Czech University of Life Sciences Prague

Faculty of Economics and Management

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Bachelor Thesis

Statistical Analysis of Coronavirus Pandemic in the Czech Republic

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CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

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Statistical Analysis of Coronavirus Pandemic in the Czech Republic

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Objectives of thesis

The aim of this thesis is to explore the development of coronavirus in the Czech Republic and come to the series of fundamental conclusions regarding the nature of the development, trends and tendencies related to particular age and gender groups.

Methodology

The main methodology of the following thesis is based on the quantitative statistical analysis that will incorporate trend estimations, seasonality analyses and creation of pertinent graphs and charts indicating the development of chosen indicators. The main framework of this work is based on the analysis of secondary data available on the interval of 2020 – 2022 from the Czech Statistical Office.

The proposed extent of the thesis

30-40 pages

Keywords

COVID-19, pandemic, Czech Republic, PCR tests, cases, mortality

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Recommended information sources

Burki, T. (2022). COVID-19 vaccine mandates in Europe . The Lancet Infectious Diseases, 27-28.

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Declaration

I declare that I have worked on my bachelor thesis titled "Development of Coronavirus Pandemic in the Czech Republic" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break any copyrights.

In Prague on 15.03.2023 _____

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Statistical Analysis of Coronavirus Pandemic in the Czech Republic

Abstract

The aim of this thesis is to explore the development of coronavirus in the Czech Republic and come to the series of fundamental conclusions regarding the nature of the development, trends and tendencies related to particular age and gender groups.

The main methodology of the following thesis is based on the quantitative statistical analysis that will incorporate trend estimations, seasonality analyses and creation of pertinent graphs and charts indicating the development of chosen indicators. The main framework of this work is based on the analysis of secondary data available on the interval of 2020 – 2022 from the Czech Statistical Office.

In conclusion, the author draws the conclusion that the pandemic caused by the coronavirus in the Czech Republic was expanding rather fast, with two main waves and an average daily rise of 5173 daily cases each day. The working days of the week were the most hazardous for the transmission of the coronavirus since this is when the seasonality variables are at their greatest and most extreme levels.

Keywords: COVID-19, pandemic, Czech Republic, PCR tests, cases, mortality

Statistická analýza pandemie koronaviru v Česku

Abstrakt

Cílem této práce je prozkoumat vývoj koronaviru v České republice a dospět k řadě zásadních závěrů týkajících se povahy vývoje, trendů a tendencí souvisejících s jednotlivými věkovými a genderovými skupinami.

Hlavní metodika následující práce je založena na kvantitativní statistické analýze, která bude zahrnovat odhady trendů, analýzy sezónnosti a tvorbu příslušných grafů a grafů naznačujících vývoj vybraných ukazatelů. Hlavní rámec této práce vychází z analýzy sekundárních dat dostupných v intervalu 2020 – 2022 od Českého statistického úřadu.

Na závěr autor vyvozuje závěr, že pandemie způsobená koronavirem se v Česku rozpínala poměrně rychle, se dvěma hlavními vlnami a průměrným denním nárůstem 5173 denních případů každý den. Pracovní dny v týdnu byly pro přenos koronaviru nejnebezpečnější, protože právě tehdy jsou proměnné sezónnosti na své největší a nejextrémnější úrovni.

Klíčová slova: COVID-19, pandemie, Česká republika, PCR testy, případy, úmrtnost

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1 Introduction

A phenomenon known as the coronavirus is almost certainly something that has been experienced at least once by anybody who does not live in complete seclusion from the rest of the world. It all began with a common ailment, but it ended up reshaping economies, governments, civilizations, and even the way people think about and interact with the world around them, not to mention how work is done.

It is reasonable to suppose that the epidemic took a far greater toll on one nation's population than it did on the populations of other countries. When looking back at the progression of the pandemic, it is obvious that it is fairly easy to evaluate the true effect of this sickness as well as the seasonality of it based on the example of a particular nation.

Given that the author lives in the Czech Republic and has firsthand experience dealing with the pandemic, he came to the conclusion that it would be beneficial to conduct research into the coronavirus pandemic in the Czech Republic and draw critical conclusions about the patterns that have emerged in the country of choice.

2 Objectives and Methodology

2.1. Objectives

The aim of this thesis is to explore the development of coronavirus in the Czech Republic and come to the series of fundamental conclusions regarding the nature of the development, trends and tendencies related to particular age and gender groups.

2.2. Methodology

The main methodology of the following thesis is based on the quantitative statistical analysis that will incorporate trend estimations, seasonality analyses and creation of pertinent graphs and charts indicating the development of chosen indicators. The main framework of this work is based on the analysis of secondary data available on the interval of 2020 – 2022 from the Czech Statistical Office.

3 Literature Review

3.1. Coronavirus

3.1.1 Emergence

Since the beginning of the pandemic, there has been a consistent increase in the severity of the labor shortage that is being experienced all across the world. The United States of America, Great Britain, Canada, Australia, and a few countries in the European Union, most notably the Czech Republic, are all suffering from a labor shortage. The Czech Republic is the most notable of these countries (Euro News, 2022). Despite the fact that, in comparison to other countries in the EU, the nation now has a relatively low position in terms of the proportion of its population that is actively engaged in gainful employment (3,5%). Even after many months have gone, many companies and industries are still unable to fill available positions, and the pandemic has only made this situation worse. This is despite the fact that virtually every individual in the country is highly busy right now.

Figure 1, Unemployment rate in the Czech Republic
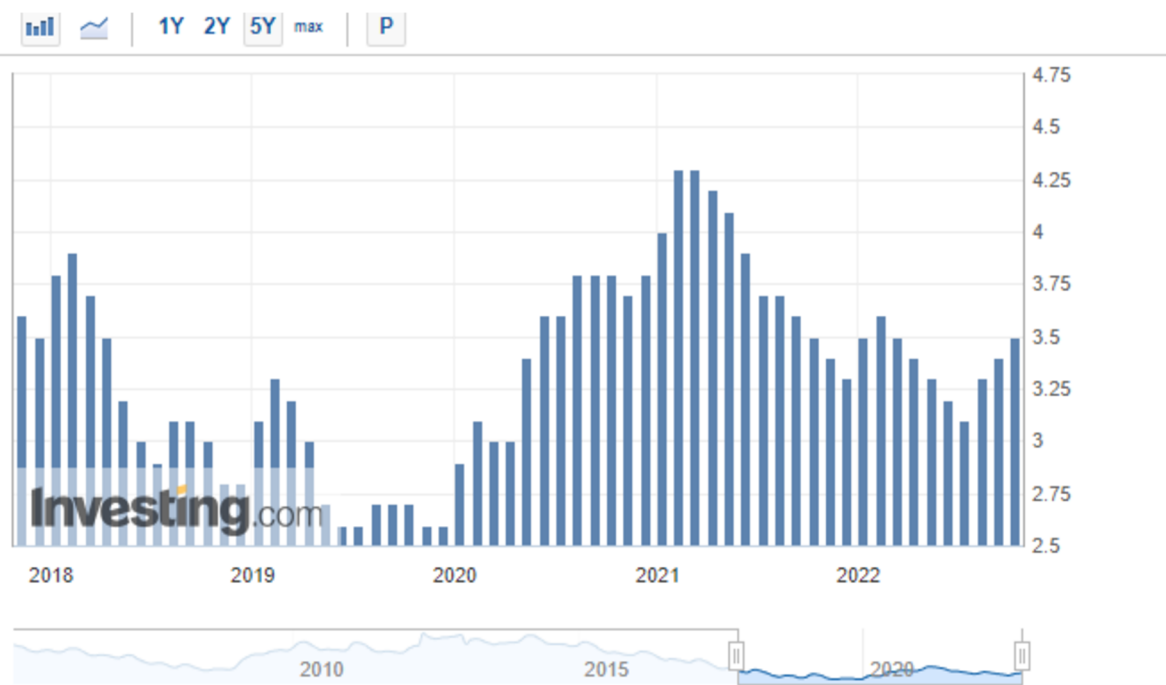
Source: Investing, 2022

It could be beneficial to start by reviewing the events that took place in the Czech Republic before to the outbreak of the pandemic and the status of affairs there at that time.

