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Impacts of COVID-19 pandemic on the labour market in the Czech Republic, Germany, Italy, and the Netherlands

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Master's Thesis

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Abstract

This thesis is focused on the analysis of the impacts of Covid-19 pandemic on the labour markets of four selected European countries – the Czech Republic, Germany, Italy, and the Netherlands. The design of Job Retention schemes introduced by the governments of selected economies to mitigate the impacts of Coronavirus recession and the most affected groups are examined. The main objective of this research is to find out whether there is a correlation between the growth of unemployment rate and the number of positive cases. Due to the limitation of the testing methodology that differs from each selected country, the empirical research focuses only on the Czech Republic.

Based on several econometric models using different estimation methods, there seems to be no or negligible effect of the number of positive Covid-19 cases on the unemployment rate in the Czech Republic. Since the most vulnerable groups are women, young and less educated people, the Job Retention schemes should mainly support these workers.

KEY WORDS:

Covid-19, positive cases, unemployment rate, labour market, Job Retention schemes

1. Introduction

The COVID-19 pandemic which spread to almost every country in the world between the end of 2019 and the first quarter of 2020 has caused significant losses on both lives and economies of individual countries so far. The temporary government measures taken due to Coronavirus pandemic have stopped the economy activity of firms and self-employed all around the world. Nowadays, mitigating the negative long-term impacts on the labour markets which were caused by the ongoing economic crisis is an important challenge for governments.

Given that the increase in positive cases results in the closure of businesses and shops by government which could ultimately lead to higher unemployment, the main goal of this research is to find out whether there is a correlation between the growth of unemployment rate and number of infected people.. There also could be a direct effect of infected people; the higher number of positive cases leads to uncertainty, people get more cautious and thus, the consumption and economic activity decline. The research finds out how Covid-19 measured as the number of new positive cases affected the unemployment rate in the Czech Republic. In the empirical part, the research hypothesis will be tested with the help of econometric specification which can be formulated as follows: with the growing number of positive cases unemployment increases. The empirical research focuses only on the Czech Republic due to the testing intensity, which was different in each selected country, so the results could be skewed.

The secondary goal of the thesis is to analyse the impacts of the COVID-19 pandemic on the labour market in the year 2020 in four selected European countries with different economic conditions such as the Czech Republic, Germany, Italy, and the Netherlands. This is achieved by monitoring the interrelationships of individual parts of the issue and their subsequent evaluation. This thesis focuses on the first and second wave of the Coronavirus crisis and Job Retention schemes that selected countries applied to mitigate the impacts of Coronavirus recession. Furthermore, the thesis aims to review the design of these schemes. The thesis examines these selected European economies for several reasons; 1) The Czech Republic has entered the recession with the lowest unemployment rate in the EU which it maintained even after the first and second wave of the Coronavirus crisis. On the other hand, unfortunately, this economy recorded the largest number of infected people per capita. (2) Italy was the hardest hit country in EU in the first months of 2020 with the most significant estimated economic impacts. (3) All selected countries had different baseline conditions before the onset of the Covid-19, therefore knowing their approach to applying the Job Retention schemes can give policy insight for other developed economies.

The thesis is divided into several chapters; Chapter 1 presents the introduction. Chapter 2 provides theoretical framework and brief overview of the Covid-19 pandemic and the design of Job

Retention schemes in selected countries. Furthermore, Chapter 3 reviews the existing literature about Job Retention schemes and the impacts of Covid-19 on the unemployment rate in the different economies. Chapter 4 presents economic analysis of the basic macroeconomic variables in the Czech Republic, Germany, Italy, and the Netherlands. Furthermore, Chapter 5 examines how Covid-19 measured as the number of positive cases affected unemployment in one specific country namely in the Czech Republic. Last Chapter 6 provides conclusion and discussion.

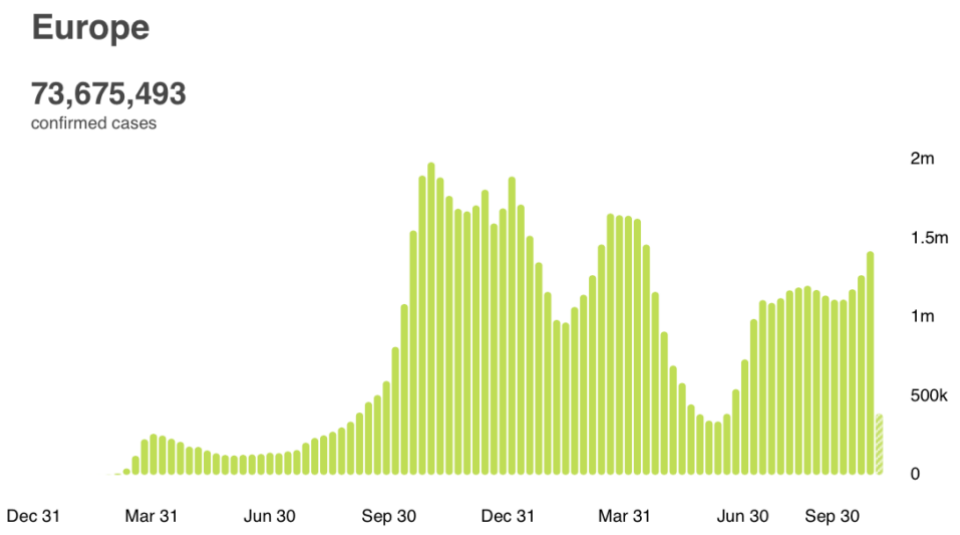
2. Theoretical Framework

In this part, the situation of Covid-19 pandemic in Europe and selected countries is summarized. Hereafter, Job Retention schemes (JR) are defined. Moreover, the designs of JR schemes introduced against the spread of coronavirus in the Czech Republic, Germany, Italy, and the Netherlands are reviewed and compared.

2.1 Coronavirus in Europe

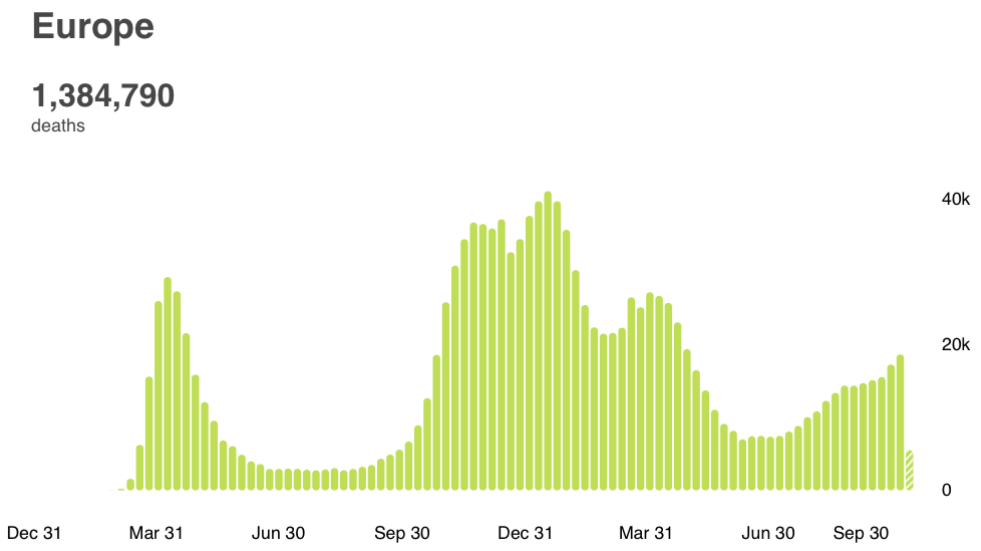
As of October 2021, more than 241 million people worldwide have been infected with the Covid-19 virus, and more than 4.9 million people died. The most confirmed cases are in the United States followed by United Kingdom, Turkey, and Russia (JHU, 2021). Regional Director for Europe of WHO, Dr Hans Henri P. Kluge, stated that the situation in Europe remained serious at a press conference in early July. More than two-month decline of positive cases in 53 European countries has ended with a 10% increase over the past week i.e., on July 1. Kluge also said that this increase is mainly due to the easing of taken government's measures and the fact that people have started to gather and travel more over the summer. The virus mutated and new versions of Covid-19 have appeared. If society is not disciplined, the European Region faces a third wave of pandemic before the autumn due to delays in vaccinating, gathering people and new variants of the virus (WHO, 2021). As of October 19, 2021, the average vaccine coverage in the European Region is 63.5%. Given this number, neither the citizens nor policy makers should believe that the pandemic is over. As of October 19, 2021, 73.895.730 infected people and 1.387.156 confirmed deaths were registered in Europe as one of the most affected areas. There has been an increase of 1.472.113 cases of infection and 19.350 deaths in the previous seven days (WHO, October 2021).

Figure 1. Development of confirmed cases in Europe (30. 12. 2019 – 18. 10. 2021)



Source: WHO Coronavirus (COVID-19) Dashboard, 2021. *WHO*.

Figure 2. Development of confirmed deaths in Europe (30. 12. 2019 – 18. 10. 2021)



Source: WHO Coronavirus (COVID-19) Dashboard, 2021. *WHO*.

The graphs 1 and 2 above show the development of Covid-19 pandemic in Europe in selected months. I suppose that the rapid increase in diagnosed cases was related to a significant increase in the testing capacities of individual countries and easing of government's measures during the few last months.

The following table 1 gives information about the total cases per population and total deaths per population in the Czech Republic, Germany, Italy, and the Netherlands as of October 18, 2021. As mentioned before, Italy is one of the most affected country in the EU with the highest number of cases and deaths more than twice as high as in the Czech Republic and the Netherlands. However, the Czech Republic has the highest number of victims of Covid-19 per million inhabitants, This also applies for the number of total deaths per population (WHO, 2021).

Table 1. Total cases, total deaths, and deaths last 7 days in selected economies as of October 18, 2021.

Country	Population in millions	Total cases per population	Total deaths per population
Italy	60.36	0.07823373	0.00218116
Germany	83.20	0.05301588	0.00113957
Czech Republic	10.65	0.16077427	0.00287042
Netherlands	17.44	0.12009576	0.00107213

Source: self-illustration, data source: COVID-19 situation in the WHO European Region, 2021. *WHO*.

2.2 Measures taken against the spread of Coronavirus in Europe

Countries around the world have been forced to take strict measures due to the consequences of the spread of Covid-19. Many states have effectively closed their boarders to all persons except their own citizens, introduced strict controls on the movement of people within the country and ordered the population to stay in their homes. Of the selected countries, Italy was first which declared the state of emergency on January 31, 2020. Italy was followed by the Czech Republic which introduced similar lockdown measures on March 12, 2020. Germany and the Netherlands took same steps in the same month.

Despite the European Commission's efforts to achieve a coordinated common policy, EU Member States have taken different steps to combat the spread of the virus. The European Commission aims to strengthen the public health sector and mitigate the socio-economic impact in the EU. It also provides financial assistance to Member States to coordinate internal measures while providing objective information on the spread of coronavirus (EC, 2020).

2.3. Job retention schemes

JR schemes play a crucial role in explaining the development of the labour market during the worldwide Covid-19 pandemic since they were used unprecedently and widely. Almost all European countries have introduced or adapted JR schemes that provide for a reduction in working time of up to 100% in line with developments in national labour markets to prevent unemployment (OECD, 2020). Several Member States have also created a legal basis for companies that dismiss returnees or re-employment. The design of JR may be short-time work (STW) schemes which straight fund hours not worked (Hijzen and Venn, 2011). This form of JR was used for instance in Germany as the *Kurzarbeit*. According to Hijzen and Venn (2011), the main aim of STW schemes is to provide help for companies experiencing a temporary decrease in demand for job retention which has become unprofitable in the short term, however which is likely to continuing be viable in the medium term. JR may also be designed as wage subsidy schemes (WS) which fund hours worked but can be utilized to subsidize the earnings of workers on reduced hours as well. The example is the Dutch Emergency Bridging Measure *(Tijdelijke Noodmaatregel Overbrugging voor Werkbehoud, NOW)*. An essential feature of all JR schemes is that employees maintain by contracts with the employer even if they are not actually working. The Czech Republic, Germany, Italy, and the Netherlands have a similar design of the JR schemes.

