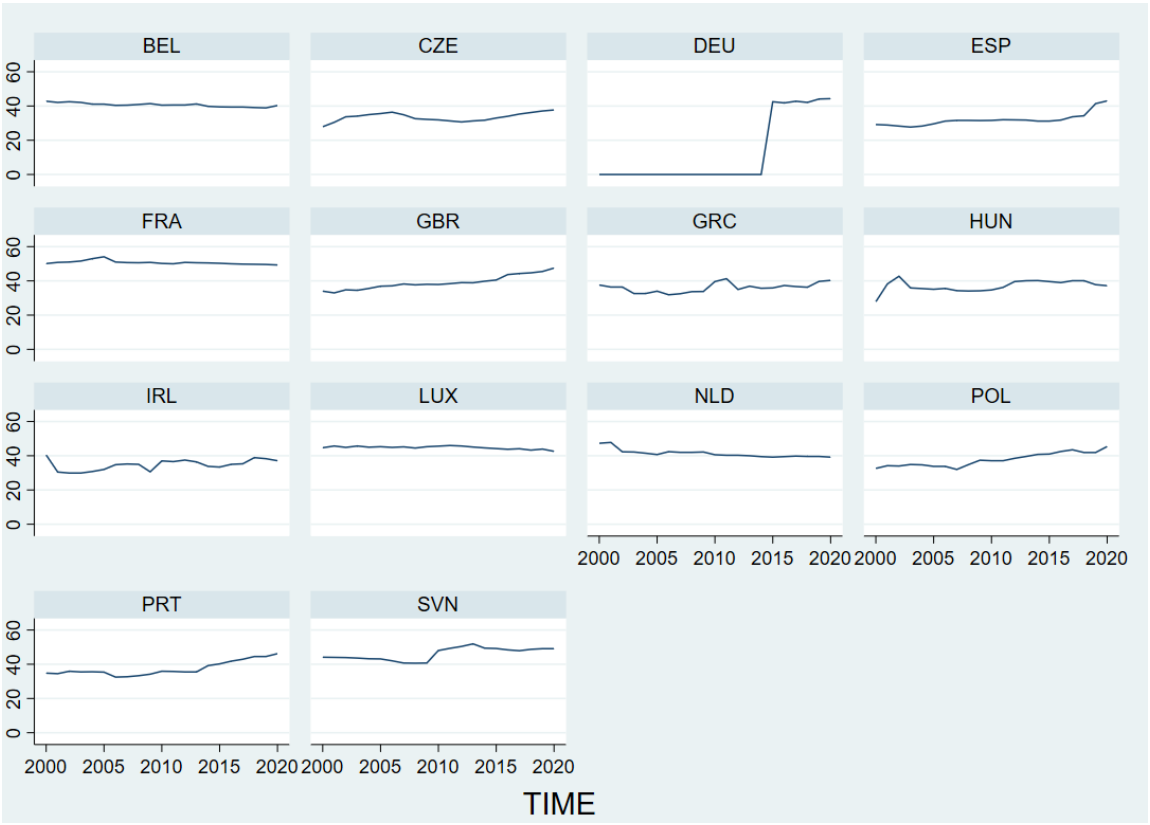

Figure 3 Trend of the minimum wage ratio per country from 2000-2020

Figure 3 shows the trend of the minimum wage ratio for each of the studied countries. It can be noticed that the highest percentage of the minimum wage during the whole period was in the northwestern part of Europe, where the percentage was steadily above 40%. Germany only implemented a minimum wage in 2015. This explains the sudden increase.

The dependent variable in this research will be the unemployment rate, which is also collected from the OECD. Unemployed people are without work but are available and have taken specific steps to find work. The unemployment rate is measured as a percentage of the labour force. The labour force is the number of unemployed people and the people in employment. The absolute number of unemployed workers in each country is not sufficient as a measure of the pressure the minimum wage has on a market. Instead, the relative population of the unemployed workers as a measure to analyse the impact of unemployment, will be a more useful measure. This measure normalizes the presence of unemployed workers in the labour force by the size of the labour market. This gives larger markets a better opportunity to accommodate more unemployed workers.