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When the first wave of the virus struck in the spring and summer of 2020, the Czech Republic was able to deal with it more efficiently than its other neighbors were able to deal with it. This is something that I am required to bring out to them. The residents then shown remarkable cohesion by embracing the tight constraints of the lockdown in an amiable manner and without voicing any objections. A public celebration in honor of the victory was held, and it was conducted on the Charles Bridge, where two thousand people sat down to dine at a table that stretched for a half kilometer in order to accommodate everyone who attended (CGTN, 2022).

Figure 2, Prague celebrates end of lockdown with outdoor dinner on Charles Bridge

Source: CGTN, 2022

However, it was instantly obvious that the delight was premature and inappropriate in its occurrence. New coronavirus strains were carried back to the United States as early as the fall by tourists who had recently returned from trips to far-flung countries. The second wave of the sickness turned out to be far more serious than the first wave had been because people started to let their guard down and the government was plainly sluggish to enact more restrictions. At one point in time, the Czech Republic held the dubious distinction of having the world's highest death rate per 100,000 inhabitants. This honor was held by the Czech

Republic (The World Bank, 2022). And this is even more puzzling when one considers the fact that the professionals in question are speaking about a country that has a reasonably developed economy and a healthcare system that includes a sufficient number of hospitals and clinics. The government of the Czech Republic was once again compelled to enforce stringent restrictions. These included the closure of colleges, schools, kindergartens, enterprises, and catering firms; the prohibition of travel between areas; the enforcement of legislation requiring inhabitants not to assemble in large numbers; and the implementation of curfews.

The pandemic was to blame for a variety of other occurrences, including a rise in the rate of unemployment, which was one of those things. Despite the fact that the unemployment rate in Prague is typically lower than the rate in the districts that surround the city, it reached 1.7% of the population in February 2020 and it had already reached 3.5% of the population in January 2021. This occurred despite the fact that the rate of unemployment in Prague is the capital city of the Czech Republic. Some businesses were actually able to survive, but it was extremely difficult for them to continue working when the highest level of unemployment that occurred in the years following the global financial crisis in 2007-2012 was 4.3%. This statistic refers to the period of time when the global financial crisis was in its early stages. Between the years 2007 and 2012, the world was experiencing the worst effects of the global financial crisis, which is the time period that this statistic relates to. In addition, there is a chance that the turbulence in the economy that was brought on by the pandemic caused by Covid-19 might, in the end, lead to the further spread of the pandemic. As an immediate and direct consequence of this, he was in a position to have an even greater level of influence on the labor market in Prague (European Commission, 2022). Given the restrictions that were in place at the time, it seemed only logical that the majority of the first tourists to visit Prague would come from within the Czech Republic, such as in the year 2020. This prediction was based on an assumption that the restrictions would remain in place until the year 2050. This seems to be the situation with the highest probability. The situation at hospitals has been in a position that may be characterized as critical for an extended length of time. This issue has been ongoing. It is also very important to keep in mind that the economy of the region shrank by 5.7% in the year 2020, despite the fact that this decrease was not as severe as the normal fall throughout the EU. This is something that has to be taken into consideration. The state proposed a variety of alternative actions that may be

carried out in order to be of assistance to enterprises. These measures included programs that would safeguard the present income level and the quantity of employment possibilities, as well as subsidies and preferential loans to businesses that had been harmed. Additionally, these measures included steps that would protect the environment (European Commission, 2022).

However, some other parts of the economy were hit far worse than others by the epidemic. The tourist industry employed 250,000 people across the country in 2019, contributing 5 billion euros to the national budget and providing job opportunities in all regions of the country. In addition, the number of visitors visiting Prague during the first three months of 2021 was 94% lower than it was during the same time period the year before.

There were already 355 thousand open positions across the country's market as autumn of 2021 was drawing closer. In spite of the fact that the data may differ from area to region, the national average unemployment rate was 3.7% in the month of November. However, the rate rose to over 5.5% in Moravia and Silesia while falling to over 2% in Central Bohemia and Pardubitsa (European Commission, 2022).

3.1.2 Development

Unemployment is now one of the most daunting problems that the economy of the world, as well as each individual country, and in particular the economies of the nations that are members of the European Union, are currently experiencing. This problem is relevant for all countries, without exception, that have selected the capitalist path of progress; the only thing that separates them from one another is the degree to which it presents itself. A rise in the unemployment rate is one of the inescapable consequences that come as a direct result of a financial crisis. There are now hundreds of thousands of people who are unemployed as a direct result of the failing economy and the shutting of enterprises. It is only logical to assume that this will be reflected in many facets of social life in the community. Long-term unemployment can result in a loss of credentials, despair, and the erosion of moral principles. One of the reasons why the pandemic has caused damage on such a vast scale across almost all levels of society and not just those levels is because of this. The situation of the labour market is the first and most important thing that the state is required to keep a careful watch

on. In addition, it is necessary to develop one-of-a-kind aid programs and to offer benefits to those who are currently without jobs. A person can make it through a difficult time in their life without succumbing to hopelessness and without having to continually hunt for work when they have access to care that is given by organizations that are funded by the government. The problem of unemployed people is still a significant one in the 21st century, just as it was in earlier eras. The removal of inefficient enterprises, the incorporation of cutting-edge technology into the industrial process, the expansion of robots, and the continuous economic crisis are all factors that lead to a reduction in the number of jobs that are accessible. On the other hand, unemployment, like any other event connected to the economy, can't merely be seen in a pessimistic light all the time. This holds true no matter how you frame the issue. It is possible that the implications of it will have both negative and positive effects on the lives of individuals. Everything hinges on the circumstances that gave rise to the start of unemployment, the idiosyncrasies of the labour market, the activities of governmental institutions, the social backdrop, and a wide range of other factors. Unemployment can be caused by a variety of factors (Zimmermannova, 2022). When new workers enter the labour market (either because they leave their jobs or because they graduate from educational institutions), but there are not currently jobs available to accommodate them, this could be one of the factors that contributes to an increase in unemployment. Other factors that could contribute to an increase in unemployment include. As a result of the epidemic, a significant number of persons who were not citizens were forced to resign from their positions since they were unable to continue living in the nation. This is a particularly important consideration when the economy is in a state of crisis because it means that a large number of skilled workers are unemployed, but it will only be possible to create jobs for them once the economy has stabilized. When the economy is in a state of crisis, this is an especially important consideration because it means that many skilled workers are unemployed. Employees frequently do not have the opportunity to find work in their area of expertise because of the closure of large businesses and the liquidation of entire economic sectors, both of which have resulted in a massive amount of workforce being made available. This is the case because both events have resulted in a massive amount of workforce being made available. The epidemic caused many enterprises to be forced to either close or relocate, which contributed to a major increase in the frequency with which this circumstance occurred following the pandemic. If one singles out the fact that unemployment is a relatively complex topic for discussion, then it only makes sense to single

out the various types of unemployment and explain the conditions that help to calculate this indicator. According to the factors that led to their inability to find work, unemployed persons can be broken down into the following groups (Chadi, 2010).

Frictional - arises because of the free, voluntary movement of workers from one workplace to another, in particular because of moving to a different place of residence, the search for a better-paid job, advantages in career aspirations and conditions of employment, the desire for greater self-realization. When a person is jobless, it may take some time before they are able to apply for a new employment after being fired from their previous position.

Structural changes in the system of production in the economy as well as in a particular firm are examples of structural shifts. These shifts are influenced by scientific and technical advancement, the introduction of new technologies, and other factors. This results in the development of new fields of expertise and occupations that call for a distinct set of knowledge and abilities than those that were previously required. This calls for greater preparation, which necessitates both additional time and additional resources. This type of unemployment is a more complicated phenomena than frictional unemployment; it is of a forced character and may be seen as the result of a disproportion between the structure of demand for labour and the structure of supply of employees in the labour market.