2.3.1. Czech Republic

The Czech Republic initiated measures against the spread of Covid-19 on 12 March 2020 by declaring a state of emergency. As in the other selected monitored countries, measures began to tighten over time. The following step was to reduce the public and private gathering of people which resulted in restrictions of movement except for travel to work and necessary travel to meet basic human needs.

The certain restrictions during the second and third quarters of 2020 have been eased. The number of infected and sick began to rise again during the summer of 2020. In the first week of September 2020, the Czech Republic ranked among the worst affected countries in Europe in terms of newly infected per million inhabitants. The government declared a state of emergency from 5 October 2020 due to the second wave of the epidemic. Subsequently, the state of emergency was continuously extended until 23 December 2020 (Government of the Czech Republic, 2021).

The spread of Coronavirus and taken preventive measures have a negative impact on employment and the labour market in the Czech Republic. Hence, the government has created a programme called *Antivirus* to mitigate the negative effects on employment. The *Antivirus Programme* was inspired by the German *Kurzabeit* job protection system. The essence of the *Antivirus Programme* was partial or full compensation of total wage costs in the form of wage compensation for employees who were affected by quarantine, emergency measures, crisis measures related to the spread of Covid-19 both in the Czech Republic and abroad and accompanying economic problems of employers. A financial contribution was paid to affected employers through the *Antivirus Programme* (MPSV, 2021).

The *Antivirus Programme* was launched on April 6, 2020. The state through the Labour Office of the Czech Republic compensated the companies for the funds paid out. It was compensation of the costs of employers whose economic activity was endangered because of the spread of the Covid-19. The compensation of wages was partial or full. This *Antivirus Programme* was divided into two regimes. These two regimes differ for instance in the maximum amount of compensation and the eligible costs. The four following conditions have been set for entitlement of the compensation. Firstly, the employer strictly follows the Labour Code. Secondly, the employee must not be within the period of dismissal and must not be given dismissal. Thirdly, employees must be employed and must take part in sickness and pension insurance. And fourthly, employer should pay the wage and pay the state contributions (MPSV, 2021).

Regime A

Pushed business restrictions and quarantine

Closure or restriction of operations based on the preventive taken measures or quarantine ordered by the competent authority

- In the case of an ordered quarantine, the employee is entitled to wage compensation in the amount of 60 per cent of the reduced average earnings
- In the case of closure of enterprise due to the state order, the employee is entitled to wage compensation in the amount of 100 per cent of the average earnings
- Contribution to the employer in the amount of 80 per cent of the wage compensation, including contributions / up to the amount of CZK 39.000

Regime B

Economic difficulties associated with the preventive taken measures

Barriers to work on the part of the employer due to related economic problems associated with the Coronavirus pandemic

- Depending on the type of barrier the employee is entitled to wage compensation in the amount of 60 to 100 per cent of the average earnings
- Contribution to the employer in the amount of 60 per cent of the paid wage compensation, including contributions / up to CZK 29.000

The application for the allowance is submitted only once, however the company must send a statement of paid wages to the Labour Office every month. As of October 18, 2021, the *Antivirus Programme* is still active. Until the end of October 2021, it is possible to apply for allowances for wage compensation in *Regime A* which applies to employers whose employees have been ordered quarantine or isolation due to Covid-19 disease. The amount of the contribution is set at 80 per cent of eligible costs wage compensation paid to employees plus the corresponding amount of statutory contributions (MPSV, 2021).

2.3.2. Germany

On March 23, 2020, the German government has introduced a comprehensive package of measures to mitigate the impacts of the spread of Coronavirus disease. The German Cabinet initiated emergency aid for small enterprises and self-employed persons by launching the KfW Special Programme 2020: A programme supporting companies that ran into temporary financial problems due to the Coronavirus pandemic. Small, medium-sized, and large enterprises could apply by simply submitting applications through their bank. Payments were set to be made fast with the funds for the KfW Special Programme being unlimited. This aid programme was approved by the EU Commission. (Federal Ministry for Economic Affairs and Energy, 2020).

German Federal Employment Agency started receiving a sharp increase in notifications of short-time work as of March with around 470.000 advertisements for short-time work received during the first weeks of the pandemic. As an immediate action programme, the federal government introduced a simplified access to short-time work benefits to help those who were affected receive instant financial support. Germany's first corona lockdown lasted seven weeks and ended on May 4, 2020. The second wave of the pandemic took hold during the autumn of 2020. The number of new positive cases was running at more than 1.000 a day in August 2020. The number of infections doubled by mid-September 2020 (The Federal Government, 2021).

Kurzarbeitergeld

If Covid-19 pandemic causes supply constraints or if the government introduced the lockdown and force the company to reduce or stop production, companies are entitled to a short-term allowance for the affected employees. *Kurzarbeitergeld* is a compensatory allowance paid by the Federal Labour Office at the time of partial unemployment (i.e., *Kurzarbeit)*. Its purpose is to compensate the loss of earnings at least partially. The short-time allowance helps companies retain valuable workers even if their employees have temporarily too little work. It is paid for hours in which the employer was unable to assign work to employees. The amount of the *Kurzarbeitergeld* contribution is about 60% of the lost net salary, resp. about 67% of lost net wages for employees whose household has at least one child. This short-term allowance can be provided for up to twelve months. The condition is that at least 10% of the company's employees must be affected by a work outage (Bundesagentur für Arbeit, 2021).

Kurzarbeit

When applying *Kurzarbeit*, the employer will reduce working hours. In case of the so-called *Kurzarbeit 0* (zero), the working hours can be reduced up to 100%. All businesses with at least one employee can apply for the *Kurzarbeit.* The short-term allowance is paid at the same level as unemployment benefit and compensates for 67 or 60 per cent of the net pay lost because of the short-time work. It can be granted for up to twelve months and can be extended for another twelve months provided that the wage loss was at least 50%. In this case, the increase in short-term contributions is distributed as follows:

- Reference month 1-3: 60/67 * per cent from net wage
- From the fourth reference month: 70/77 * per cent from net wage
- From the seventh reference month: 80/87 * per cent from net wage

* Household with at least one child

Employees working short time must cope with a reduction in their income, but they remain in jobs subject to social security contributions. They maintain their social protection in the form of health insurance, pensions, long-term care insurance, occupational accident insurance and unemployment insurance. Germany simplified access to *Kurzarbeit* due to the Covid-19 pandemic's impact on the labour market. The conditions for receiving the short-time work allowance are following: the reduction in working hours must be due to economic reasons or circumstances beyond the employer's control, it must be inevitable, and the firm must do everything in its power to mitigate or reduce them. Furthermore, the reduction in working hours must be temporary and the employment agency must be informed. In addition, the employee must remain in employment subject to social security contributions and must not be dismissed. As mentioned above, at least ten percent of the company's employees must face a reduction. This is a modified condition due to the Coronavirus pandemic. Usually, one third of the company's employees must be affected by reduction in working hours (Federal Ministry of Labour and

Social Affairs, 2021). The public employment service compensates to employers 100% of social insurance contributions for the lost work hours whereas during the Global Financial crisis in 2008 compensated only 50% (OECD, 2020).

2.3.3. Netherlands

The first measures in the Netherlands which entered into force on March 12, 2020, included for instance the ban of gatherings of more than one hundred people or the request on universities and institution of higher education to offer online teaching instead of offline lectures. Only a few days later, it was decided the primary and secondary schools will be closed from Monday March 16. All restaurants and bars were closed from March 15 to April 6, 2020. In addition, a rule that has applied in every public space in the Netherlands until recently was introduced – all people were requested to keep at least 1.5 metres distance from other person. It can be said that since then the lockdown measures have only been extended repeatedly. The Dutch government has been implemented the package of unprecedented economic measures due to the Coronavirus outbreak on March 17, 2020. One of these measures was the implementation of a temporary scheme allowing entrepreneurs to utilize help in paying the costs on wages since they had less or no work for their employees. This temporary scheme replaced the Regulation for Reduction in Working Hours (Government of the Netherlands, 2020).

Tijdelijke Noodmaatregel Overbrugging voor Werkbehoud (NOW)

Temporary Emergency Bridging Measure for Sustained Employment (NOW) is provided to each company which expects to lose at least 20% of its earnings. The allowance enabled to companies paid their employees' wages up to a maximum of 90 per cent of their salary depending on the loss of turnover. Companies received the compensation immediately after the application, nevertheless the final arrangement was based on the actual turnover loss. The following conditions have been set for entitlement of the compensation. If the entrepreneurs are receiving the financial Covid-19 support, they must file a final turnover statement for every three-month period over which they were receiving support. In case the company will have a higher turnover than expected, it will have to return (part of the) allowance. The entrepreneurs must apply for the final arrangement for each three-month period separately. In addition, if they do not request the final arrangement of any contribution period (in time), the compensation will be declared zero and they will have to return the full amount they have received. They applied for a subsidy of less than €25.000 and the advance payment did not exceed €20.000. If companies received the advance payment of between €20.000 and €100.000, a third-party statement is needed. This statement may be issued by the administrative authority, the accounting adviser, or the accounting officer. If the company has applied for a grant of €125.000 or more, it will need an auditor's report. Moreover, the enterprises may not lay off any employee for economic reasons during the period covered by the contribution (Government information for entrepreneurs, 2020).

2.3.4. Italy

In Italy, a state of emergency was declared on January 31, 2020, for a period of six months. Subsequently, the state of emergency was extended until October 15, 2020. The most radical taken measure since the beginning of the pandemic occurred on March 21, 2020, when it was forbidden to carry out any outdoor recreational activities. Allowed was only movement near the home and at least one meter away from other people. Staying in cottages or any transfer to other homes was not allowed as well. A gradual relaxation of taken measures has started on May 25, 2020, due to the favourable development of the Covid-19 pandemic (Italian Government Presidency of the Council of Ministers, 2021).

Italy has long been one of the most indebted countries in Europe together with Greece and Portugal. The economic situation in Italy was already very problematic before the outbreak of the pandemic mainly due to long-term structural problems and high public debt in relation to GDP. The subsequent regulation related to the closure of companies and the suspension of production was devastating not only for large companies but also for small and medium-sized enterprises which are the driving force of the Italian economy (Ministero del Lavoro e delle Politiche Sociali, 2021). The lockdown measures had a large negative impact on the labour market. Between 2015 and 2017, Italy experienced a significant economic recovery. However, GDP grew by only 0.3 % in 2019 compared to the previous year while in the second half of the year there was stagnation and subsequent negative development (ISTAT, 2020). Another indicator is employment, respectively unemployment which the country has been struggling with for a long time especially among young people. Although employment grew in 2019, specifically by 0.5 %, the increase was lower than in the previous year (0.7 %). This increase was due to a more significant increase in the number of part-time employees while full-time employment remained stable. This trend is particularly significant in the manufacturing sector and has slowed down the increase in the number of hours worked in the economy. The unemployment rate therefore decreased and reached an average of 10 % in 2019 (it was 10.6 % in the previous year). This is the lowest unemployment rate registered since 2012 (Banca d'Italia, 2020). The policy measures introduced by the Italian government aim to mitigate the impact of Coronavirus pandemic on the labour market, to protect employees and support businesses during the introduction of lockdown measures. These policy measures provide income compensation for temporary disruption of economic activities (ILO, 2020).