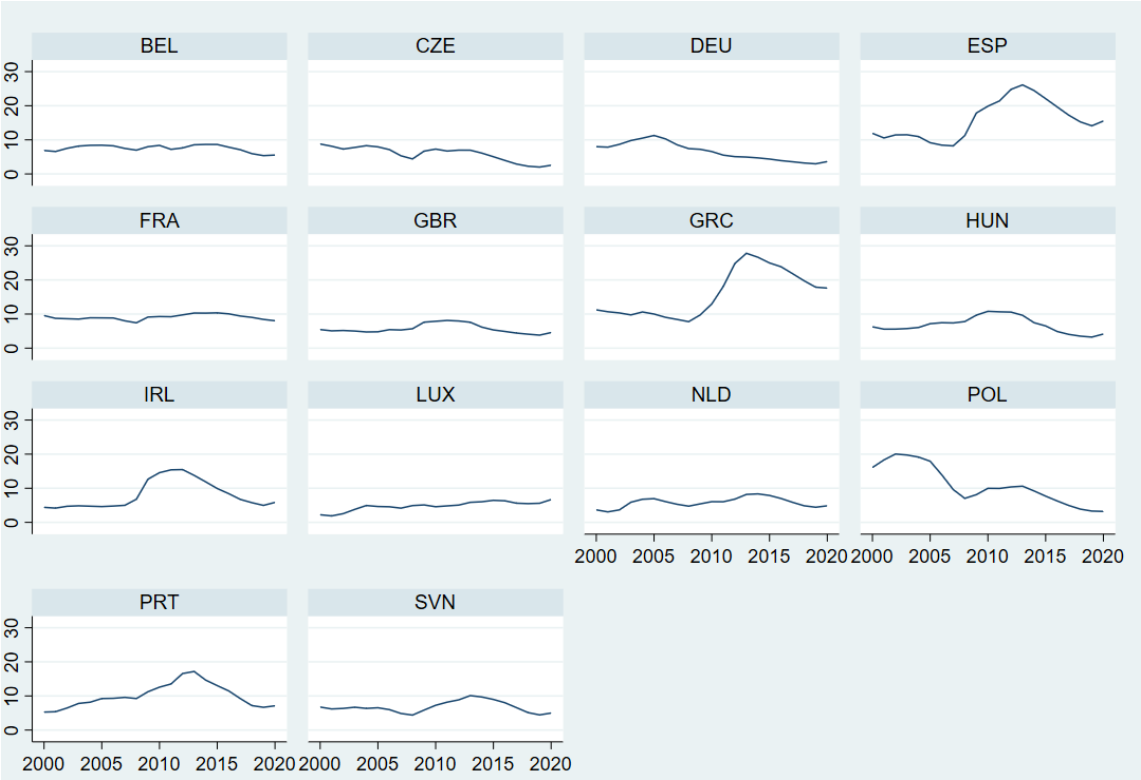

Figure 4 Trend of the unemployment rate per country from 2000-2020

Figure 4 shows the trend of the ratio for each of the studied countries. By analysing this figure, it can be noticed that southern Europe is the region with the highest percentage of unemployed workers in the labour force, which represented in Spain on average over 26% of the labour force in 2013, while in northern Europe the unemployed workers have not accounted for more than 17% of the labour force during this period. For this research, the log will be taken from this variable. Taking the log ensures a stabilisation of the variation. The unemployment ratio shows variation over the years. By using the log, the variation will be stabilized. Besides that, using a log makes it easier to interpret the effects of the independent variables on the dependent variable, as the coefficients can be interpreted as percents.

3.2 Control variables

The variables added in this model aim to reduce omitted variable bias. The variables considered will be the GDP growth rate, interest rate, inflation, job vacancies, public spending on the labour market and the strictness employment protection.

GDP growth, interest, and inflation rate are three variables used by Bartolucci et al. (2017) which had a significant effect on the unemployment rate. According to Okun's law, we expect a negative correlation between the GDP growth and the unemployment rate (Prachowny, 1993). The GDP growth data is taken from the OECD and is the growth rate compared to the GDP growth of the previous year. Interest is also known to influence unemployment. The data from the long-term interest rate is conducted from

the OECD website. It refers to government bonds maturing in ten years and can be seen as general averages of daily rates, measured as a percentage.

The Phillips-curve states there is a negative correlation between inflation and unemployment. The inflation rate is conducted from the OECD website. Inflation is the change in the prices of a basket of goods which are typically purchased by specific groups of households. The inflation is the growth compared to the previous year. The vacancy rate comes from Eurostat. This rate measures the proportion of the total posts that are vacant. It is expressed as a percentage of the number of occupied posts plus the number of job vacancies. This rate is merged with a specific dataset for the vacancy rate in France, so all countries are covered. The data on public spending on labour markets is available through Eurostat. Public spending on labour market programmes includes public employment services, training, hiring subsidies and direct job creation in the public sector. For the unemployed people, unemployment benefits are available. Data is based on information which appears in state budgets, accounts and annual reports and is measured as a percentage of the GDP. Another variable that needs to be considered, is the strictness employment protection. This consists of procedures and costs which are related to dismissing or hiring employees, individuals, or a group of workers (Venn, 2009). The data is conducted through the OECD. The OECD indicators of employment protections are indicators of the strictness of regulations on the dismissals and the use of temporary contracts.

Table 2 in appendix A provides the panel summary statistics for the unemployment variables. The number of observations is 294, since there are no missing values.

The variables are:

UE	Unemployment rate
MW	Minimum wage ratio compared to the average wage of a full-time worker
GDP	GDP growth rate, compared to the GDP of the previous year
INF	Inflation rate
INT	Long term interest rate
SPE	Spending on active labour market policies as a percentage of the GDP
VAC	Vacancies, expressed in percentages
SEP	Strictness Employment Protection

Table 3 in appendix B shows that the mean value of the unemployment rate is 8.6. These European countries are all developed countries, where the differences are visible between the eastern countries and the western countries.