Cyclical - happens during a period of declining economic activity; it is related with a fall in production volumes and, as a direct result of this, with a reduction in the number of jobs and employees. It manifests itself as a significant qualitative and quantitative gap between these locations and the available workforce on the market for labour. Involuntary unemployment is a type of joblessness that can be both long-term and severe.

The three categories of unemployment that have been outlined above are the most prevalent sorts of unemployment and are responsible for the largest amount of difficulty, not only for the economy but also for the lives of individual people. There are, however, forms of unemployment that, at points in time, play a more detrimental function than others.

Seasonal refers to the characteristics that are typical of categories of workers who are engaged in employment that is seasonal in nature. For instance, the agricultural industry, the

tourism industry, some forms of building labour, and so on and so forth. This is a form of unemployment that is not chosen by the employee and is mostly tied to the worker's capacity to transition to different sorts of work during the off-season. It is dependent on his degree of qualification as well as whether he possesses any relevant specialty. It is not global in scope, and it does not have a cataclysmic impact on the economy.

Technological - because of increased mechanization and automation in manufacturing, a portion of the labour force may become obsolete or may be required to get a higher level of certification. This type of unemployment is referred to as technological unemployment. It is forced onto the employee and is closely tied to the phenomenon of structural unemployment.

Institutional is a term that is used to describe a situation in which the state or those agencies that are authorized by the state are unable to deal with the challenges that are presented by the labour market. For instance, when the government fails to pass legislation in a timely manner that regulate and fix the link between the amount of work available and the number of people looking for jobs. Or when the organizations that are mandated to address issues of employment, advanced training, or retraining of employees who have lost their jobs for a variety of reasons are unable to complete the responsibilities that have been delegated to them (Maitah, 2015).

The total workforce is divided into two parts:
1. Employed (E) - these are people who have a job, even if they work part-time/week.
2. Unemployed (U) - these are people who do not have a job, but they are looking for it and are ready to start it.
3. The total labour force (L) is determined by adding the number of employed and unemployed:

$$L = E + U$$

The unemployment rate (u) is the ratio of the number of unemployed to the labour force (the sum of employed and unemployed), defined as a percentage:

$$u = \frac{U}{L} * 100\%$$

In other words, the unemployment rate shows the share (as a percentage) of the unemployed in the labour force (The Balance Money, 2022).

3.1.3   Current Status

In the Czech Republic, the major mission of the government has been to encourage the development of an atmosphere that is amenable to entrepreneurs and the production of new employment opportunities. In the beginning of the program, there were 59 million euros available to business owners in the form of loans with no interest; however, all this money was borrowed within the first few days of the program. They were also exempt from paying a portion of the payments, such as necessary health insurance premiums and social insurance contributions for a period of six months (European Central Bank, 2022). This exemption applied to both types of payments. This exemption was in effect for the duration of their employment in its entirety. It is now acceptable to put off paying rent payments since penalties for missing the deadlines for making tax payments have been removed. This change in policy was brought about by the abolition of such penalties. At this time, further measures to support the operations of businesses are being evaluated for potential implementation. One example of these measures is the provision of several tax breaks, which may be taken advantage of by individuals as well as by legitimate businesses and organizations. It was decided to eliminate some of the restrictions that were preventing the Czech National Bank from engaging in operations on the open market. These restrictions had been in place for some time. About forty million euros' worth of compensation was handed to the Ministry of Culture so that it could make up for the harm that was brought on by the coronavirus. In addition, several steps have been taken in the directions of agriculture, transportation, tourism, and the development of activities that are geared toward exportation. One portion of the funds was reserved specifically for the purpose of carrying on the fight against the coronavirus.

In addition, for the year 2021, a reserve that is equivalent to five percent of the GDP will be built. To account for all the actions that were taken to combat the epidemic, the national budget of the Czech Republic required to undergo some necessary revisions. As a

direct consequence of this, the deficit went from 1.6 billion euros to 7.5 billion euros, which is equivalent to around 3.6% of the GDP (ECDC, 2022).

The epidemic and the reaction of member states had an impact on the labour market throughout the European Union during the first three months of the year 2020. Cyprus, Greece, Spain, Italy, and France were found to have the greatest rates of workers missing time from their jobs owing to being on temporary leave for reasons related to the economy or technical issues, while the Czech Republic, Slovakia, Sweden, and Hungary had the lowest percentages. According to the findings of a recent study, the rate of unemployment in Europe could double and take until 2024 to return to levels seen before the financial crisis. This would result in the loss of over 60 million jobs, which would account for more than a quarter of all jobs in the EU.

The most challenging circumstances will be faced by workers who have a poor degree of education, which will further worsen existing socioeconomic disparity. The industries of customer service and sales, catering, commerce, and construction account for half of all employment that are at danger in the short term. Workers in the healthcare industry, education and science, mechanical engineering, and the legal system are among the least impacted. COVID-19 has had a significant impact on income, rates of savings and investment, investment rates, household consumption, gross operating surplus of non-financial corporations, profit share and business investment ratios, data collection and reporting of quarterly sector reports, and business investment ratios. When implementing policy responses to the coronavirus, it is necessary, according to the opinions of experts from other countries (Atkeson, 2020), to strike a balance between the priorities of epidemiological safety and socio-economic sustainability, considering the long-term consequences of the measures taken to halt the spread of the virus. This is because there is a risk that the policy responses could have unintended consequences. While this is happening, more investment by the government on health care during a recession may have a synergistic impact. They make it more likely that the economy will recover in the near run (Reeves, 2013). In the long term, they can be a crucial element in retaining employment, particularly for women and other disadvantaged groups (Boniol, 2019).

If the author of this work touches on the situation today, then in the Czech Republic there are not enough drivers, builders, electricians, mechanics, storekeepers, locksmiths, dentists, engineers, and IT specialists. These industries have long been supported mainly by foreign labor, but due to the pandemic, many migrants have returned home. Knowledge of the Czech language is not a prerequisite for employment: large international companies often speak English. However, language proficiency significantly increases the chances of getting a good job and a Czech diploma: all state universities provide free education for foreign citizens, subject to successful completion of entrance exams in specialized subjects and the state exam for knowledge of the Czech language (Go Study, 2022). The pandemic has led to new trends in the Czech labor market. Employers now focus on the ability of employees to quickly adapt (including to remote work) and learn new technologies. Employees, on the other hand, pay more attention to stability: the reliability of the company is now more important than career growth or salary levels

Figure 3, Overview of coronavirus disease (between 2020 and 2022)

Overview of coronavirus disease (COVID-19) by date

New cases

26 Oct 2020
New cases: 7 300

02 Feb 2022
New cases: 57 247
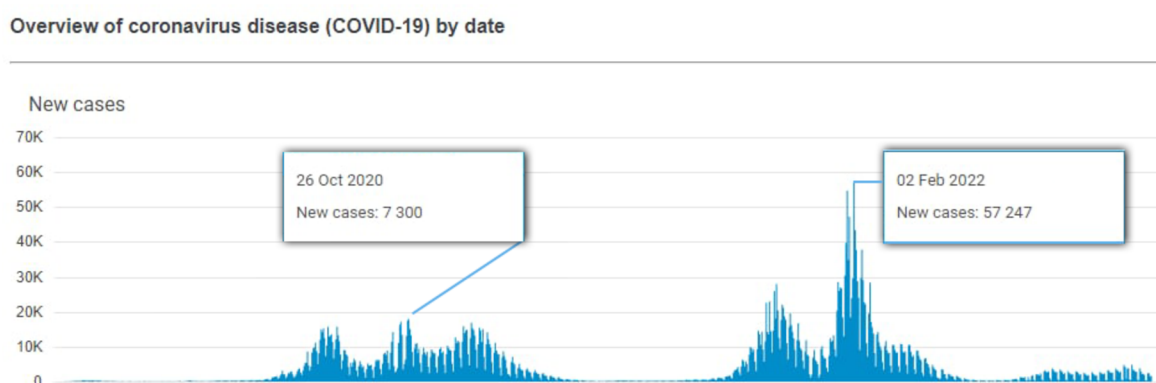
Source: World Health Organization, 2022

At the same time, the Czech market also lacks highly qualified specialists, especially in logistics, the IT industry and e-commerce. In May 2021, researchers from the Mendel University in Brno and the Prague Metropolitan University published a report in which they called on the state to stop treating migrant workers as a threat and start seeing them as an opportunity to increase the competitiveness of the Czech economy (Šimberová, 2022). At the moment, the situation in the Czech Republic, as well as around the world, is not certain, since the corona virus is still a problem that brings its own problems. It is fairly easy to note the fact that the pandemic has affected almost all members of the European Union, but the Czech Republic felt it much more literally at the beginning of 2022, when a record number

of cases were registered. Below are the statistics for the most active month at the time of the coronavirus outbreak and today's year, respectively.