Cassa integrazione guadagni

The *Casa integrazione guadagni* provide income support to workers. Italy significantly extended the scope of this short time work scheme which compensate to employees 80 per cent of the gross wage and full social security contribution. Before the Coronavirus crisis the compensation was provided only to companies in the manufacturing and building construction with at least fifteen employees. With

declaration of a state of emergency, short time work scheme was expanded to all sectors of any size. (ILO, 2020).

Although the application process to STW scheme has been simplified, some of the recipients have experienced problems in accessing the STW scheme and receiving fast support. The participation of the employers has been postponed whereas benefit levels for employees remained same. As mentioned above, the compensations are 80% of the gross wages and capped at €998 for wages up to €2.159 and €1.199 for wages over this rank. Thus, for an employee with an average wage it means an effective replacement approximately 45% when the working hours decreased to zero. As in Germany, employers who were required to pay part of wages or social security contributions for not worked hours were reduced to zero (OECD, 2020).

Looking at the comparison of JR schemes, the main difference between the Czech *Antivirus Programme* and the German *Kurzarbeit* is that the German JR scheme is not based on the condition of obstacles at work, but on maintaining the partial employment. The advantage of the *Kurzarbeit* is the possibility to receive a contribution before the salary is paid compared to the *Antivirus Programme*. This also applies to the Dutch JR scheme *NOW*. In the Czech Republic, the employers must send a statement of paid wages to the Labour Office every month whereas in the Netherlands they report it over a period of three months. All four selected countries had STW schemes before the Coronavirus crisis, the Netherlands introduced the new temporary wage subsidy schemes. However only the Czech Republic and Germany increased the benefit generosity. In addition, all countries increased access and coverage of these schemes.

3. Literature Review

3.1 Introduction

As the devastating social and economic consequences of the Coronavirus crisis become apparent, a major challenge for governments is to limit adverse long-term effects on the labour market. The governments always try to limit the short-term effects, but the aim should be to limiting the long-term effects. To do this, it is first necessary to analyse properly what specifically for instance rising unemployment causes. To reduce the impacts of Covid-19 pandemic on the labour markets, EU countries have introduced the supportable labour market measures. These measures include JR Retention (JR) schemes which in various forms help firms and individuals to mitigate the negative impacts of Covid-19 on their well-being. All studied countries increased access, coverage and the benefit generosity of these schemes or introduced new ones. Since the JR schemes have been the main instrument in selected countries and were used unprecedently and widely, it is necessary to evaluate them.

This literature research will focus on JR schemes and their evaluation. Moreover, it reviews the most affected groups by lockdown measures. Secondly, it is trying to find out what impact of the spread of the Coronavirus had on macroeconomic variables especially on the unemployment rate. The literature review discusses several papers about impacts of Covid-19 on labour market in selected and other countries. Here are some of them; The first one is that of Chi-Wei Su et al. (2021) which assess the influence of Covid-19 on unemployment in five selected European developed countries such as France, Germany, Italy, Spain, and UK. The second paper from Anderton et al. (2021) which analyses the development of labour markets in the whole euro area since the beginning of the Covid-19 pandemic. The third paper is that from Bauer and Weber (2021) who focused on the impact of lockdown measures in Germany. The fourth paper is that from Ahmad et al. (2021) who predict the development of the unemployment rate of 6 selected European economies, including Germany and Italy. The results have shown that Italy and Germany have a significant positive change in unemployment due to Covid-19 (Chi-Wei Su et al., 2021). In terms of JR schemes, all reviewed studies confirm their undeniable positive effects on the unemployment rate during a pandemic. Nevertheless, authors stress that employment and unemployment data may not reflect the real situation and may be skewed due to the artificial employment caused by JR schemes (Anderton et al., 2021 & Bell, Codreanu and Machin, 2020). In addition, the most affected groups are women, young and less educated people.

In the existing empirical research, it could be found many researchers who examined microeconomic data from labour force surveys (Rodrigo Ignacio Barra Novoa, 2021 & Brewer, M. and Gardiner, L., 2020). However, these papers focused only on one specific country. That is probably due to the lack of labour force surveys focusing on more countries at once. Since The European Union Labour Force Survey 2021 release which includes data up to 2020 was not available at the time of beginning of writing this thesis, I decided to focus on the unemployment rate only in the Czech Republic.

3.2 Evaluation of Job retention schemes

According to Rodríguez-Caballero and Vera-Valdés (2020), the unemployment shocks after the pandemics are more persistent than in times without pandemics. Authors in their study are trying to assess the influence of pandemics on economic growth and unemployment in the UK and in other countries for instance in Italy and the Netherlands to show that the long-lasting effects are similar. They were studying the Great Pandemic of 1870–1875, Russian flu and the Spanish flu. They also suggest having policies for minimizing and avoiding job losses during the pandemic. Hence, it is important that governments implement effective JR schemes.

Papers focusing on the effectiveness and evaluation of JR schemes conclude that care must be taken when interpreting labour market statistics (Anderton et al., 2021 & Bell, Codreanu and Machin, 2020). It is undeniable that government support policies in the form of JR schemes have served their purpose and reduced the impact of the Covid-19 pandemic on the labour market specifically increased employment and decreased unemployment. On the other hand, we cannot estimate how many people will return to work and how many will be at risk of losing their jobs. The sharp fall in labour market participation indicates that there are probably more unemployed people than the unemployment rate which is skewed due to JR schemes show us (Anderton et al., 2021). For example, Bell et al. 2020 confirmed this in their study that employment fell while the official unemployment was not changed between February and June 2020 in the UK.

Looking at the comprehensive study from OECD, it has not been proven that JR schemes would hinder job creation or keep employees in companies with long-term problems for which JR schemes are not intended. In addition, the risk of increasing JR allowance dependence appears to be minimum. During the period when it was possible to resume economic activity, the utilization rate of JR schemes decreased rapidly. However, the JR schemes should not become a tool to support companies with structural problems because it threats the creation and redistribution of the job positions (OECD, 2020).

Most affected groups

In terms of the most affected groups, recent studies came up with the following findings. Alon, T. et al. (2020) analysed causes and consequences of why in the United States were more affected women in the job market than men during Covid-19 pandemic. In the previous crises it was opposite. They used a macroeconomic model which included variables such as gender heterogeneity, childcare needs, or human capital. Alon and his colleagues found out that it is caused by a larger share of women in the high contact jobs. A good example are hotels and restaurants. Another reason is the school's closure during the pandemic. Women faced on average more additional childcare obligations. Thus, this decreased their ability to work.

Furthermore, Bell, Codreanu and Machin (2020) compared the pandemic crisis caused by Covid-19 with the previous crisis in the UK from the labour market perspective. They found out similarities with the earlier crises. The crisis again hit mostly young, less educated, poor or minority citizens. This confirmed another study from Kartseva and Kuznetsova (2020) that young and low skilled people are at greater risk for job loss. Authors also pointed out that the Russian situation is not unique and other countries face similar shocks. However, Russia has a relatively big proportion of low skilled jobs. They are saying that it is important to support retention at the labour market by the government.

Another research suggests that less educated are one of the most affected groups. Chetty R. et al. (2020) build a public database with anonymized real-time data from private companies. This allows them to analyse many macroeconomic indicators such as consumer spending and for us more importantly employment rates. They pointed out that high income people reduced consumption in restaurants and other places that require in-person interactions. This influenced higher unemployment rates in these sectors where in-person interactions are needed, and mostly low skilled workers. In addition, the low skilled workers had higher persistence in unemployment than high skilled employees. Another interesting finding is that state-ordered reopening of economies had just a little impact on consumer spending and employment rates. Moreover, stimulus payments to low-income people causes an increase of their spending but this money did not flow to the most affected business by Covid-19.

Researchers from Joint Research Centre (2020) stress that the most affected groups are women with low wages and young people. They were trying to assess the Covid-19 restrictions implications on employment in European countries. They split employees into five categories to estimate impacts of Covid-19 restrictions. The 5 categories are Essential, Telework, Partly active, Mostly non-essential and Closed. They are also identifying groups of differences. Here are summarized key findings from these differences 1) by gender - in most countries women are represented more in fully closed business. 2) by age - an important part of young people is in the fully closed business. On the other hand, senior workers have a relatively larger share in the Essential sector. 3) by employment type - people with temporary contracts and self-employed people are relatively more involved in the closed sector. Nevertheless, there are some differences across Europe. The share of uncertain jobs is higher in Southern and Eastern Europe. 4) by skill level - High skilled workers have a relatively larger share in the telework sector. Low skilled workers are relatively more distributed in all sectors. 5) by wage - low skilled workers with low wages are mostly in closed businesses while employees with high wages are mostly participating in the telework sector. The authors are very consistent with previous research since they argue that the most impacted employees are young people and women with low wages. Authors also pointed out that it is a good idea to support the most endangered workers.

3.3 The impact of Covid-19 on unemployment rate

The number of Covid-19 cases has an impact on the unemployment rate. Looking at the empirical evidence, Chi-Wei Su et al. (2021) found this causality between the total number of Covid-19 cases and unemployment. In addition, they stated that the coronavirus pandemic rose the unemployment rate dramatically in most EU countries. This finding is supported by few other papers, like Ahmad et al. (2021) and Anderton et al. (2021). According to their econometric model, the total number of Covid-19 cases cause unemployment in Germany and Italy between December 2019 and December 2020. They used a Fourier causality test. Moreover, Chi-Wei Su et al. (2021) examines the causality between the unemployment and total number of Covid-19 deaths. In Italy, this causality has been proven. However, they concluded that they found the greater effect of the number of positive cases on the unemployment rate compared to deaths.

In addition, as mentioned before in the theoretical framework part, the Czech Republic has the highest number of Covid-19 deaths per million inhabitants. Although the fact that the Czech Republic ranked among the worst affected countries in Europe in terms of the number of new infections per million inhabitants, the impact on unemployment in the fourth quarter of 2020 was not as great as in other economies (Hedvičáková and Kozubíková, 2021). Currently, reference is being made mainly by employers to artificial employment which arises as a secondary effect of the government's taken measures. Thus, employment and unemployment data may not reflect the real situation and may be skewed. The issue is that in many cases are artificially maintained jobs which will disappear after the end of governments programs and assistance. At the same time, these employees could already look for a job in other positions.

Bauer and Weber (2021) focused on the short-term labour market impact of the lockdown measures introduced due to the spread of Covid-19 in Germany. They used a difference-in-differences method, distinguishing enterprises that are affected by the lockdown measures from the other enterprises. As explanatory variables, they used the days of economic shutdowns and days of curfews. Authors found that 60% of unemployed people became unemployed in April 2020 precisely because of preventive measures introduced by the German government. They concluded that STW schemes are apparently not enough to prevent a significant decrease in unemployment.

Bauer and Weber (2021) used lockdown measures as the indicator rather than number of positive cases. They distinguished between two industries those that have been affected by the preventive measures and those that have not. However, the unemployment in these industries developing similarly before the Covid-19 crisis and this limits their approach. Since the rise of positive cases results in the closure of businesses and shops by government leading to higher unemployment in the end, I decided to use the number of positive cases as an indicator in this research. Moreover, the number of positive

cases is more general. This research used linear regression, so it considered each new infected case and its effect on the unemployment. In addition, there could be a direct effect of infected people: the higher number of positive cases leads to uncertainty, people get more cautious and thus, the consumption and economic activity decline. On the other hand, the disadvantage of this research approach is the testing intensity which was different in each region of the Czech Republic.