The unemployment rate was the highest in Greece in 2013 until 2017. This data reflects the depth of the country's recession. There were years of cuts in the economy which were demanded by the European

Union. This also leads to the highest interest rate from the dataset, as the government needed to cut to prevent people from overspending. Luxembourg has the overall lowest unemployment rate, which never exceeded 7%. This might be because Luxembourg is a small country (Eccardt., 2005). Luxembourg is small and therefore, not many people are living in this country. Yet, it is an independent country with its own mediums, railroads and airport, while other small countries do not have this. This leads to relatively much work available.

Then, the minimum wage is the lowest in Germany, while Germany did only introduce a minimum wage in 2015. There were some minimum wages in specific sectors, but not an annual minimum wage which is used in this research.

The country with the biggest GDP growth is Ireland, as it has the fastest growing economy in the EU. Many large multinational companies are holding their intellectual property there (Honohan, 2021). It was also the only country whose GDP did not decrease because of the Covid-19 pandemic. Many western European countries also had a decrease in interest in 2020 as a response to the Covid-crisis, for people to start spending more. The biggest decrease in Ireland however was in 2008, when a financial crisis occurred.

The spending on labour markets is the highest in 2020 in Spain. This is because the Covid-19 crisis made pre-existing problems in the country even worse. To address structural issues in the labour market, the government spent more money on the labour market. This lowered the inequalities in the country (OECD, 2021).

Table 4 Covariance between the variables

	UE	**MW**	**GDP**	**INF**	**INT**	**SPE**	**VAC**	**SEP**
UE	1.000							
MW	-0.130	1.000						
GDP	-0.220	-0.040	1.000					
INF	-0.199	-0.047	0.175	1.000				
INT	0.306	-0.150	0.008	0.389	1.000			
SPE	0.293	-0.067	-0.243	-0.296	-0.102	1.000		
VAC	-0.266	-0.047	-0.039	-0.028	-0.297	0.019	1.000	
SEP	0.028	-0.071	-0.138	0.036	0.030	0.001	0.057	1.000

Based on the covariance analysis on the panel data study, the variables in this research are correlated with one another. The strongest link between the variables is the link between the interest rate and the inflation rate, with a positive correlation of 0.389. This result is as expected. When there is inflation, a

bank will increase the interest to make people start saving more and consuming less. This points to a positive and strong relationship.

Two other variables that are highly related to each other, are the interest rate and the unemployment rate. This is also no surprise, as a higher interest rate leads to a decrease in the spendings of the consumer as mentioned before. Now, less people are needed to work as demand decreases. This leads to a reduction in hiring and therefore a higher unemployment rate. Hence, the positive relationship between these two variables.

In appendix C is table 5 visible, which shows the covariances between the variables, divided into the first difference variables and lagged variables. The link between the interest rate and the inflation rate is also strong in this table. Another strong link is the link between the first differences between the GDP growth and the spendings on the labour market. Spendings on the labour market lead to more trainings for people, which increases the human capital. This leads to a higher productivity and more output and eventually to an increase in the GDP.

4.METHODOLOGY

4.1 Analysis

The analysis that will be conducted in this thesis is based on the effect of the minimum wage on the unemployment rate. For this analysis, a fixed effects model with an Arellano-Bond estimation will be used. Panel data analyses the evaluation of countries in a specific period (Gujarati & Porter, 1999). Panel data analysis is a very effective method in economics, as this provides the possibility to develop data prediction and theoretical results (Greene, 2003). When using panel data, parameters can be measured accurately and reliably. Panel data has several advantages, like controlling for heterogeneity and reducing the multicollinearity problem, which is likely to appear in time series data.

A cross sectional analysis will be done with the data mentioned earlier. This panel data set contains a time-series variable (year) and a cross sectional variable (country). The relationship that this study may find between the unemployment and minimum wage, might be dependent on the included countries and the studied years. Hence, a fixed effect model for this study is more accurate than a pooled model. When using a pooled model, the individual coefficients are not considered (Collischon & Eberl, 2020). A fixed effects controls for heterogeneity between the countries, as the characteristics of the country are included in the intercept. Using a fixed effect also controls for yearly variations. As some unexpected things happened during the studied period which affect the dependent variable, this can be controlled for. Between 2000 and 2020, multiple crises took place, and many people lost their jobs. This would have affected our dependent variable unemployment.

In the data, many differences in the level of economic development and the different environments in the countries of interest can be assumed. Multiple countries, like Hungary and Czech Republic, are former Soviet Bloc countries and differ substantially from Western European countries. This would lead to heteroskedasticity, as differences in the cross-sectional residuals might exist. To test for heteroskedasticity, the Breush-Pagan/Cook-Weisberg test is done, where the null hypothesis states that there is constant variance at the conventional levels of significance. The p-value came out to be 0.000, which is less than the conventional significance level. Therefore, we can conclude that there is significant evidence that heteroskedasticity exists in this regression model. This means that the variance of the error terms is not constant over time. To lower the heteroskedasticity, the log is taken from the dependent variable, unemployment.