3.2.   Restrictions in the Czech Republic

This rule, which was put in place at the beginning of the pandemic and is still in existence, is scheduled to be withdrawn as soon as at least 75% of the population of the nation has been inoculated against the disease. At the beginning of the epidemic, a regulation was adopted that required everyone to wear masks, and that policy is still in effect today. One of the restrictions that was put in place at the beginning of the pandemic and continues to be in force today is the requirement that people are wearing masks. This limitation is perhaps the one that is obvious to the typical person the most. There is no need to state the obvious when it comes to the fact that the reality that the government can cancel measures based on a bigger level of vaccination was a significant factor in the conditions that were there for a pandemic in 2021 (Simunek M., 2021). This was one of the factors that contributed to the beginning of the epidemic that swept the world. The comments that were made at the time by the Minister of Health indicate that such concessions may influence the needed usage of masks as well as the capacity to organize large gatherings. These events are now only available to a restricted number of participants, and to participate, individuals are needed to provide immunization certificates first.

At this time, the Czech Republic has access to four distinct coronavirus vaccines, including those produced by the American corporations Moderna, Pfizer, and Johnson & Johnson, in addition to those produced by the Anglo-Swedish company AstraZeneca. In the end, about 14 million individuals across the country were vaccinated against the disease (Burki, 2022). The estimations of the population of the Czech Republic that were released by the Czech Office of Statistics during the month of March of this year indicated that there were more than 11 million people living in the Czech Republic. There are various restrictions that have recently been put into effect around the country. Citizens are needed to wear masks, there is a maximum number of people that can sit at a table in a restaurant while maintaining a distance of 1.5 meters, and there is a limit number of people that may attend sporting events, of which half are required to be vaccinated against the disease. There can be no more than 2,000 people present outside of mass meetings, and there can be no more than 1,000 people present inside of them.

3.3. Vaccination

The issue with vaccinations is murky, as was just said, and there is a lack of clarity regarding it. The information regarding immunization that was available a year ago was different from the scenario that exists today because the time frame during which the EU nations obtained, or manufactured vaccines coincided exactly with the stage during which the coronavirus stalled. As a result of this, the information regarding immunization that was available a year ago was different from the scenario that exists today. Once the Czech Republic had a new administration in place, the decision that had been taken by the previous cabinet of ministers in the country was reversed. The previous government, which was led by Prime Minister Andrej Babi, issued an order at the beginning of December that made vaccination mandatory for people over the age of 60. The order also made vaccination mandatory for medical personnel, police officers, firefighters, and students interested in pursuing a career in medicine. The order was issued by the previous government, which was led by Prime Minister Andrej Babi. It was originally planned for it to become effective on March 1st of this year. On the other hand, the administration of Babis was removed from its position on December 18, 2021, and it was replaced by a new five-party government that was led by Prime Minister Petr Fiala (Martínel, 2022).

Getting vaccinated against COVID-19 is no longer a requirement for individuals in the Czech Republic. Even though it does not desire to further exacerbate pre-existing social differences or create new ones among the population, the government continues to hold the belief that the vaccine is the most effective weapon to deploy against the coronavirus. According to the European Centre for Disease Prevention and Control (ECDC), the current proportion of Czech citizens who are considered to have had all recommended vaccinations is at 64 percent. This figure is lower than the average vaccination rate across the EU. In a nation with a total population of 11 million people, the third dosage has been given to close to 3.5 million individuals. The new administration in the Czech Republic came to this conclusion at a time when the country is dealing with a rise in the number of persons afflicted with the coronavirus caused by the omicron strain. Despite the record number of COVID-19 infections that have been reported, the number of persons who were hospitalized because of the virus decreased to 1,635 on January 18 (Fajfr, 2022).

The incidence of the disease and its spread have fluctuated significantly over the duration of the COVID-19 pandemic in the Czech Republic, from the preliminary downturn in the spread of disease through community spread without the ability to effectively search for contacts to the current steady decrease of the epidemic. According to the data, there are likely exposures to infectious agents (without specific evidence of contact with the infection's source), and at least one-third of these exposures are related to work. As a result, various anti-epidemic measures at work are extremely important practically for the control of epidemics (Martínel, 2022).

4. Practical Part

4.1. Daily Cases

To begin with, the author focuses on the most important statistics reflecting the development of the coronavirus pandemic in any country on Earth – number of daily cases. In addition to the initial breakdown of the number of cases and the new daily cases.

The following chart reflects the development of the total number of cases for the Czech Republic.

Figure 4, scatterplot of total cases in the Czech Republic
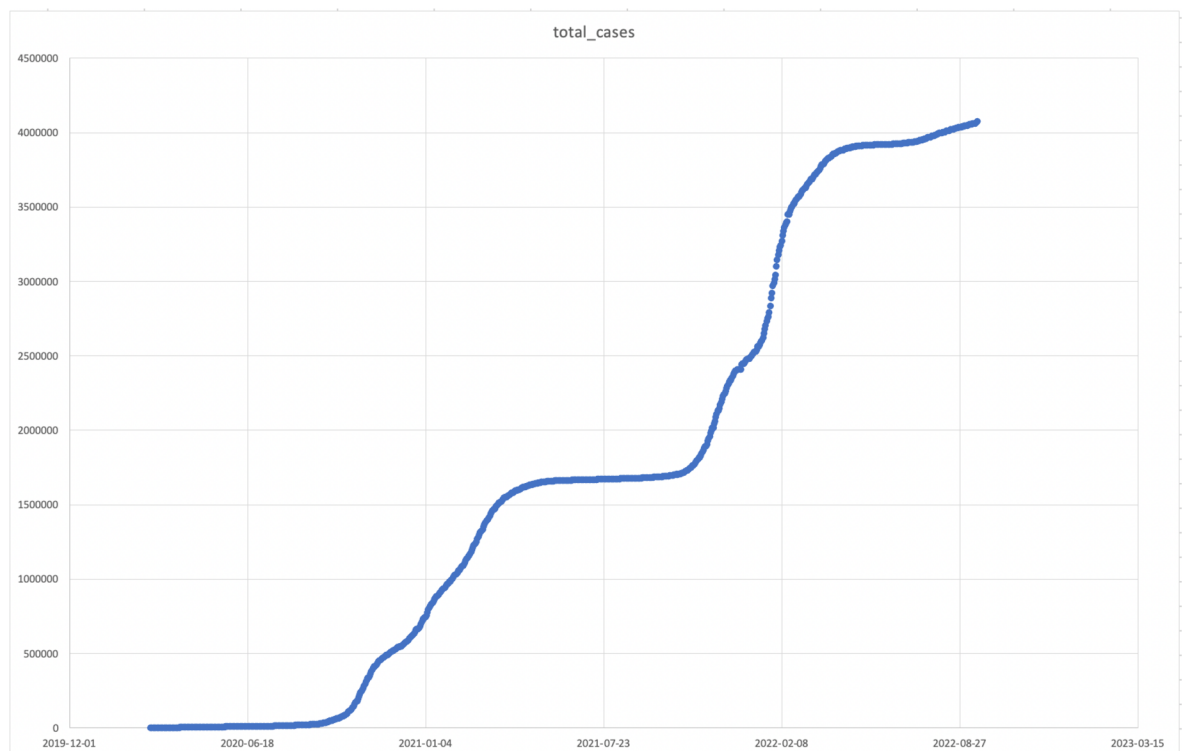
Source: OWN PROCESSING

As it is visible on the following chart, the total number of cases in the Czech Republic was drastically increasing only over particular periods of time – from approximately 01.04.2021 to 01.06.2021 and from 01.01.2021 to 04.04.2022. Yet, it is downright essential

to create the trend that will reflect the total number of cases for the Czech Republic. For this purpose, the author uses the application SPSS statistics to find the trend parameters.