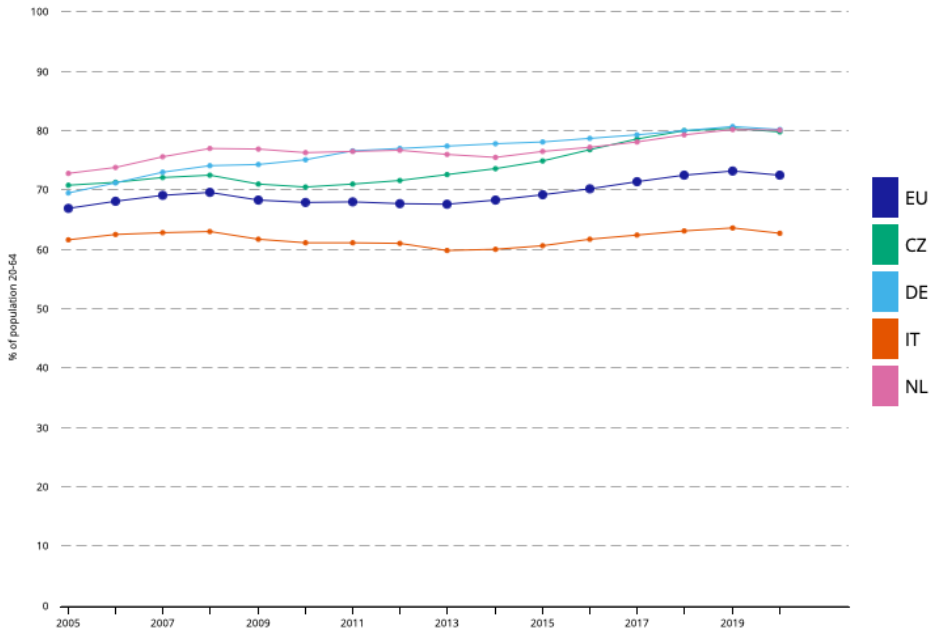
According to Ahmad et al. (2021) and their prediction model results, the unemployment rate in selected European countries will increase in the coming years due to Covid-19 and overcoming the consequences of coronavirus will take at least five years.

4. Economic analysis

4.1 Employment, unemployment and actual hours worked

The labour market of many European countries has been severely hit by the Covid-19 and subsequent regulation measures. The line graph below illustrates the EU employment rate for people aged 20 to 64. The EU employment rate decreased from 73.1 % in 2019 to 72.4 % in 2020, falling to the same level as in 2018. The drop was not so sharp compared to 2009, the year after the Global Financial crisis. The EU employment rate fluctuated over the period of the Great Recession between 2008 and 2013. The largest decline in employment compared to previous year was recorded in Italy by almost 1 %. In contrast, the employment in the Netherlands fell only by 0.01 %.

Figure 4. The EU employment rate (for people aged 20 to 64)



Source: Eurostat, Employment – annual statistics, 2021. *EUROSTAT*.

Table 2. Total employment for people aged 20 to 64 (percentage of total population)

GEO/TIME	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
EU	69.0	69.5	68.2	67.8	67.9	67.6	67.5	68.2	69.1	70.1	71.3	72.4	73.1	72.4
CZ	72.0	72.4	70.9	70.4	70.9	71.5	72.5	73.5	74.8	76.7	78.5	79.9	80.3	79.7
DE	72.9	74.0	74.2	75.0	76.5	76.9	77.3	77.7	78.0	78.6	79.2	79.9	80.6	80.1
IT	62.7	62.9	61.6	61.0	61.0	60.9	59.7	59.9	60.5	61.6	62.3	63.0	63.5	62.6
NL	75.5	76.9	76.8	76.2	76.4	76.6	75.9	75.4	76.4	77.1	78.0	79.2	80.1	80.0

Source: self-illustration, data source: EUROSTAT (lfsi_emp_a).

Table 3. Unemployment (percentage of active population)

GEO/TIME	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
EU	7.5	7.2	9.1	9.8	9.9	10.8	11.4	10.8	10.0	9.1	8.1	7.2	6.7	7.1
CZ	5.3	4.4	6.7	7.3	6.7	7.0	7.0	6.1	5.1	4.0	2.9	2.2	2.0	2.6
DE	8.7	7.5	7.8	7.0	5.8	5.4	5.2	5.0	4.6	4.1	3.8	3.4	3.1	3.8
IT	6.1	6.7	7.8	8.4	8.4	10.7	12.2	12.7	11.9	11.7	11.2	10.6	10.0	9.2
NL	4.2	3.7	4.4	5.0	5.0	5.8	7.3	7.4	6.9	6.0	4.9	3.8	3.4	3.8

Source: self-illustration, data source: EUROSTAT (une_rt_a).

The unemployment rose more slowly due to the existence of Job Retention schemes and transitions into inactivity. The EU unemployment rate reached from 6.7 % in 2019 to 7.1 % in 2020. However, a more interesting indicator for our analysis is index of total actual hours worked. The table 4 below shows that occurred drop of average hours worked. Demand for goods and services has fallen. This was accompanied by a decline in the availability of labour in the European labour market with actual hours worked in the second quarter of 2020, 14.1 index points below the level in 2006 and 15.2 points below the level in the second quarter of 2019. The number of actual hours worked increased in the third quarter of 2020 but fell slightly in the last quarter.

Table 4. Index of total actual hours worked in the main job (2021 = 100)

GEO/TIME	2019Q1	2019Q2	2019Q3	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4	2021Q1	2021Q2
CZ	105	102	103	103	100	90	103	91	99	101
DE	105	104	104	106	:	:	:	:	99	101
EU	104	103	103	104	100	87	101	98	99	101
IT	107	106	107	108	97	80	103	100	99	101
NL	97	98	98	98	96	92	98	96	102	98

Source: self-illustration, data source: EUROSTAT (lfsi_ahw_q).

Furthermore, table 5 below shows that the labour force dropped to a record low level in the second quarter of 2020 compared to second quarter of 2019, by almost 5 million fewer people. Units are measured in thousand. In the last two quarters of 2020, the number of worked people increased, however, did not reach the same level as in the last quarter of 2019. Index of total actual hours worked changed significantly more than employment and GDP.

Table 5. Employed persons (from 15 to 64 years)

GEO/TIME	2019Q1	2019Q2	2019Q3	2019Q4	2020Q1	2020Q2	2020Q3	2020Q4	2021Q1	2021Q2
EU	192902,4	194937,1	195758,9	195796,9	193300,5	189942,7	192171,8	192687,7	189,514,7	192,946,9
CZ	5154,8	5141,6	5153,6	5153,8	5126,5	5064,7	5086,7	5069,6	5023,5	5023,8
DE	40826,4	40681,2	41153,3	41599,4	:	:	:	:	40,036,8	40,059,4
IT	22396,9	22850,8	22796,2	22704,7	22395,9	22032,7	22189	22273,2	21,345,2	22,136,0
NL	8617,4	8679,4	8727,1	8733,1	8741,2	8622,6	8660,9	8699,4	8869,8	9034,4

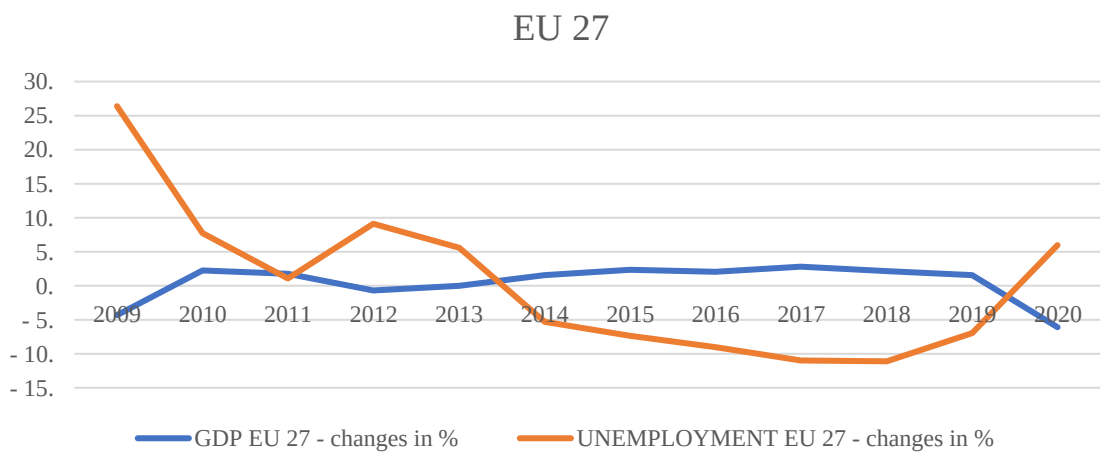
Source: self-illustration, data source: EUROSTAT (lfsq_pganws).

Table 6. Real GDP growth rate (2007-2020)

GEO/TIME	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
EU	-4.3	2.2	1.8	-0.7	0.0	1.6	2.3	2.0	2.8	2.1	1.6	-6.1
CZ	-4.7	2.4	1.8	-0.8	0.0	2.3	5.4	2.5	5.2	3.2	2.3	-5.6
DE	-5.7	4.2	3.9	0.4	0.4	2.2	1.5	2.3	2.6	1.3	0.6	-4.8
IT	-5.3	1.7	0.7	-3.0	-1,8	0.0	0.8	1.3	1.7	0.9	0.3	-8.9
NL	-3.7	1.3	1.6	-1.0	-0.1	1.4	2.0	2.2	2.9	2.4	1.7	-3.7

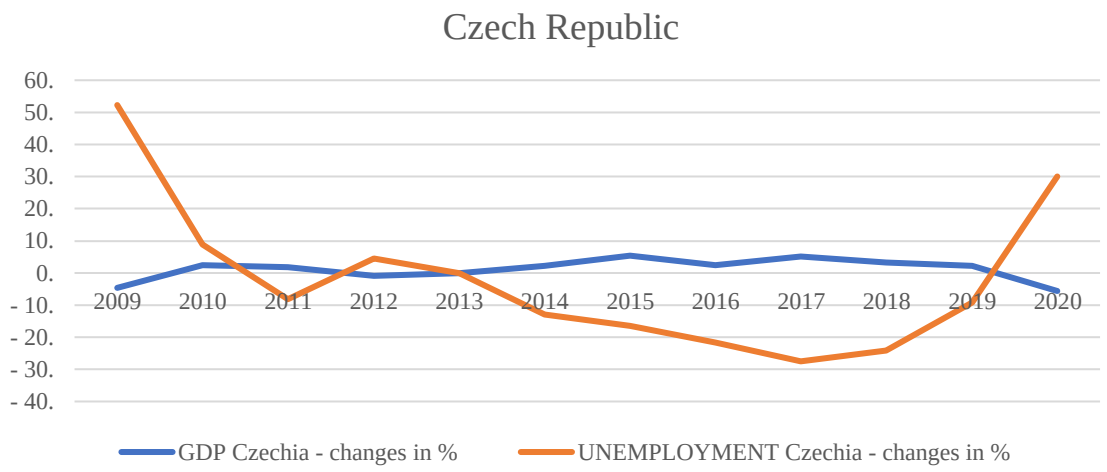
Source: self-illustration, data source: EUROSTAT (tec00115).