Based on the Jarque-Bera normality test, where the null hypothesis states that the residuals are normally distributed, the chi(2) value of 0.0513 is greater than 0.05, so the null-hypothesis can not be rejected. We can therefore state that the residuals are normally distributed.

A fixed effects with an Arellano-Bond estimation will be suitable for this research. The individual heterogeneity can be controlled for by implementing the fixed effects, so differences between countries will be considered. As the countries have different characteristics which do not change over time, but might influence the outcome, this will also be taken into account with this method. In this estimation, lags of one year will be added for all variables. This helps with serial correlation, meaning that the error terms over time are correlated with each other. An Arellano-Bond estimation gives weights to different moment equations. This gives more weight to more reliable moment equations and tackles the problem of heteroscedasticity.

For this fixed effects model with an Arellano-Bond estimation, the first difference will be taken from the variables, as well as a one-year lag. This gives the possibility to look for the short-run effects and the long-run effects.

4.2 Model

For the analysis, seven models are used, which are reported below. In this analysis, country as well as year-fixed effects will be used. The first models only consist of the effect of the minimum wage ratio on the unemployment rate. Evidently, the employment rate does not depend only on the minimum wage ratio. Other variables which are assumed to influence the unemployment rate are added to the model. Yet, not all variables are included, as many variables might affect unemployment. The variables that are correlated with the unemployment rate, which is the dependent variable, are added one at a time to analyse the significance of these variables. First, the GDP growth rate is added to the model. The second variable will be the inflation growth rate, followed by the interest rate. Thereafter, the spendings on active labour market policies will be added and the vacancies. Lastly, the strictness employment protection policies will be added to the model. Then, the independent variable and control variables are tested on perfect multicollinearity.

The null hypothesis will be tested is that the minimum wage has no effect on the unemployment rate. The other variables considered in the regression will be control variables. In the next section, several models will be included to find the best fitting results.

The models used to estimate the effects of a change in minimum wage are defined as follows:

1. $\Delta UE_{it} = \alpha + \gamma\, UE_{i,t-1} + \beta_1 \Delta MW_{it} + \delta_1 MW_{it-1} + \mu_i + \tau_i + e_i$

2. $\Delta UE_{it} = \alpha + \gamma\, UE_{i,t-1} + \beta_1 \Delta MW_{it} + \delta_1 MW_{it-1} + \beta_2 \Delta GDP_{it} + \delta_2 GDP_{it-1} + \mu_i + \tau_i + e_i$

3. $\Delta UE_{it} = \alpha + \gamma\, UE_{i,t-1} + \beta_1 \Delta MW_{it} + \delta_1 MW_{it-1} + \beta_2 \Delta GDP_{it} + \delta_2 GDP_{it-1} + \beta_3 \Delta INF_{it} + \delta_3 INF_{t-1} + \mu_i + \tau_i + e_i$

4. $\Delta UE_{it} = \alpha + \gamma\, UE_{i,t-1} + \beta_1 \Delta MW_{it} + \delta_1 MW_{it-1} + \beta_2 \Delta GDP_{it} + \delta_2 GDP_{it-1} + \beta_3 \Delta INF_{it} + \delta_3 INF_{it-1} + \beta_4 \Delta INT_{it} + \delta_4 INT_{it-1} + \mu_i + \tau_i + e_i$

5. $\Delta UE_{it} = \alpha + \gamma\, UE_{i,t-1} + \beta_1 \Delta MW_{it} + \delta_1 MW_{it-1} + \beta_2 \Delta GDP_{it} + \delta_2 GDP_{it-1} + \beta_3 \Delta INF_{it} + \delta_3 INF_{it-1} + \beta_4 \Delta INT_{it} + \delta_4 INT_{it-1} + \beta_5 \Delta SPE_{it} + \delta_5 SPE_{it-1} + \mu_i + \tau_i + e_i$

6. $\Delta UE_{it} = \alpha + \gamma\, UE_{i,t-1} + \beta_1 \Delta MW_{it} + \delta_1 MW_{it-1} + \beta_2 \Delta GDP_{it} + \delta_2 GDP_{it-1} + \beta_3 \Delta INF_{it} + \delta_3 INF_{it-1} + \beta_4 \Delta INT_{it} + \delta_4 INT_{it-1} + \beta_5 \Delta SPE_{it} + \delta_5 SPE_{it-1} + \beta_6 \Delta VAC_{it} + \delta_6 VAC_{it-1} + \mu_i + \tau_i + e_i$

7. $\Delta UE_{it} = \alpha + \gamma\, UE_{i,t-1} + \beta_1 \Delta MW_{it} + \delta_1 MW_{it-1} + \beta_2 \Delta GDP_{it} + \delta_2 GDP_{it-1} + \beta_3 \Delta INF_{it} + \delta_3 INF_{it-1} + \beta_4 \Delta INT_{it} + \delta_4 INT_{it-1} + \beta_5 \Delta SPE_{it} + \delta_5 SPE_{it-1} + \beta_6 \Delta VAC_{it} + \delta_6 VAC_{it-1} + \beta_7 \Delta SEP_{it} + \delta_7 SEP_{it-1} + \mu_i + \tau_i + e_i$

The α is the intercept, γ is the lagged effect of the dependent variable, β is the parameter for the first difference variables, δ is the parameter for the lagged effects, μ is the cross-section fixed effect, τ is the time fixed effects and e is the error term.