Figure 5, trend parameters for total cases

Model Summary and Parameter Estimates

Dependent Variable: total_cases

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.942	14940.423	1	928	.000	−699432.22	5173.355

Source: OWN PROCESSING

The model has the following format:

$$Y = -699432.22 + 5173.355t$$

The quality of the model is expressed by the coefficient of determination, and it is possible to conclude that 94.2% of the variation in the total cases is explained by the dependent variable. This is a pretty good result, so it is possible to make conclusions based on it.

Based on the model, it is possible to conclude that the average daily growth of coronavirus cases is equal to 5173.355 (time vector represents a day).

Now, the author will focus on another variable reflecting the daily increase of coronavirus cases and the following scatterplot reflects the development of this indicator over time.

Figure 6, scatterplot of daily cases over time
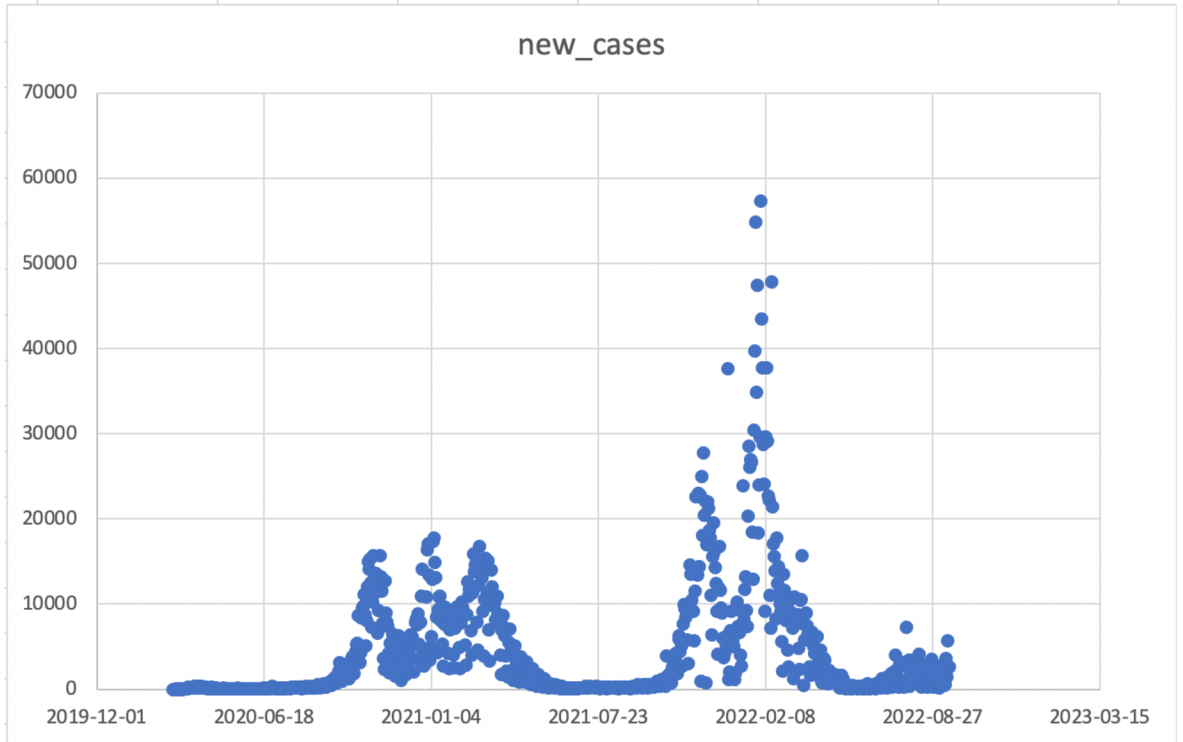
Source: OWN PROCESSING

As it becomes evident after looking at the following scatterplot, there was just two major waves of coronavirus pandemic in the Czech Republic – in 2021 and 2022. Yet, the second wave is believed to be much more intensive compared to the first one with the number of daily cases exceeding 40 000 people. Then, the following scatterplot presents the same statistics but according to quarters of the year. By looking at the following graph, it will be possible to distinguish quarters where the pandemic was much more intensive compared to other quarters.

Figure 7, daily average by quarters
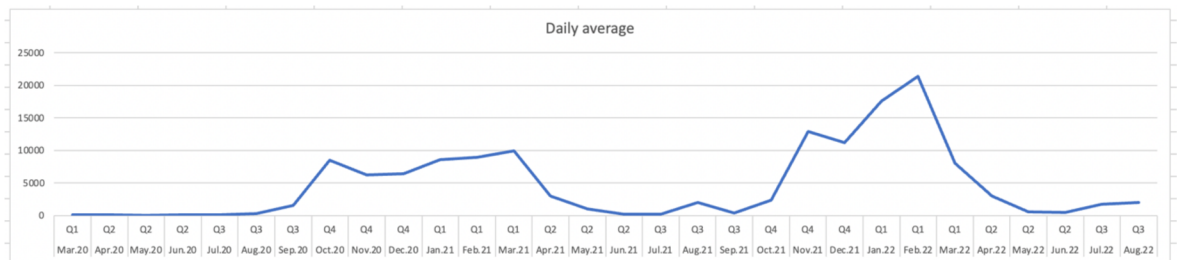
Source: OWN PROCESSING

Now, the author will analyse this piece of statistics and determine the quarter, when people fall ill more based on the seasonality factor.

Figure 8, seasonal factor per each quarter

		Seasonal Factor
Q1	10647,07	207%
Q2	941,57431	18%
Q3	1044,4603	20%
Q4	7939,3595	154%
Grand Average	5143,1159	

Source: OWN PROCESSING

Based on the seasonality factor calculation, the author is able to conclude the following:

- In the first quarter of the year, the number of daily cases on average is 107% higher.
- In the second quarter of the year, the number of daily cases on average is 88% lower.
- In the third quarter of the year, the number of daily cases on average is 80% lower
- In the fourth quarter of the year, the number of daily cases on average is 54% higher.

In other words, the most severe quarter in terms of coronavirus in the Czech Republic is the first one (January, February and March) and the fourth one (October, November and December). This proves the hypothesis that coronavirus is much more contagious and dangerous during cold seasons.

Then, using the same piece of statistics (seasonality factor), the author will determine which day of the week is the most severe in terms of coronavirus. This time, the author will rely on SPSS statistics for the calculation due to the extremely high sample size.

Table 1, seasonality factor for days of the week

Period	Seasonal Factor (%)
1	58.8
2	70.2
3	114.7
4	130.1
5	121.0
6	116.3
7	89.0

Source: OWN PROCESSING

Before specifying the output from SPSS Statistics reflecting the seasonality factor per each day of the week, it is essential to provide a quick interpretation –

1 – Sunday

2 – Monday

3 – Tuesday

4 – Wednesday

5 – Thursday

6 – Friday

7 – Saturday

Thus, the author is able to conclude the following:

- The number of new cases on Sunday is 41.2% lower than the average.
- The number of new cases on Monday is 29.8% lower than the average.
- The number of new cases on Tuesday is 14.7% higher than the average.
- The number of new cases on Wednesday is 30.1% higher than the average.
- The number of new cases on Thursday is 21% higher than the average.
- The number of new cases on Friday is 16.3% higher than the average.
- The number of new cases on Saturday is 11% lower than the average.