Figure 5. GDP and unemployment changes in %



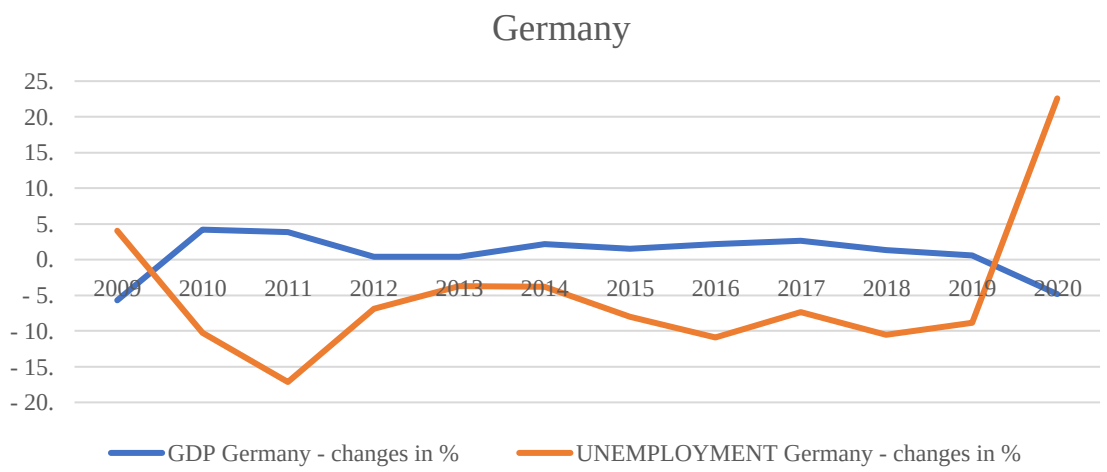
Source: self-illustration, data source: EUROSTAT.

Figure 6. GDP and unemployment changes in %



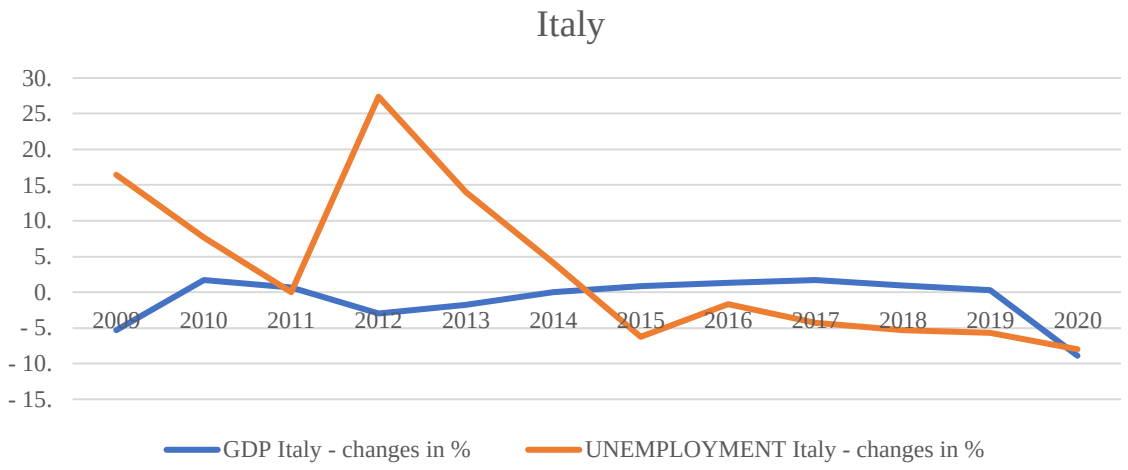
Source: self-illustration, data source: EUROSTAT.

Figure 7. GDP and unemployment changes in %



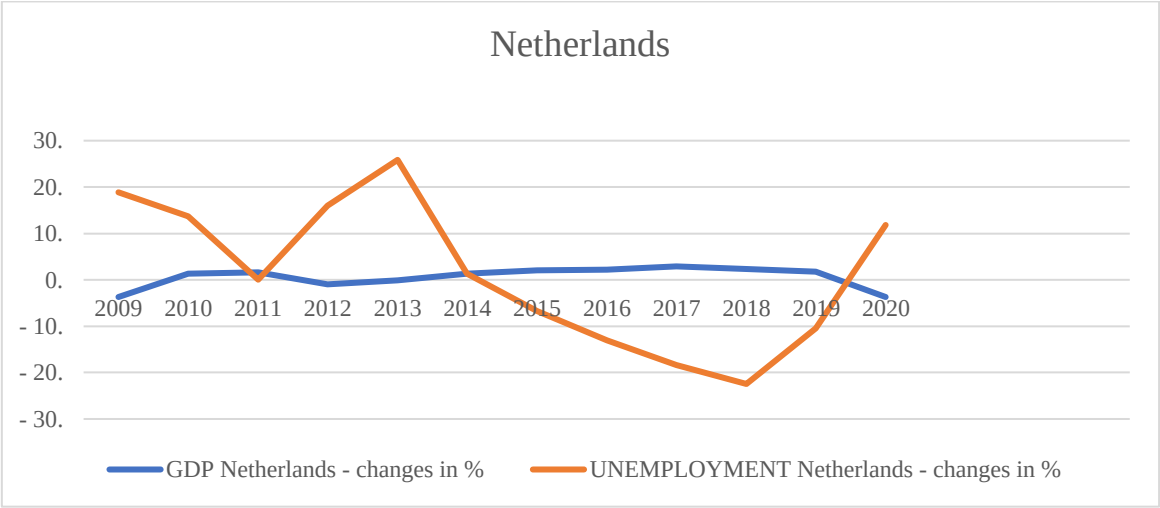
Source: self-illustration, data source: EUROSTAT.

Figure 8. GDP and unemployment changes in %



Source: self-illustration, data source: EUROSTAT.

Figure 9. GDP and unemployment changes in %



Source: self-illustration, data source: EUROSTAT.

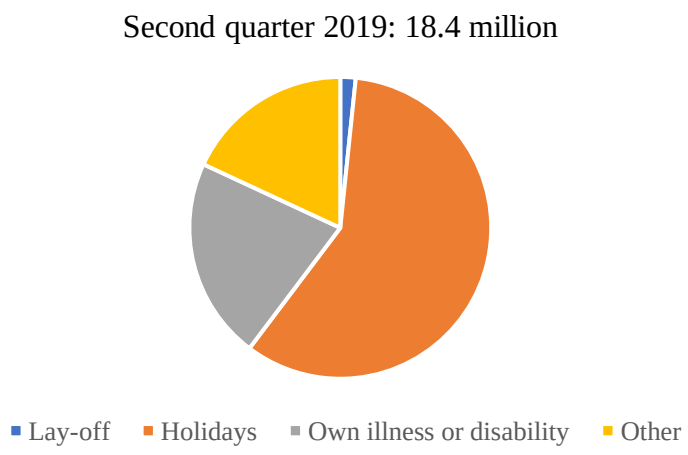
In the figures 6, 7, 8 and 9 above, it could be seen that the volatility in unemployment in percentage changes is relatively greater than volatility in percentage changes in GDP. In most countries, except Italy, we can see an increase in unemployment during pandemic years (2019 and 2020) and a decrease in GDP as well. According to Tommaso Colussi (2020), falling unemployment in Italy can be explained by the fact that the lockdown measures on employment levels have not manifested yet. The aid provided by the government and the suspension of the layoffs have mitigated the short-term effect of Coronavirus pandemic on the labour market. Italy registered a decline in the unemployment at the end of March 2020 compared to March 2019. The fall in unemployment reflected a significant rise in the number of economically inactive people.

4.2 Absence from work

"Absence from work" as listed in the EUROSTAT database is defined as: persons who are employed and have a formal attachment to employment. Examples of such as formal attachments are salaries, wages, and security of return to work. The European Labour Force Survey mentioned leave, self-illness, short-term work and temporary lay-off as reasons for such absences. Workers who have been temporarily made redundant are classified as employees if they are guaranteed to return to work within three months or receive at least 50 % of their wages or salary from their employer.

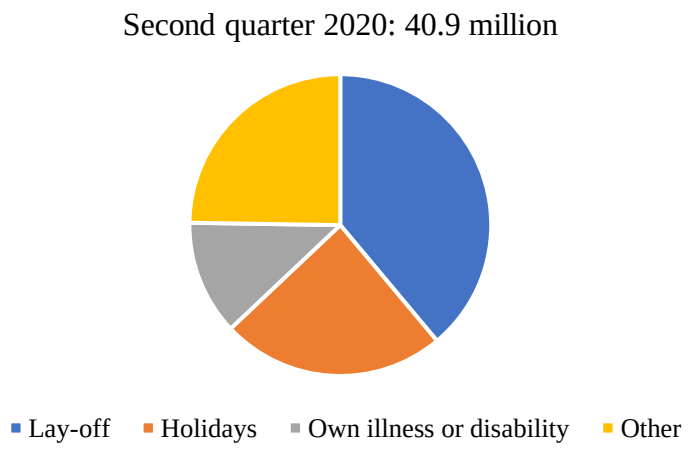
At the EU level, in the second quarter of 2020 approximately 40.9 million people aged between 20 and 64 were temporarily absent from work for some reason which is twice as many as compared to the previous year's period. More than 50 % of absences were caused by lay-off due to par-time work or similar reasons.

Figure 10. Absence from work by main reason 2019Q2



Source: self-illustration, data source: EUROSTAT (lfsi_abs_q).

Figure 11. Absence from work by main reason 2020Q2



Source: self-illustration, data source: EUROSTAT (lfsi_abs_q).

5. Data and methodology

The Coronavirus recession provides a new research space to describe how the Covid-19 pandemic harms the labour market. It was decided to examine how Covid-19 measured as the number of positive cases affected unemployment in one specific country namely in the Czech Republic. The main reason is that testing intensity was different in each selected country, so the results could be skewed.

In this thesis, the data are combined from publicly available official statistics of the Czech Statistical Office (ČSÚ) and The Ministry of Health of the Czech Republic. To better demonstrate the impacts of the Covid-19 on the labour market, individual regions of the country were examined as well. The dataset contains data on the unemployment rate and the number of positive cases. All data are available for 14 regions of the Czech Republic on a monthly basis from March 2020 to May 2021. These are therefore panel data with a cross-sectional unit (region) and a time unit (month). The informative value of the interpreted results is higher for the monthly data than for quarterly data. However, the strength of the Covid-19 epidemic varied on a weekly basis rather than on a monthly or even quarterly basis. Monthly data were selected for this research because weekly data were not available, the unemployment is measured only on monthly basis.

5.1 Descriptive statistics

This part presents the basic descriptive statistics of variables that are used in this thesis. Table 7 shows descriptive statistics of variables used for the reader's idea of what values the variables acquire. In addition, methodologies of their measurement, advantages, and disadvantages of use in models and possible alternatives to selected indicators are also provided. Lagged variables are variables that are lagged by one or two months. It is the same as using lag function in RStudio, but it is here just to show the descriptive statistics of these variables.

Table 7. Descriptive statistics unemployment and positive cases

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
unemployment	210	3.8	1.0	2.0	3.0	4.3	6.1
unemployment_lag	196	3.8	1.0	2.0	3.0	4.3	6.1
positive_cases	210	7,815.2	9,584.9	7	254.8	13,077.5	47,134
positive_cases_lag	196	8,227.6	9,788.4	7.0	183.5	13,438.5	47,134.0
positive_case_lag2	182	8,353.2	10,110.1	7.0	167.2	13,687.2	47,134.0

Source: own calculations, data source: ČSÚ.