5.RESULTS

Table 6 shows that the minimum wage does not have a significant impact on the unemployment rate with taking first difference and an one-year lag using fixed effects with an Arellano-Bond estimation.

Table 6 Results of the fixed effects model with Arellano-Bond estimation

ΔUnemployment rate	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Unemployment rate							
First Difference	0.6303***	0.3994***	0.4078***	0.364***	0.3504***	0.3102***	0.3172***
	(0.4637)	(0.0433)	(0.0427)	(0.0437)	(0.0434)	(0.0445)	(0.0449)
Lag	-0.2431***	-0.2425***	-0.2159***	-0.2278***	-0.2414***	-0.2629***	-0.2559***
	(0.0220)	(0.0175)	(0.018)	(0.0186)	(0.0219)	(0.0226	(0.0227)
Minimum Wage							
First Difference	-0.0035*	-0.0046**	-0.0030*	-0.0022*	-0.0021	-0.0022	-0.0018
	(0.0023)	(0.0017)	(0.0017)	(0.0017)	(0.0017)	(0.0016)	(0.0016)
Lag	-0.0026*	-0.0039***	-0.0026*	-0.0019*	-0.0018	-0.0017	-0.0017
	(0.0014)	(0.001)	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)
GDP Growth							
First Difference		-0.0341***	-0.0293***	-0.0296***	-0.0274***	-0.0286***	-0.0285***
		(0.0024)	(0.0025)	(0.0024)	(0.0029)	(0.0031)	(0.0030)
Lag		-0.0462***	-0.0398***	-0.0384***	-0.0352***	-0.0371***	-0.0377***
		(0.0037)	(0.0040)	(0.0038)	(0.0042)	(0.0043)	(0.0043)
Inflation							
First Difference			-0.0105***	-0.0162***	-0.0161***	-0.0158***	-0.0143***
			(0.0040)	(0.0043)	(0.0044)	(0.0045)	(0.0046)
Lag			0.0113	0.0002	0.0015	0.0020	0.0052
			(0.0046)	(0.0055)	(0.0055)	(0.0055)	(0.0059)
Interest							
First Difference				0.0115**	0.0127**	0.0182**	0.0183**
				(0.0079)	(0.008)	(0.0080)	(0.0083)
Lag				0.0156***	0.0145***	0.0089**	0.0098**
				(0.0045)	(0.0045)	(0.0048)	(0.0049)
Spending on labour market							
First difference					0.0248	0.0181	0.019
					(0.0211)	(0.0210)	(0.021)
Lag					0.0457**	0.063***	0.057***
					(0.0194)	(0.0199)	(0.020)
Vacancies							
First difference						-0.0265	-0.0222
						(0.0137)	(0.0139)
Lag						-0.0333***	-0.0320***
						(0.0093)	(0.0093)
Strictness Employ-ment Protection							
First difference							0.0841
							(0.0633)
Lag							-0.0319
							(0.0451)
Constant	0.5960***	0.7268***	0.5847***	0.5488***	0.4964***	0.5867***	0.6471***
	(0.0773)	(0.0617	(0.071)	(0.0707)	(0.0775)	(0.0812)	(0.1392)

Notes: Standard errors are reported in parentheses. $*\ p < 0.05$, $**\ p < 0.01$, $***\ p < 0.001$

The results of the regressions show that minimum wage does have a small significant negative effect on the total unemployment rate in the first four models. This was also found by empirical studies of Card et al. (1994). In model (2), the minimum wage is more significant than the other models. The results can be affected by several conditions. A possibility is that the unemployment rate and the minimum wage ratio depend on the added variables and thus lower the effect of the minimum wage ratio on the unemployment. The minimum wage ratio seems to have a negative effect on unemployment. An increase in minimum wage leads to a decrease in unemployment. This result can not be explained by the standard model of competitive labour markets, but rather by the monopsony model. Yet, as the final model does not include significant results, no conclusions can be drawn from these results.

The GDP growth has a negative and significant effect on unemployment. This is in line with Okun's law, which states that there is a negative correlation between the GDP and unemployment rate. The variable GDP growth is significant in all models, both the first differences as well as the lags. These results are in line with the paper of Neumark and Wascher (2004). This means that when the GDP increases, it goes well in the economy and the demand increases, so more people are needed to keep up with the demand, leading to less unemployment. It might also lead to higher wages on its own, when the demand for labour exceeds the labour supply. Firms might also expand their businesses when they sell more, which also leads to less unemployment. However, this might take some time, leading to a significant effect in the long run.