In fact, this finding concludes the assumption that people less frequently fall ill with the coronavirus on weekends (41.2% and 11% lower on average) but additionally, Monday seems to be quite a safe day with the number of almost 30% lower. Yet, the worst days are Wednesday, Tuesday and Thursday. All in all, these pieces of statistics are the most important ones needed for understanding the coronavirus pandemic in the Czech Republic. Now, the author will focus on vaccination and testing statistics.

4.2. Tests

Then, after analyzing the daily cases and the total cases, the author focuses on another interesting piece of statistics reflecting the situation with the coronavirus in the Czech Republic – number of tests performed in the country. The following scatterplot presents the development over time.

Figure 9, coronavirus tests performed in the Czech Republic over time
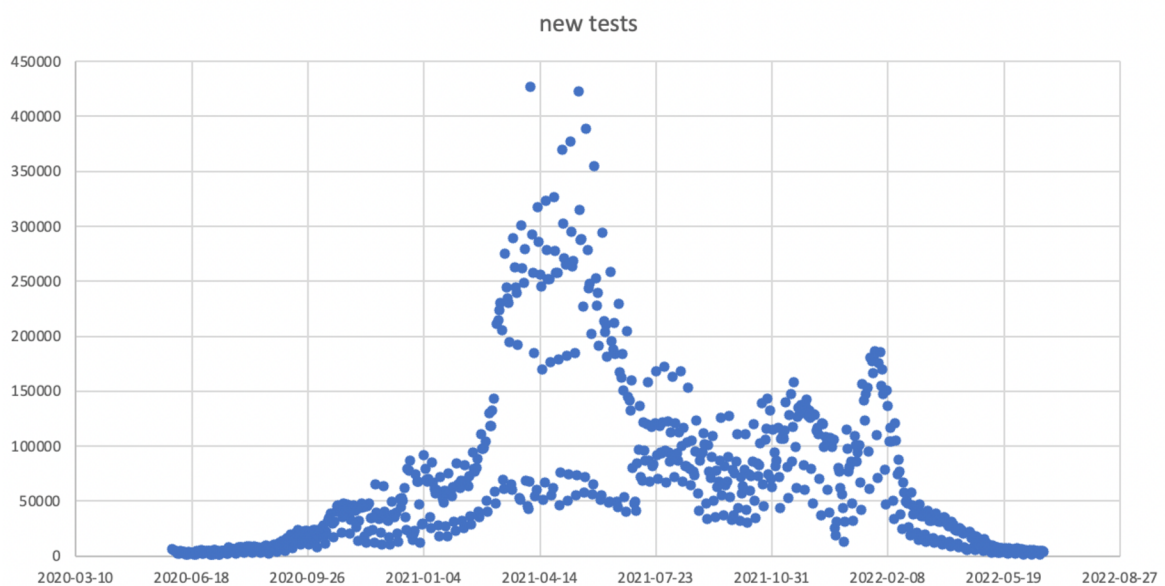
Source: OWN PROCESSING

Based on the scatterplot, the author can conclude that the pattern of the tests performed in the country does somewhat resemble the scatterplot of daily cases in the country. Then, the author estimates the trend that will reflect the development of the total number of coronavirus tests – both antigen and PCR ones performed in the Czech Republic. The following figure contains the output from SPSS Statistics.

Figure 10, trend parameters for total tests

Model Summary and Parameter Estimates

Dependent Variable: total tests

Equation	R Square	Model Summary				Parameter Estimates	
		F	df1	df2	Sig.	Constant	b1
Linear	.959	17364.837	1	750	.000	−9799303.3	94025.360

Source: OWN PROCESSING

The author estimated the model with the following parameters:

Y = -9799303.3 + 94025.360t

Given the quality of 0.959, which translates into 95.9%, the author concludes that it is possible to make conclusions based on the following model. It is possible to observe that the daily increase of total tests performed is equal to 94 025 tests per day. When comparing this value to the average daily increase from the previous model estimated – 5173, it is possible to conclude that the number of tests per day exceeds the number of daily cases by 18 times.

In addition to this, the average percentage of positive test result, based on two models is equal to *5 173 / 94 025 = 5.5%.*

Then, the author also analyses the trends behind the number of tests performed daily by calculating the seasonality factor that will reflect the day on which the most tests were performed. The author uses SPSS Statistics for the calculation. The output is presented below.

Figure 11, seasonal factors for tests on days on the week

Seasonal Factors

Series Name: new tests

| Period	Seasonal Factor (%)
1	129.3
2	118.5
3	113.6
4	116.0
5	119.1
6	60.0
7	43.5

Source: OWN PROCESSING

Following the output, the author concludes the following:

- The number of tests performed on Sunday is 29.3% higher.
- The number of tests performed on Monday is 18.5% higher.
- The number of tests performed on Tuesday is 13.6% higher.
- The number of tests performed on Wednesday is 16% higher.
- The number of tests performed on Thursday is 19.1% higher.
- The number of tests performed on Friday is 40% lower.
- The number of tests performed on Saturday is 56.5% lower.

Thus, it is possible to say that people were getting tested less on Friday and Saturday. The most popular days for testing were Sundays and Thursdays. This is quite different from the previous seasonality identified by the author.

In addition to all this, the author does also investigate the percentage of positive cases per day, and the chart is available on the figure below.

Figure 12, percentage of positive tests

percentage of positive
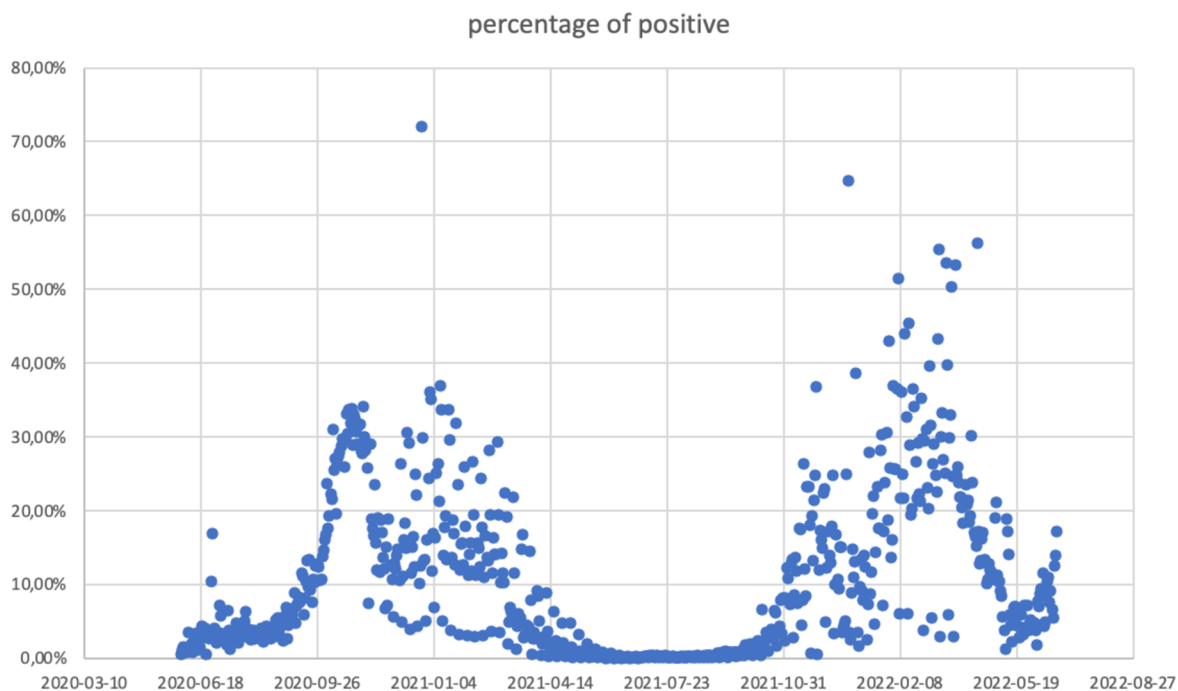
Source: OWN PROCESSING

In fact, the following pattern does one more time prove the fact that there were just 2 major waves of coronavirus in the Czech Republic. In addition to this, the author also finds seasonality behind this indicator.