Column *n* indicates the number of observations. The number of observations varies because delayed variables are used. Column *Mean* gives the arithmetic mean calculated across all cross-sectional units and months, following column *St. Dev.* indicates the standard deviation. Furthermore, the last columns

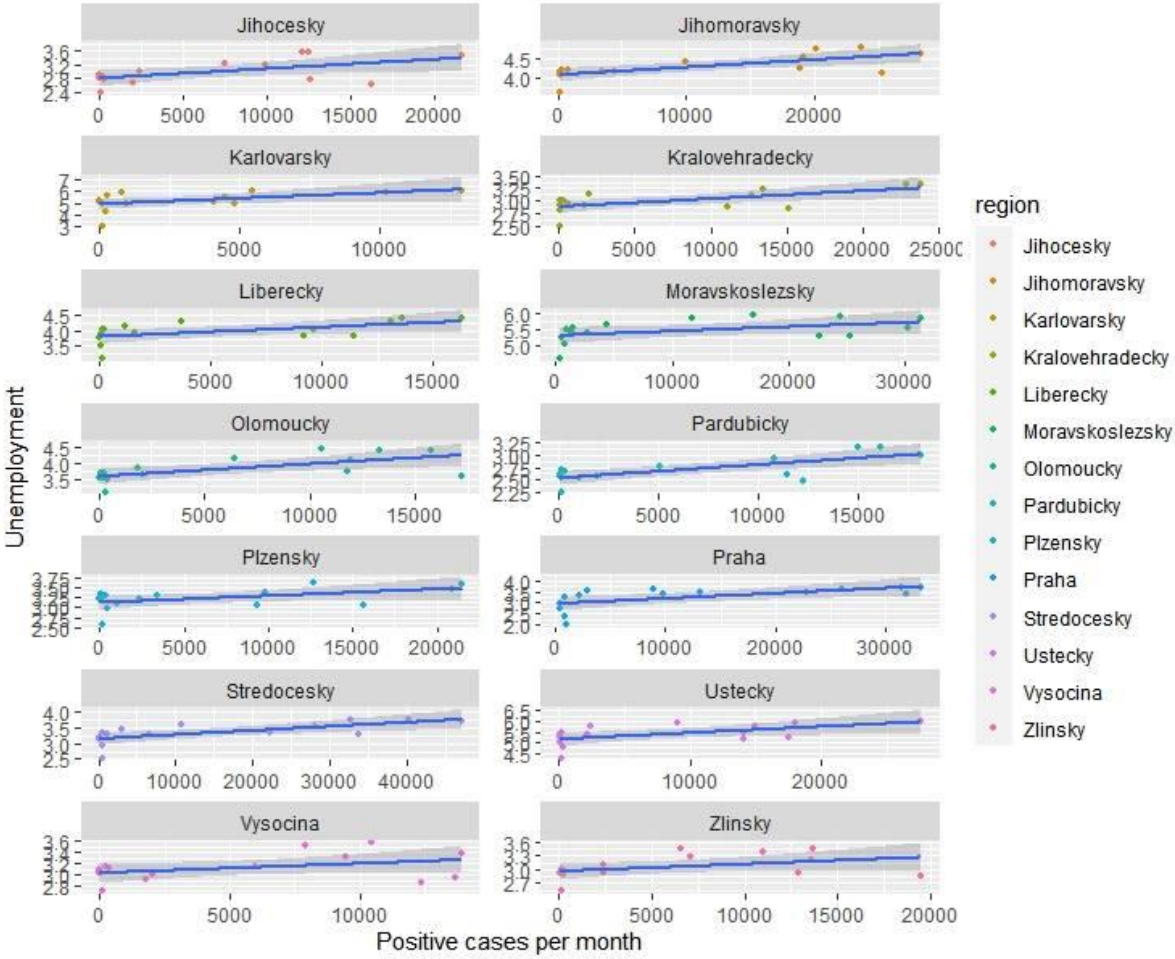
Min and *Max* indicate minimum respectively maximum value in the monitored period. Table shows that the maximum unemployment from March 2020 to May 2021 was 6.1 % and the maximum number of positive cases was 47.134 in some of the regions of the Czech Republic. Moths before the Coronavirus started were not included because it might bias the estimates in econometric models.

5.1.1 Unemployment

The unemployment rate (endogenous variable $unempl$) in the observed period between March 2020 and May 2021 fluctuated from 2.0 % to 6.1 % with an average value slightly below 4 %. For the purposes of this thesis, unemployment data are used from the ČSÚ which adopts the internationally recognized methodology of the *International Labour Organization* (ILO). This indicator, officially called *general unemployment rate*, is determined in the Czech Republic by Labour Force Sample Survey (LFSS) which includes approximately 27.000 household ensuring a representative distribution across the population. In addition, the survey is based on the principle of a "rotating panel" design where a fifth of households surveyed are changed every quarter. According to the ILO methodology, unemployed person is a person over 15 years of age who has not worked at least 1 hour for a wage, salary, or another rewards, is actively looking for a job and is able to start work within 14 days (ILO, 2020). The significant advantage of use of the general unemployment rate compared to the purely national indicator of the share of unemployed persons from the Ministry of Labour and Social Affairs of the Czech Republic (MPSV) is that the general unemployment rate also reflects undeclared work if the respondent admits it in an anonymous questionnaire although he is registered as unemployed and receives state support. In this case, according to the ILO, the respondent is not considered as unemployed and does not artificially increase the indicator of the general unemployment rate. Another important difference in the calculation methodologies lies in the basis against which the number of unemployed persons is related. The general unemployment rate indicator chosen for this research indicates the ration of unemployed to economically active population whereas the share of unemployed persons by MPSV is defined as the number of unemployed applicants 15-64 years (MPSV, 2020). Moreover, the advantage of using the indicator of the general unemployment rate according to the ILO is the possibility of comparing the results of this thesis with other European research using the international ILO methodology.

The figure 12 illustrates the overall development of the general unemployment rate in individual regions based on the positive cases per month. These values are interspersed with a linear trend using the *Ordinary Least Squares* method (OLS) which shows the direction of the dependence. The figure serves for descriptive purposes only. In all regions of the Czech Republic, there is an obvious positive growing trend from the beginning to the end of the observed period. The figure 12 seems to show a positive correlation between these two variables but this assumption will be later proved or rejected by econometrics models.

Figure 12. Development of unemployment by region based on the positive cases per month



Source: own processing in the RStudio programme, data source: ČSÚ.

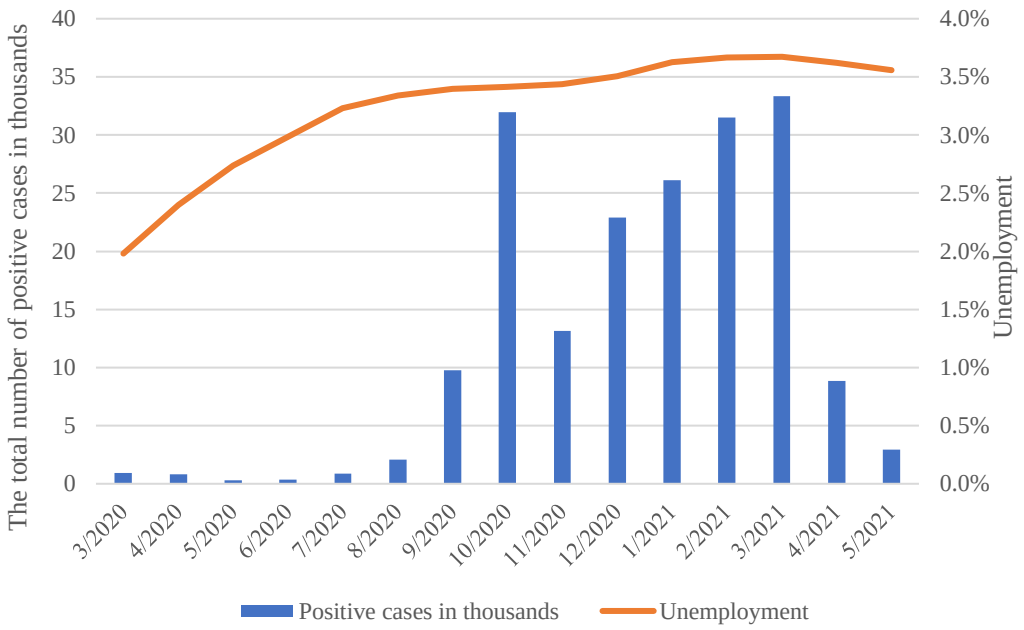
5.1.2 Positive cases

The number of positive cases (exogenous variable $positive\_cases$) indicates the number of people who were tested positively on Covid-19 in each region and month. I am aware that this variable is not ideal because does not capture the exact number of infected people. I chose a reporting methodology within one country. However, the problem of testing intensity also occurs within regions. People were tested at a different intensity in each region. There are several inconsistencies; for instance, in the Prague region, the unemployment increased significantly at the beginning of the observed period. As we can see on the figure 13 below, the unemployment rose gradually during the first wave of the pandemic whereas the real number of confirmed positive cases was very low. Between March and September 2020, the unemployment increased from 1.98 % to 3.39 % while the number of positive cases was only 914 in March and reached less than 10 000 in September 2020. On the other hand, the number of positive cases peaked at 31 994 persons in October 2020 before falling dramatically to about 1 300 cases in November 2020 whereas the unemployment showed only a very slight increase.

This occurred due to the temporary government measures against the spread of Covid-19 which were introduced in October 2020 and the declaration of the state of emergency in March 2020. Dummy

variable for lockdown in October 2020 was not possible to add into the regression since the measures taken by government were changing almost on daily basis in Czech Republic and were different in each region according to the current situation. Before Christmas 2020 the government eased almost all taken measures and introduced them back in January 2021. Hence, defying the start and the end of the lockdown would be inaccurate.

Figure 13. Development of positive cases and unemployment in the Prague region

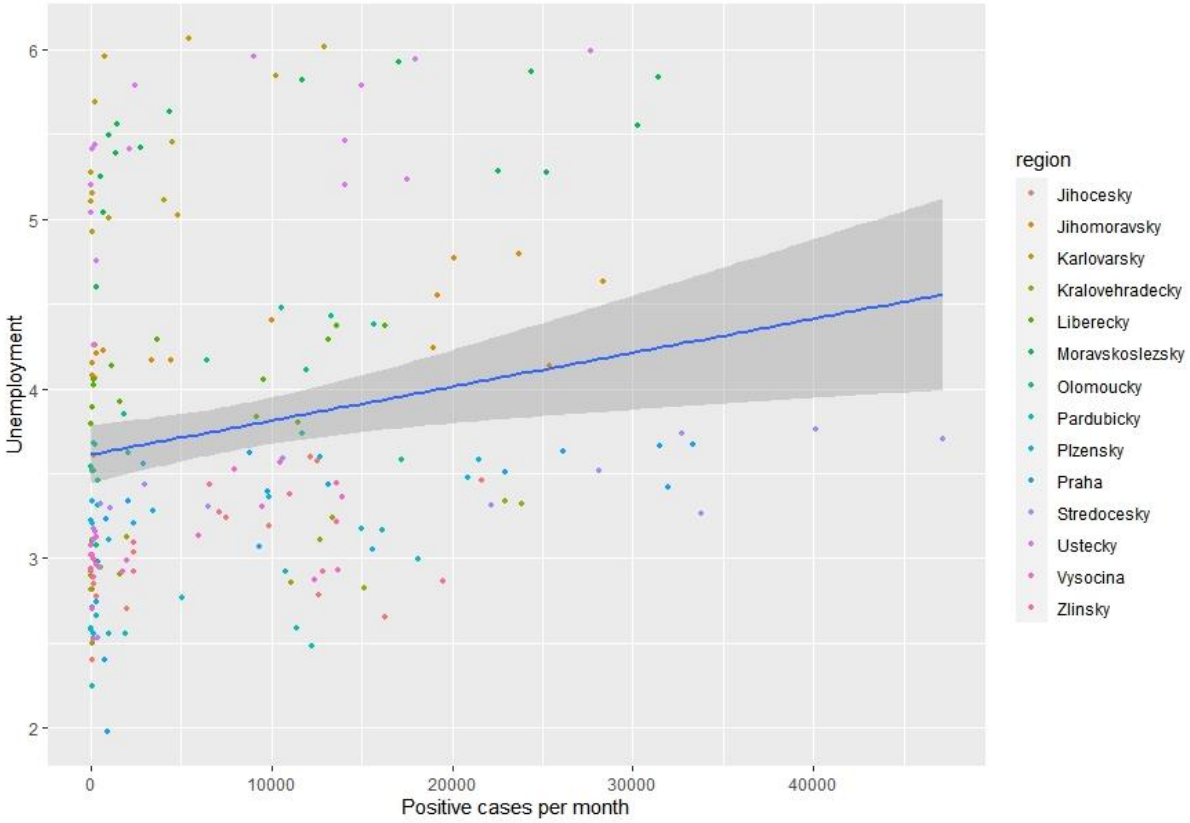


Source: own processing, data source: ČSÚ, The Ministry of Health of the Czech Republic.