The inflation rate shows a significant effect on the unemployment in all the models where this variable is added. It is only significant for the first differences. The results are not significant for the long run. The effect of the inflation rate on the unemployment rate is negative. This is aligned with the Phillips curve, which states that unemployment and inflation have an inverse relationship. When the inflation rate increases, the unemployment rate decreases. This means that when inflation is increasing, which often is the result of an increase in GDP, this leads to more demand and less unemployment.

The interest rate shows a significant positive effect in all the models in which this variable is added for the long run as well as the short run. This is in line with the literature. When the interest rate increases, people start to save more, leading to a decrease in demand. Less people are needed, thus an increase in unemployment.

The variable spending policies show in a significant effect in all three models in which the variable is added, but only for the long run. For the short run, the models are insignificant. All three models show a positive relationship between spending on the labour market and unemployment. Yet, the intentions of these spending are to reduce unemployment. There is no paper found which could explain the result of this variable.

Vacancies seem to have a negative and significant effect on unemployment for the lagged effects. An increase in vacancies means that unemployment decreases in the long run. This is in line with the literature. When there are more vacancies, people can find a job that fits their characteristics, which leads to a lower unemployment rate. It might take some time before people see the vacancy, react to it and actually get the job, hence the lagged effects.

The strictness employment protection does not show a significant effect on unemployment. The effect is negative for the lagged effects, which is in line with the literature. An increase in strictness employment rate leads to a decrease in unemployment, as it is more costly to fire workers with the regulations and their increase in bargaining power. In the short run, firms need to adjust to the loss of flexibility. To deal with this, firms will not hire more people, but wait until they know for sure they need more people. Now, it is not as easy to fire people anymore, so firms are more careful. Yet, as the results are not significant, no hard conclusions can be drawn.

The last model includes all the variables which are introduced in this paper. Here, the minimum wage ratio is not significant. Therefore, we can not conclude that minimum wage has a significant effect on unemployment.

The GDP growth rate and interest both have significant effects on the unemployment for the short and the long run. The GDP growth rate decreases unemployment, while the interest rate increase unemployment. Inflation leads to a decrease in unemployment in the short run. Vacancies and the spendings on the labour market has a long-term effect. The vacancies decrease the unemployment, but the spendings in the labour market lead to an increase in the unemployment.

When checking for multicollinearity, the variance inflation factor (VIF) is calculated.

Table 7: Multicollinearity of the variables

	VIF	**1/VIF**
Minimum wage		
First difference	1.09	0.916
Lag	1.12	0.891
GDP growth		
First difference	2.10	0.476
Lag	2.14	0.467
Inflation		
First difference	1.94	0.514
Lag	2.46	0.407
Interest		
First difference	1.19	0.837
Lag	1.92	0.521
Spending		
First difference	1.79	0.559
Lag	1.38	0.724
Vacancies		
First difference	1.25	0.799
Lag	1.27	0.785
Strictness Employment Protection		
First difference	1.11	0.897
Lag	1.07	0.935

As all values of VIF are not relatively high and the highest being 2.46, we can conclude there is not a high degree of multicollinearity in this model. There is thus not a high degree of correlation within the independent variables.

6.CONCLUSION

Multiple studies looked at the effect of a minimum wage on unemployment. Since scientists still disagree on whether it has a positive or negative effect on unemployment, this subject is scientifically relevant. In addition, there are only a few studies about the effect of the minimum wage on the total unemployment compared to the unemployment rate for certain groups, like low-skilled workers or teenagers. This thesis looks at the effect of the minimum wage on the total unemployment rate for 14 European countries from the year 2000 to 2020. A fixed effect model with Arellano-Bond estimation is used. The dependent variable is the unemployment rate. The independent variable is the minimum wage ratio. Multiple control variables will be added to reduce omitted variable bias.

The results do not show that an increase in the minimum wage has a significant effect on the unemployment rate, as stated in the hypothesis. When taking more variables into account, the significant effect of the minimum wage decreases. The negative coefficient was not expected, as the standard economic competitive model assumes a positive relationship. This effect is on the other hand in line with the monopsony model, which assumes a negative effect to a certain level. Card, Katz and Krueger (1994) also used the monopsony model to discuss their results. Yet, as the results came out insignificant, no conclusion about the minimum wage can be made.

The macroeconomic variables are in line with the theory and have a statistically significant effect on unemployment. Inflation has a statistically negative effect on the unemployment rate in the short run. Inflation is a consequence of an improved economy. More goods are demanded, and people will be hired to produce goods, so the unemployment decreases. The interest rate has a significant positive effect on the unemployment rate in both the short and long run. When interest increases, lending will become more expensive, and saving will be preferred. This leads to less production and consumption. Less workers are needed, so unemployment increases. The spendings on the active labour markets does show a significant positive effect on the unemployment rate in the long run. There is no research which could explain this coefficient. The strictness employment protection does not show a significant effect on the unemployment. No conclusions about the strictness employment protection can thus be made based on these results. Vacancies show significant negative effects on unemployment on the long term. This means that an increase in the vacancy rate results in a decrease in the unemployment rate. This complete model is not based on a paper and therefore these results can not be linked to other empirical studies.