Figure 13, seasonal factors for percentage of positive cases

Seasonal Factors

Series Name: percentage of positive

Period	Seasonal Factor (%)
1	46.5
2	89.3
3	106.6
4	94.1
5	89.5
6	150.8
7	123.2

Source: OWN PROCESSING

Following the output, the author concludes the following:

- The percentage of positive tests 53.5% lower on Sundays.

- The percentage of positive tests 10.7% lower on Mondays.

- The percentage of positive tests 6.6% higher on Tuesdays.

- The percentage of positive tests 5.9% lower on Wednesdays.

- The percentage of positive tests 10.5% lower on Thursdays.

- The percentage of positive tests 50.8% higher on Fridays.

- The percentage of positive tests 23.2% higher on Saturdays.

Based on the seasonality, the author concludes that there is no particular pattern behind this indicator related to seasonality.

4.3. Vaccination Statistics

Then, it is essential to take a look at the way how the vaccination was developing in the chosen country. Clearly, the first vaccine was developed months after the breakout of the pandemic, so it is essential to understand whether the situation has somehow improved after the vaccination process kicked off in the Czech Republic. The following chart shows the development of the total number of vaccinations in the country

Figure 14, total vaccination development in time

total vaccionations
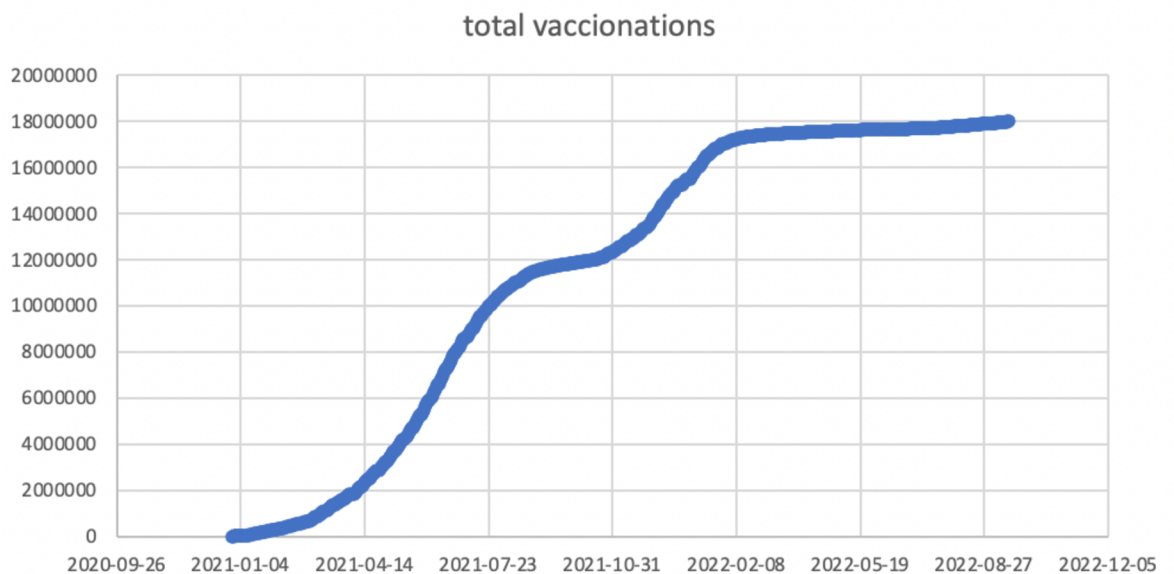
Source: OWN PROCESSING

Following the depiction of the total vaccination variable, it is essential to find the trend that will tell us more about the vaccination process in the Czech Republic.

Figure 15, total vaccinations trend

Dependent Variable: total vaccinations

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.907	6113.216	1	626	.000	859004.206	33699.561

Source: OWN PROCESSING

The author estimated the model with the following parameters:

Y = 859004.206 + 33699.561t

Thus, the average daily increment of new vaccinations is approximately equal to 33699. Given the overall quality of $0.9 = R^2$, the author concludes that general assumptions can be made based on this model.

Given the fact that the first ever registered case of coronavirus vaccination took place on 28.12.2020, the author now computes the trend for the total number of confirmed coronavirus cases starting from this day in order to find if there is any difference in the speed at which the pandemic was spreading. The following figure presents the trend parameters for the total cases after 28.12.2020.

Figure 16, total cases trend parameters after the vaccination

Model Summary and Parameter Estimates

Dependent Variable: total_cases

|		Model Summary				Parameter Estimates	
Equation	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.908	6175.350	1	626	.000	635284.095	5832.853

Source: OWN PROCESSING

The author estimated the model with the following parameters:

Y = 635284.095 + 5832.853t

When comparing the daily average increment before the vaccination kicked off (5173) with the new one (5832), it becomes evident that the vaccination process did not in fact halt the pandemic entirely and the daily increment slightly increased even despite the vaccination. In addition to things discussed above, the author also presents the chart reflecting the development of two indicators simultaneously – daily confirmed cases and daily vaccinations.

Figure 17, daily vaccination compared to daily cases
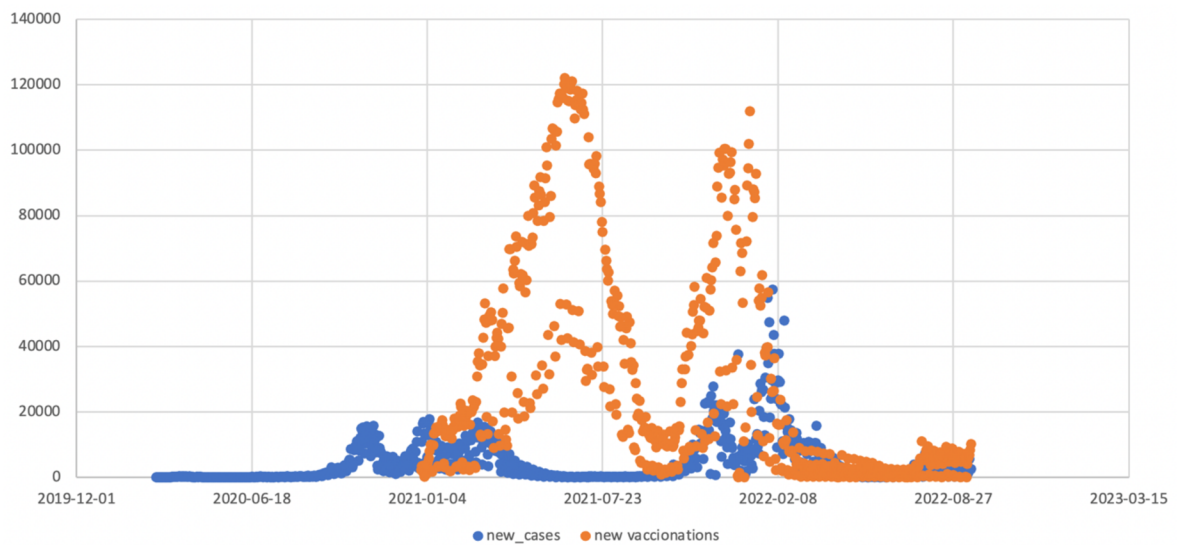
Source: OWN PROCESSING

Clearly, the chart proves the author's finding that the vaccination process did not entirely halt the coronavirus pandemic in the Czech Republic, because the number of daily cases has even increased. Yet, this might be the direct consequence of new mutations of the virus that lead to the increase in the transmittance.

In addition to all this, the author also computes the seasonality behind the vaccination to understand which days were the most popular among Czechs for vaccination. The following figure contains the output from SPSS Statistics.