The figure 13 above shows data starting from March 2020 since there were no positive cases prior to this month. The first positive case was discovered in March 2020. We must be aware that the variable of positive cases includes just the number of confirmed cases by laboratories but not the actual number of positive cases in the society. This variable is unmeasurable. On March 14, 2020, all stores were closed except those with food, electronics, fuel, pharmacies, opticians, animal goods and feed, laundries, and newsagents. Other restrictive measures include a ban on re-exports of medicines and medicinal products registered on the Czech market to the EU. Moreover, there was a restriction on exports outside the EU (Government of the Czech Republic, 2020). As a result of these restrictive measures, large companies and small and medium enterprises have closed, and many people have been laid off because employers had nothing to pay (Akbulaev et al., 2020). According to Hedvičáková and Kozubíková (2021), the average number of hours worked per week fell by 3.6 hours year-on-year to 31.6 hours in the Czech Republic due to the Coronavirus pandemic. Thus, although there were not so many positive confirmed cases, the closure of economy caused an increase in unemployment.

The following figure 14 gives information about the development of unemployment of 14 regions merged into one based on the positive cases per month. The blue line shows growing trend with 95 % confidence interval in the whole Czech Republic across all months from March 2020 to May 2021.

Figure 14. Development of unemployment by region based on the positive cases per month



Source: own processing in the RStudio programme, data source: ČSÚ, The Ministry of Health of the Czech Republic.

5.2 Fixed-Effects Model

The method of Fixed-Effect (FE) and the method of Random-Effect (RE) will be used to estimate econometric models. The Hausman test will be used to assess which model is more appropriate. It is based on testing the covariance between the vector of exogenous regressors in the model and the unobserved heterogeneity (Hausman, 1978). If the tested hypothesis of zero covariance cannot be rejected, the RE model is considered more relevant. Otherwise, in case of rejecting the tested hypothesis of zero covariance, the FE model is more appropriate.

The result of regression is summarised in the table 8 below. The table shows the six model specifications using the FE method. An F-test was performed which shows the statistical significance of the model. The individual columns marked as (1) – (6) denote 6 differently specified econometrics model hereinafter referred to as model (1) – model (6). Models (5) and (6) seems to be the most relevant

model that most accurately determinates how Covid-19 measured as the number of positive cases affected unemployment because their adjusted coefficient of determination R^2 is the highest. The coefficient of determination R^2 captures the extent to which the exogenous variables used in the model can explain the variability of the endogenous variable. Due to the fact, that both models include lagged endogenous variable the R^2 is not reliable. Therefore, GMM method is used afterwards.

Table 8. FE estimates – The impact of the number of positive cases on unemployment

	Dependent variable:					
	log(unemployment)					
	(1)	(2)	(3)	(4)	(5)	(6)
I(positive_cases/1000)	0.0057***	0.0017**		0.0016***	0.0011***	0.0010**
	(0.0007)	(0.0007)		(0.0006)	(0.0004)	(0.0004)
I(positive_cases_lag/1000)		0.0039***	0.0024***	0.0012*	0.0005	0.0013***
		(0.0007)	(0.0006)	(0.0007)	(0.0005)	(0.0005)
I(positive_case_lag2/1000)			0.0029***	0.0030***	0.0008*	
			(0.0006)	(0.0006)	(0.0005)	
unemployment_lag					0.1476***	0.1395***
					(0.0127)	(0.0090)
Observations	210	196	182	182	182	196
R^2	0.2515	0.3807	0.4309	0.4560	0.7018	0.7367
Adjusted R^2	0.1978	0.3291	0.3794	0.4033	0.6708	0.7132
F Statistic	65.5188***	55.3216***	62.8364***	46.1056***	96.4729***	166.9752***
Note:						*p<0.1; **p<0.05; ***p<0.01

LSDV estimate

The table 9 below shows estimates using LSDV method. The estimates are identical to model (6) but also include regional dummy variables. Many of them are statistically significant. Ústecký and Moravskoslezský region have the higher level of unemployment while Pardubický region reports lower level of unemployment. LSDV estimate is complement to FE method allowing more precise prediction. In addition, I have incorporated quarterly time dummies into the model. The seasonality in the unemployment rate can be better observed on quarterly data than on monthly basis. Therefore, I decided to use quarterly time dummies instead of month dummies. The results are displayed on the right-hand side in the table 10 below. The base quarter is Q1 (months January, February, and March) and therefore there are just Q2, Q3 and Q4 in the model. All three dummy variables are statistically significant on the 1% significance level suggesting that the unemployment rate is strongly influenced by seasonality. Compared to the base quarter Q1, all the other seasons show lower unemployment - on average, the unemployment rate in Q2 is lower by 8,4% (not percentage points) on average, by 7,7% in Q3 and by 6,3 in Q4 all compared to Q1. These results are in line with the expectations since winter offers the least job offers due to rainy and freezing weather which does not almost allow outdoor work such as for example road construction.

Table 9. LSDV

	Dependent variable:	
	log(unemployment)	
	(1)	(2)
I(positive_cases/1000)	0.001** (0.0004)	−0.001** (0.001)
I(positive_cases_lag/1000)	0.001*** (0.0005)	0.001*** (0.0004)
unemployment_lag	0.140*** (0.009)	0.118*** (0.009)
Stredocesky	0.001 (0.015)	0.010 (0.013)
Jihocesky	−0.045*** (0.016)	−0.064*** (0.014)
Plzensky	−0.0002 (0.016)	−0.014 (0.014)
Karlovarsky	0.227*** (0.025)	0.247*** (0.024)
Ustecky	0.212*** (0.025)	0.248*** (0.023)
Liberecky	0.109*** (0.018)	0.108*** (0.016)
Kralovehradecky	−0.047*** (0.016)	−0.064*** (0.014)
Pardubicky	−0.108*** (0.016)	−0.133*** (0.014)
Vysocina	−0.023 (0.016)	−0.042*** (0.014)
Jihomoravsky	0.123*** (0.018)	0.141*** (0.016)
Olomoucky	0.085*** (0.017)	0.084*** (0.015)
Zlinsky	−0.031** (0.016)	−0.049*** (0.014)
Moravskoslezsky	0.202*** (0.025)	0.248*** (0.023)
Q2		−0.084*** (0.012)
Q3		−0.077*** (0.013)
Q4		−0.063*** (0.009)
Constant	0.717*** (0.029)	0.875*** (0.031)
Observations	196	196
R^2	0.974	0.982
Adjusted R^2	0.972	0.980
Residual Std. Error	0.041 (df = 179)	0.035 (df = 176)
F Statistic	425.958*** (df = 16; 179)	493.426*** (df = 19; 176)
Note:		*p<0.1; **p<0.05; ***p<0.01

5.3 Results and Limitations

According to the F-test, model (1) is statistically significant at the 1 % level of significance and the adjusted coefficient of determination indicates that the selected exogenous variable explains 25 % of the variability of the dependent variable; an increase in the number of newly infected by 1 000 in the region and month will cause an average increase in unemployment by 0.57 % (compared to the previous month).

The delay of the number of positive cases by one month is incorporated in model (2) which shows that both the original and the delayed variables are statistically significant. The effect of non-delayed variable of positive cases on the unemployment rate decreased to 0.17 % and the effect of the delayed variable of positive cases is 0.39 %. Adding a delayed variable to the model increases the coefficient of determination and the model has a higher indicatory value. It seems that the delayed variable has slightly greater effect on the unemployment rate. That is because the economy is not able to adjust quickly to the real situation. Therefore, the delayed variable has the bigger impact than the non-delayed variable.

For model (3), a two-month delayed variable of the number of positive cases is added and its effect is 0.29 %. Moreover, the effect of the one-month delayed variable decreased from 0.39 % to 0.24 %.

Furthermore, model (4) includes non-delayed variable of positive cases, one-month delayed variable of positive cases and two-months delayed variable of positive cases. All three variables are statistically significant at least at the 10 % level of significance. This shows that the direction of dependence of the delayed and non-delayed variable is still the same. For model (4) effects, see table 9.

Model (5) indicates that if the unemployment increases by 1 percentage point in the previous month, then the current unemployment rate in the same region will increase by 15.90 %.

The last model (6) suggests that if the unemployment increases by 1 percentage point in the previous month, then the current unemployment rate in the same region will increase by 14.97 %. The effect of non-delayed variable is 0.1 % and 0.13 % of one-month delayed variable. The effect of model (6) may seem to be insignificant, however, we can see that in fact the month-on-month change was not only the increase of new positive cases by 1 000 but even by 10 000. For instance, in the Prague region in October 2020, the number of positive cases increased by 22 000 month-on-month.

At the first glance it seems that the most relevant model can be considered both models (5) and (6). It seems that they could best explain the variability of the dependent variable. This is because the model (6) has the largest coefficient of determination and the adjusted coefficient R^2 as well. The coefficient of determination R^2 reached 73 % which would mean that the model explains almost three quarters of the variability of the dependent variable. However, the inclusion of a delayed unemployment rate in the model creates endogeneity bias. The endogeneity is defined as a correlation between the explanatory variables and the error term in a regression (Roberts, M. and Whited, T., 2013). Therefore, the more suitable estimation method is Generalized method of moments (GMM).

Generalized method of moments (GMM)

I used another estimation method GMM because it is used in case of endogeneity bias. According to the model, the number of positive cases has no effect on the unemployment. Moreover, based on z-value the variable is insignificant. The delayed unemployment rate is also statistically insignificant due to large z-value. One of the reasons why the estimates are not significant may be small N (in this case just 14 regions). The GMM method is very sensitive to small N and therefore, Anderson & Hsiao estimator will be used.

From the table 10 below we can see that none of the variables is statistically significant even at the 10% level of significance. This means that neither the number of positive cases nor the delayed number of positive cases nor the delayed unemployment rate has a direct effect on the current unemployment rate.

Table 10. GMM method

	Dependent variable:	
	log(unemployment)	
	(1)	(2)
I(positive_cases/1000)	−0.0001	0.0001
	(0.0003)	(0.0002)
I(positive_cases_lag/1000)		−0.0006
		(0.0005)
lag(unemployment, 1)	0.3835	−0.8354
	(0.5074)	(0.6215)
Observations	14	14
Note:	*p<0.1; **p<0.05; ***p<0.01	

Anderson & Hsiao (1981)

Even more precise estimates can be done using method described by Anderson & Hsiao (1981). The table 11 below shows the estimates using Anderson & Hsiao (1981) estimation method. This method is especially useful for panel data with low N (in this case just 14 regions), since the consistency is based on N*T, instead of on N only. However, the results remain the same as in the previous models – both positive cases and unemployment variables are statistically insignificant even on the highest possible 10% level. Results suggest that the current level of unemployment cannot be predicted by lagged unemployment nor by the number of positive cases. The unemployment could be affected by the number of positive cases provided that the government does not compensate worker's wages. Wage

compensation caused irrational behaviour of many companies which did not lay off their employees only thanks to 100% wage compensation.