For the government making policy decision regarding the labour market, one should take the variables into account which can be adjusted by the government. The interest rate or the spending on labour markets have a positive effect on the interest rate and therefore increase the unemployment. The GDP growth and the associated inflation lead to a decrease in the unemployment rate. The goal of the government is therefore an important consideration. If the inflation needs to be tackled and the

government increases the interest rate, the unemployment rate will also increase. Looking at the data, GDP growth ensures lower unemployment, as does inflation. Yet too much GDP growth and inflation are also not desired. The lags also need to be considered, as some variables may take some time to see the actual results. This makes it harder to respond quickly in the labour market. As the government is deciding which factors to implement, the goal of the policy and the time it takes for effects to be visible needs to be considered.

7.DISCUSSION

This research consists of fourteen countries in Europe and analyses the period between 2000 to 2020. More countries can be added as well as an increase of years which are researched. This might lead to different results. The reason for these given countries and time periods is the limited data which is available. In further research, more control variables can be added to the model to minimize omitted variable bias. In this research, the strictness employment protection variable did not show any significant effect and therefore no conclusions can be made based on this variable.

The minimum wage variable can be improved. Germany has only introduced the minimum wage in 2015 but is included in the regression. By including this country, an imprecise effect on the overall coefficient may be estimated. The implied minimum wage change of Germany can be relatively large compared to the other countries.

Further research can be done by investigating the effect of the minimum wage on unemployment of specific groups related to the total unemployment, like the unemployment of teenagers. This way, the effect of the minimum wage on unemployment can be evaluated specifically for a group.

This thesis uses a lag of one year. Yet, Neumark and Wascher (2004) suggest that lagged variables can be useful in finding negative effects on employment. Taking lagged effects into account may change the results and might be the reason for the insignificant effect of the minimum wage on unemployment. It might be interesting to look at more lags, as effects may not be visible within one year.

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9.APPENDICES

APPENDIX A

This appendix shows the summary statistics of the variables.

Table 2 Summary statistics of the variables

Variable	N	Mean	Median	Max	Min	Std. Dev.
UE	294	8.6	7.5	27.8	1.9	0.494
MW	294	37.4	39	54.1	0	10.408
GDP	294	1.9	2.2	24.4	-11.3	2.273
INF	294	2.1	2	10.1	-4.5	1.847
INT	294	3.8	3.9	22.5	-0.5	1.838
SPE	294	1.6	1.4	4.5	0.2	0.928
VAC	294	1.6	1.4	6.2	0.2	0.947
SEP	294	2.4	2.4	4.6	1.1	1.103

APPENDIX B

This appendix shows the summary statistics of the variables by country.

Table 3 Summary statistics of underlying data of variables from the years by country