Figure 18, seasonal factor for vaccinations per day

Seasonal Factors

Series Name: vaccination per day

Period	Seasonal Factor (%)
1	106.7
2	113.5
3	129.2
4	132.0
5	162.8
6	33.8
7	22.0

Source: OWN PROCESSING

Following the output, the author concludes the following:

- The number of vaccinations done on Sunday is 6.7% higher.
- The number of vaccinations done on Monday is 13.5% higher.
- The number of vaccinations done on Tuesday is 29.2% higher.
- The number of vaccinations done on Wednesday is 32% higher.
- The number of vaccinations done on Thursday is 62.8% higher.
- The number of vaccinations done on Friday is 66.2% lower.
- The number of vaccinations done on Sunday is 78% lower.

Thus, it is possible to say that the most popular days for vaccinations were Wednesdays and Thursdays. The less popular days were Fridays and Sundays.

4.4. Death Statistics

Finally, the very last piece of statistics that will be considered by the author – death statistics. The following chart shows the development of the new death cases from COVID-19 in the Czech Republic over time.

Figure 19, development of death cases over time

new_deaths
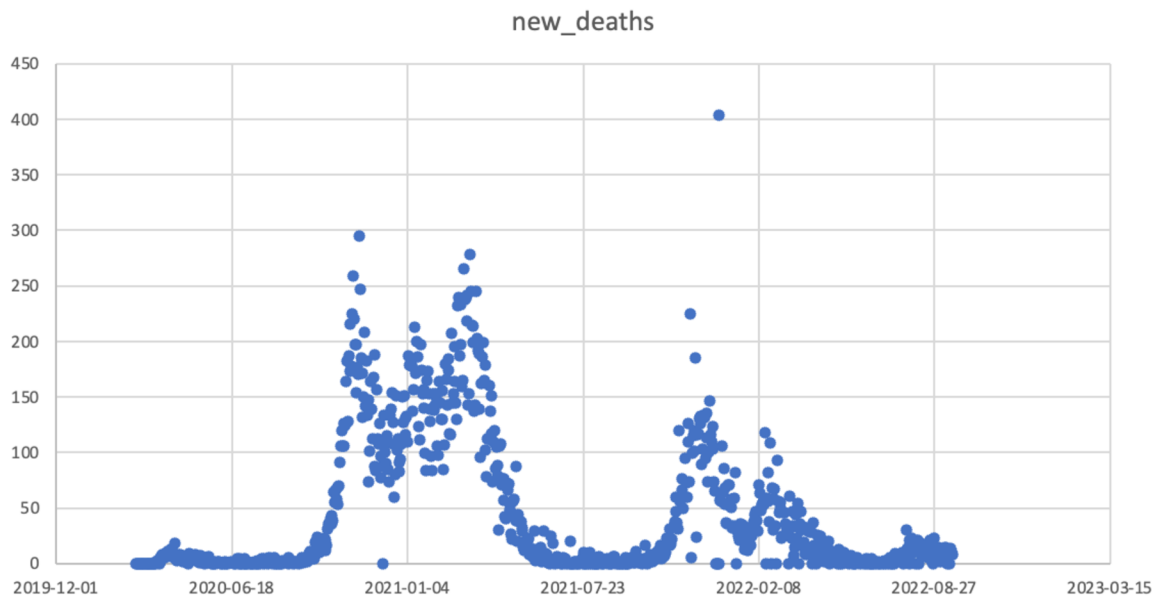
Source: OWN PROCESSING

The development of daily death cases somewhat resembles the development of new daily confirmed cases. Now, the author estimates the model for the total number of death due to the COVID-19 in the Czech Republic, and the following figure shows the parameters.

Figure 20, total deaths trend

Model Summary and Parameter Estimates

Dependent Variable: total deaths

| Equation | Model Summary | | | | | Parameter Estimates | |
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.919	10488.407	1	928	.000	−3597.929	56.208

The quality of the estimated trend is equal to 91.9%, and it is a fairly good result. The estimated model has the following characteristics:

$$Y = -3597.929 + 56.208t$$

It means that the average daily increment of deaths for the Czech Republic is equal to 56.

Finally, the author will find out if the average daily death increment slowed down after the start of the vaccination process in the country. For this purpose, the author creates the model for the very same indicator but after the start of the vaccination process in the country – 28.12.2020. The output from SPSS Statistics is presented on the figure below.

Figure 21, total deaths after the vaccination campaign

Model Summary and Parameter Estimates

Dependent Variable: total deaths

Equation		Model Summary				Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.865	4019.364	1	626	<.001	9312.019	38.667

The quality of the estimated trend is equal to 86.5%, and it is a fairly good result. The estimated model has the following characteristics:

$$Y = 9312.019 + 38.667t$$

It means that the average daily increment of deaths for the Czech Republic after the start of the vaccination campaign is equal to 38.667. Clearly, it is a partial piece of evidence for the fact that the vaccination helped to decrease the mortality rate of the coronavirus.

5. Results and Discussion

To begin, it is imperative to emphasize the most significant discovery made by the author, which is that the pandemic in the Czech Republic was comprised of two main waves: the first of which occurred in 2021 (from March to May), and the second of which occurred in 2022. (From November until March, when daily averages were the highest). According to the results of other writers, who felt that there have been more than two severe coronavirus pandemics in the nation, the author feels that, from a statistical point of view, there have only been two major ones. The first lockdown, which occurred in November of 2022, served more as a preventative measure (Novy, 2022).

The author also discovered that the most severe quarters for a coronavirus outbreak were the first quarter and the fourth one (Q1 and Q4), which both have the seasonality factor for new confirmed daily cases equal to 207% and 154%, respectively. This information was discovered after the author had previously found out that the first quarter and the fourth one were the most severe quarters for a coronavirus outbreak. This essentially indicates that there are 107% more daily cases during the first quarter of the year and that there are 54% more daily cases during the fourth quarter of the year. In the Czech Republic, the most severe cases of the coronavirus occurred during the months of January, February, and March, as well as October, November, and December. Other months in which the virus was most infectious include October, November, and December. This is in complete agreement with the findings of the other scientists, who believed that the coronavirus is much more dangerous during the winter months, indicating that there is evidence for the seasonality of the disease (Smit, 2020).

In addition to all of this, the author raises concerns about the viability of the coronavirus vaccine on the grounds that it was not successful in achieving its main objective, which was to prevent the coronavirus from spreading. After the beginning of the vaccine procedure, the author saw that the pandemic was progressing at a little speedier rate than it had been before. However, as other experts have come to the same conclusion, the severity of novel coronavirus variations and mutations, particularly the Omicron variant, is totally responsible for this phenomenon (Chen, 2021). In spite of this, the vaccination was shown to be quite useful in reducing the fatality rate caused by the coronavirus. The author

discovered data supporting the claim that the mortality rate caused by the coronavirus began to drop soon after the outbreak of the pandemic (the average daily increment of deaths decreased from 56.208 to 38.66). Of course, this could be justified by less lethal variants, but the author's statistical findings coincide with the findings of other authors who also came to the conclusion that the vaccine was not a panacea against the transmission of the virus, but it did help to reduce the mortality rate (Jaboska, 2021).

Also, the author's findings about the days when the virus was spreading the most – on working days (from Monday to Friday) – coincide with the findings of other authors who blamed the daily activities including work, leisure, and shopping for an accelerated spread of the coronavirus pandemic during the days of the highest social activity – working days from Monday to Friday. This accelerated spread of the coronavirus pandemic occurred during the days when there was the most social activity. Working days are Monday through Friday (Ricon-Becker, 2020).

Last but not least, the author draws the conclusion that working days are the most common times for people to be vaccinated, which is a finding that is not surprising at all.

6. Conclusion

In conclusion, the author draws the conclusion that the pandemic caused by the coronavirus in the Czech Republic was expanding rather fast, with two main waves and an average daily rise of 5173 daily cases each day. The working days of the week were the most hazardous for the transmission of the coronavirus since this is when the seasonality variables are at their greatest and most extreme levels.

The vaccination program was successful in lowering the death rate, but it was not able to halt the spread of the coronavirus across the country.

As a result of the fact that the first and fourth quarters were the most severe ones in terms of the contamination and intensity of the pandemic in the country, colder seasons are, in fact, far more deadly, and the coronavirus follows a pattern quite similar to that of any influenza.

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