Table 11. GMM Anderson & Hsiao

	Dependent variable:
	log(diff(unemployment))
diff(I(positive_cases/1000))	0.370
	(0.574)
lag(diff(unemployment))	8.322
	(26.965)
Constant	−3.874
	(4.913)
Observations	95
R^2	0.086
Adjusted R^2	0.066
F Statistic	0.555
Note:	*p<0.1; **p<0.05; ***p<0.01

The effect of the number of positive cases is very weak because from the beginning of the pandemic the rise in unemployment was huge, although the number of positive cases was not so marked and declined several times. There are several reasons why the effect of the number of positive cases is weak; firstly, the seasonal unemployment – in some month the unemployment is higher compared to others. If there was no seasonality, the unemployment might be a little different. The unemployment does not develop only according to the number of positive cases. To estimate the effect of seasonality on the unemployment, quarterly dummies were added into the model. Nevertheless, there are just 14 months covered in the dataset which is not a sufficient sample to clearly specify the magnitude of the effect. Therefore, including quarterly time dummies seems of minor importance. For further analysis, I would recommend running a long-term regression to obtain reliable results of the effect of seasonality on unemployment. Secondly, the global economic situation – restrictions on tourism, the closure of businesses, stopped exports and imports etc. The Covid-19 has slowed the economy by reducing the total number of jobs on the labour market. Furthermore, the coronavirus recession damaged the production of many companies (Chi-Wei Su et al., 2021). Even the world's largest manufactories have suspended the production of their products such as car manufacturers (Ahmad et al., 2020). In April 2020, sales of new passenger cars dropped by 53 % because of the restrictive measures taken against the spread of Covid-19 and decreased demand in the Czech Republic. One of the largest declines in sales

was recorded by Škoda Auto. The carmaker temporarily stopped the production on March 20, 2020. The suspension of production had negative impact not only on Škoda Auto employees but also on supplier companies. In the Czech Republic, Škoda Auto employs around 37 000 people including those through employment agencies (Kufelová, I. and Raková, M., 2020).

There are also few limitations of the econometric model. For future expansion of the economic model, I would recommend the addition of other exogenous variables such as the occupancy of hospitals or the number of tests. In terms of occupancy of hospitals, the Ministry of Health of the Czech Republic kept secret these data from the public during the year 2020. The Institute of Health Information and Statistics of the Czech Republic (ÚZIS) began to publish a different data structure with an explanation that better describes the actual state of hospital occupancy, to distinguish between covid beds and non-covid beds from the beginning of March 2021. In addition, antigen testing started in December 2020, so the testing intensity increased.

For the FE method, until I include delayed unemployment, the results appear to be reasonable and roughly in line with the literature. The correlation was shown to be positive; a higher number of positive cases leads to a higher unemployment. Statistically the effect is significant, however the real effect is weak. The GMM method showed no effect. The unemployment is caused not only by Covid-19 but also by the economic situation, restrictive measures etc. The government artificially supported employment – it paid wages back to all closed companies. The entrepreneurs had to pay wages to their employees, but then the state paid it back to the entrepreneurs in full. Employers had no reason to lay off employees because 100 % of their wage costs were paid by the state. This was only for closed businesses (restaurants, shops, retail, services, etc.). I supposed that this is the reason why the effect is very weak or non-existent.

6. Conclusion and discussion

The main purposes of this thesis were to analyse the impacts of the Covid-19 pandemic on the labour market in the year 2020 in four selected European countries and found out how Covid-19 affected the unemployment rate in the Czech Republic. We found out that the labour market slack is certainly greater than indicated by the unemployment rate. This occurs due to Job Retention schemes. Although people are officially employed, the index of total actual hours worked and absence from work show that people are not actually working.

In terms of JR schemes in selected countries which aimed to mitigate the impacts of Covid-19 pandemic and subsequent economic inactivity, it is particularly important that the financial aid reaches entrepreneurs in time. For schemes to serve their purpose, they must firstly be timely, secondly properly targeted, and thirdly temporary. Since the Covid-19 crisis is not over yet, governments must continue to provide support to affected companies in a timely manner. Reducing delays in payments to a minimum is essential for the effectiveness of JR support, but there are significant differences between countries between the application and the first payment. Where possible, payments should be made at least in part in advance and any required eligibility checks should be made later. This was not the case of all monitored countries; in the Czech Republic and Italy, some recipients encountered problems such as bureaucracy and untimely support. Czech policymakers should be inspirated by the German scheme and pay out the compensation in advance. Given that the most affected groups are women, young and less educated people, JR schemes should mainly support the most endangered employees. Despite the JR schemes, we found out that the unemployment rate in the Czech Republic increased with the number of positive cases. Thus, this must be caused by the unemployment that could not be prevented by the JR schemes. Given that fact, there could be a heterogeneity across the type of jobs that can be saved by JR schemes and those that cannot.

There are also a few limitations of the econometrics model described in the previous chapter. Since unemployment is a very complex indicator, it’s very difficult to estimate this rate based on just a few exogenous regressors. The major problem of the variable positive cases is that it does not fully show the real situation in the country – according to many experts, the actual number of positive cases is always larger than the number of positive tests because a certain percentage of people are asymptomatic meaning that they do not suffer from respiratory problems, exhaustion, or other typical symptoms of Covid-19. These people also might be positive but do not take a test to confirm the disease. Another issue that probably caused that the variables used in the models are statistically insignificant are governmental regulations. The measures that were introduced during the Covid-19 crises strongly influenced the unemployment rate causing the rate to not behave in a natural way. The announcement of strict quarantines restricting most economic activities resulted in a decrease in the number of hours

worked and productivity – negative supply shock. Furthermore, there also could be a direct effect of infected people: the higher number of positive cases leads to uncertainty, there are changes in the behaviour of households and companies in the form of reducing consumption and investment – negative demand shock. Furthermore, from the LSDV model, seasonality seems to play a role in unemployment. However, in this case, there are too few observations to obtain reliable estimates of quarterly seasonal effects.

For the future analysis of the impact of Covid-19 on the unemployment rate, I would recommend adding other exogenous variables such as the occupancy of hospitals or the death rate (number of people who died of Covid-19). As already mentioned, the Ministry of Health of the Czech Republic kept the data concerning hospital occupancy in the course of 2020 secret from the public. Since Covid-19 pandemic is far more determinates by how many people are in hospital, the number of hospitalized people could be a better indicator. A comparison with other European countries might be also interesting but there is a limitation that the testing methodology differs from state to state. Each country had a different data structure with an explanation that captures the actual state of hospital occupancy. The same holds for the number of deaths caused by Covid-19 – some countries count everyone who dies and is positive at that time, while other countries count just people whose main cause of death was Covid-19. Another possibility how to extend and improve the econometric models could be a new dummy variable the governmental aid. As mentioned before, all selected countries supported closed business through the JR schemes to which governments simplified access and increased the benefit generosity. This support led to the situation that companies did not have to fire their employees even though they would normally do so without any financial aid. As the Covid crises started to decline during summer months, governments released many of the restricting measurements and cut off the financial support to the businesses as they were no longer closed. The dummy variable governmental aid would determine if cutting off the support made companies fire some employees causing a larger unemployment. Overall, further research with better data is necessary in future.

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Appendix

Table 12. ADF test

```
> summary(ur.df(positive_cases, lags = 1, selectlags = "AIC", type="trend"))

###############################################
# Augmented Dickey-Fuller Test Unit Root Test #
###############################################

Test regression trend


Call:
lm(formula = z.diff ~ z.lag.1 + 1 + tt + z.diff.lag)

Residuals:
   Min     1Q Median     3Q    Max 
-25560  -2614  -2111   2187  26105 

Coefficients:
              Estimate Std. Error t value Pr(>|t|)    
(Intercept) 2721.61861 1029.03644   2.645  0.00881 ** 
z.lag.1       -0.29949    0.05167  -5.796 2.55e-08 ***
tt            -3.34876    7.67432  -0.436  0.66304    
z.diff.lag     0.08376    0.06982   1.200  0.23168    
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 6640 on 204 degrees of freedom
Multiple R-squared:  0.1452,	Adjusted R-squared:  0.1326 
F-statistic: 11.55 on 3 and 204 DF,  p-value: 5.038e-07


Value of test-statistic is: -5.796 11.2113 16.816 

Critical values for test statistics: 
      1pct  5pct 10pct
tau3 -3.99 -3.43 -3.13
phi2  6.22  4.75  4.07
phi3  8.43  6.49  5.47
```

Table 13. GMM estimate 1

```
> summary(gmm_1)
Twoways effects Two steps model

Call:
pgmm(formula = log(unemployment) ~ I(positive_cases/1000) + lag(unemployment,
    1) | lag(unemployment, 2:2), data = data_panel, effect = "twoways",
    model = "twosteps", robust = T)

Balanced Panel: n = 14, T = 13, N = 182

Number of Observations Used: 154

Residuals:
      Min.    1st Qu.     Median       Mean    3rd Qu.       Max.
-0.0616150 -0.0124485  0.0000559  0.0004192  0.0148237  0.0559832

Coefficients:
                          Estimate  Std. Error z-value Pr(>|z|)
I(positive_cases/1000) -0.00010046  0.00033550 -0.2994   0.7646
lag(unemployment, 1)    0.38353100  0.50744736  0.7558   0.4498

Sargan test: chisq(10) = 5.234287 (p-value = 0.87499)
Autocorrelation test (1): normal = 2.280054 (p-value = 0.022604)
Autocorrelation test (2): normal = -0.4943403 (p-value = 0.62107)
Wald test for coefficients: chisq(2) = 0.8588626 (p-value = 0.65088)
Wald test for time dummies: chisq(11) = 1501.519 (p-value = < 2.22e-16)
```

Table 14. GMM estimate 2

```
> summary(gmm_2)
Twoways effects Two steps model

Call:
pgmm(formula = log(unemployment) ~ I(positive_cases/1000) + I(positive_cases_lag/1000) +
    lag(unemployment, 1) | lag(unemployment, 2:2), data = data_panel,
    effect = "twoways", model = "twosteps", robust = T)

Balanced Panel: n = 14, T = 13, N = 182

Number of Observations Used: 154

Residuals:
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
-0.203640 -0.051267 -0.007539 -0.003093  0.041916  0.199301

Coefficients:
                            Estimate  Std. Error z-value Pr(>|z|)
I(positive_cases/1000)      0.00012083  0.00022790  0.5302   0.5960
I(positive_cases_lag/1000) -0.00061745  0.00054790 -1.1269   0.2598
lag(unemployment, 1)       -0.83541134  0.62147445 -1.3442   0.1789

Sargan test: chisq(10) = 3.475376e-16 (p-value = 1)
Autocorrelation test (1): normal = 1.397115 (p-value = 0.16238)
Autocorrelation test (2): normal = 1.16202 (p-value = 0.24523)
Wald test for coefficients: chisq(3) = 1.943154 (p-value = 0.58429)
Wald test for time dummies: chisq(11) = 5492.807 (p-value = < 2.22e-16)
```

List of abbreviations

COVID-19	Coronavirus SARS-Co-V-2
ČSÚ	Czech Statistical Office
EU	European Union
FE	Fixed effect
GMM	Generalized Method of Moments
ILO	International Labour Organization
JR	Job Retention
MPSV	Ministry of Labour and Social Affairs of the Czech Republic
OLS	Ordinary Least Squares
RE	Random effect
STW	Short-time work
WHO	World Health Organization
WS	Wage subsidy