		BEL	CZE	DEU	ESP	FRA	GBR	GRC	HUN	IRL	LUX	NLD	POL	PRT	SVN
UE	*Mean*	7.50	6.15	6.62	14.83	9.09	5.67	14.40	6.89	8.07	5.02	5.83	10.94	10.04	6.77
	SD	1.00	1.78	2.57	4.35	0.79	1.35	4.82	2.32	4.12	0.96	1.43	5.56	3.48	1.67
	Min	5.37	3.57	3.57	8.23	7.43	3.83	7.77	3.57	4.18	3.57	3.57	3.57	5.27	4.32
	Max	8.66	8.78	11.29	19.12	10.35	8.13	19.74	10.80	15.48	6.69	8.35	19.74	17.17	10.11
MW	*Mean*	40.68	33.48	12.27	31.99	50.69	39.05	36.01	37.05	34.69	44.77	41.33	37.69	37.45	46.06
	SD	1.10	2.50	9.88	3.80	1.11	4.02	2.71	3.27	3.13	0.87	0.36	0.98	4.2	3.62
	Min	38.9	27.9	0	27.7	49.3	33	31.9	27.8	29.9	42.6	39.2	32	32.5	40.6
	Max	42.8	37.7	44.3	43	54.1	47.5	41.3	42.7	40.5	46	47.8	45.4	46.2	51.9
GDP	*Mean*	1.38	2.55	1.12	1.22	1.00	1.21	-0.10	2.33	4.99	2.70	1.30	3.58	0.47	2.16
	SD	2.01	3.19	2.37	3.74	2.41	3.27	4.73	3.18	5.98	2.57	2.11	2.07	2.88	3.45
	Min	-5.36	-5.50	-5.69	-11.33	-7.79	-11.03	-10.15	-6.60	-5.10	-3.24	-3.89	-2.02	-8.30	-7.55
	Max	3.72	6.77	4.18	5.25	3.92	4.09	5.79	5.36	24.37	8.10	4.20	7.06	3.82	6.98
INF	*Mean*	1.90	2.28	1.40	1.98	1.38	1.97	1.77	4.26	1.75	1.94	1.84	2.59	1.79	2.92
	SD	1.06	1.51	0.65	1.55	0.77	0.83	2.06	2.73	2.48	0.96	0.92	2.38	1.48	2.76
	Min	-0.05	0.12	0.14	-0.50	0.04	0.40	-1.74	-0.23	-4.48	0.29	0.32	-0.93	-0.84	-0.53
	Max	4.49	6.36	2.63	4.08	2.81	3.80	4.71	9.80	5.59	3.41	4.16	10.09	4.37	8.91
INT	*Mean*	2.93	3.31	2.46	3.50	2.79	3.22	6.84	6.06	3.64	2.50	2.66	4.97	4.40	3.56
	SD	1.82	1.91	1.88	1.68	1.74	1.61	4.78	2.27	2.39	1.84	1.84	2.10	2.49	1.94
	Min	-0.15	0.43	-0.51	0.38	-0.15	0.37	1.27	2.23	-0.06	-0.41	-0.38	1.50	0 .42	0.08
	Max	5.59	7.47	5.26	5.85	5.39	5.32	22.50	9.12	9.60	5.52	5.40	10.68	10.55	6.40
SPE	*Mean*	2.72	0.53	2.19	2.76	2.91	0.54	0.90	0.94	2.00	1.22	2.57	0.98	1.80	0.79
	SD	0.33	0.20	0.74	0.79	0.32	0.10	0.47	0.21	0.85	0.45	0.47	0.34	0.31	0.42
	Min	1.99	0.4	1.31	2.08	2.35	0.38	0.44	0.68	0.87	0.65	1.79	0.45	1.25	0.21
	Max	3.17	1.33	3.39	4.54	3.97	0.78	2.24	1.32	3.69	2.94	3.93	1.78	2.31	2.08
VAC	*Mean*	2.44	2.37	2.38	0.69	2.03	2.31	1.33	1.43	0.70	0.86	2.15	1.48	0.6	1.14
	SD	0.53	1.65	0.74	0.22	0.29	0.21	0.60	0.54	0.25	0.45	0.66	0.96	0.18	0.59
	Min	1.6	0.8	1.3	0.4	1.6	1.9	0.4	0.8	0.2	0.4	1.2	0.4	0.3	0.5
	Max	3.5	6.2	3.8	1.4	2.6	2.7	2.4	2.7	1	1.7	3.3	3.2	1.0	2.5
SEP	*Mean*	1.81	3.42	2.60	2.20	2.57	1.45	2.81	1.85	1.21	2.14	3.33	2.33	3.91	2.45
	SD	0.17	0.17	0.08	0.18	0.08	0.08	0.34	0.21	0.07	0.20	0.11	0.21	0.64	0.27
	Min	1.64	3.25	2.51	1.96	2.50	1.35	2.45	1.59	1.10	1.98	3.24	2.13	3.14	2.08
	Max	2.07	3.64	2.72	2.36	2.71	1.51	3.13	2.00	1.27	2.39	3.61	2.57	4.58	2.65

APPENDIX B

This appendix shows the covariance between the variables divided into first differences and lagged effects.

Table 5 Covariance between the variables divided into first difference effects and lagged effects.

	LUN D	LUN L	MW D	MW L	GDP D	GDP L	INF D	INF L	INT D	INT L	SPE D	SPE L	VAC D	VAC L	SEP D	SEP L
LUN D	1.00															
LUN L	-.108	1.00														
MW D	-.066	-.015	1.00													
MW L	.040	-.133	-.223	1.00												
GDP D	-.239	.226	-.030	-.031	1.00											
GDP L	.356	-.350	-.018	.030	-.471	1.00										
INF D	-.377	-.033	.052	-.006	.148	.150	1.00									
INF L	.326	-.197	-.063	-.029	-.251	.202	-.498	1.00								
INT D	.039	-.094	-.011	-.010	-.048	.092	.211	.109	1.00							
INT L	.272	.321	-.086	-.122	.057	-.123	-.132	.421	-.088	1.00						
SPE D	.371	-.179	-.012	.111	.451	-.068	-.344	.156	.003	-.077	1.00					
SPE L	.064	.344	-.048	-.087	.125	-.317	.060	-.275	-.074	-.068	-.154	1.00				
VAC D	-.281	-.031	.007	-.020	.231	.079	.099	-.111	.028	-.186	-.284	.010	1.00			
VAC L	-.101	-.271	.006	-.029	-.162	.041	.049	-.050	.114	-.294	.034	.054	-.139	1.00		
SEP D	-.070	-.120	-.002	-.041	.002	.174	.137	-.090	.087	-.162	-.068	.077	-.008	.095	1.00	
SEP L	.021	.047	.016	-.071	-.021	-.135	.019	.029	.053	.046	.015	-.009	.043	.046	-.107	1.00