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The Non-Accelerating Infection Rate of Unemployment as an Alternative to the Non-Accelerating Inflation Rate of Unemployment for the Period of the COVID-19 Pandemic: the Example of the Industries of the Czech Republic

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The objective of this paper is to use a meso-level empirical analysis to confirm the usefulness of the concepts of the Non-Accelerating Inflation Rate of Unemployment (NAIRU) and the Non-Accelerating Infection Rate of Unemployment (NARRU). The atypically negative values are consistent with the findings in an economy in transition and during a global financial and economic recession. A higher value of NARRU than NAIRU signals that the intensity of the government's counter-pandemic measures is inadequate to match the depth of the COVID-19 pandemic's impact on the labour market. The lower value of the positive gap between unemployment for the NAIRU concept versus that of NARRU implies that the impact of counter-pandemic measures on the labour market was smaller than that required by the pandemic burden on society. The government of the Czech Republic should have implemented a stricter lockdown or ensured a sufficient supply of respirator masks. Localised negative Phillips curve (PC) slopes at the meso level confirm the suitability of applying the NAIRU and NARRU concepts during the period of COVID-19. Ad hoc analysis and regression estimation of PC shifts on a rolling basis and a Break model in the last period analysed (April 2021 to March 2022) found that the PC in the first phase (April to August 2021) and in the fourth phase (February to March 2022) typically had a negative slope in both concepts. In the second phase (September and October 2021) and third phase (November 2021 to January 2022), the analysis located a PC with an atypically positive slope, which is related to fluctuations associated with the pandemic and measures against it.

Keywords: *Phillips Curve; NAIRU; NARRU; Economic Cycle; Differences in Unemployment across Sectors; COVID- 19.*

Introduction

This paper seeks to test the applicability of the PC and NAIRU concepts in the volatile environment induced by the COVID-19 pandemic. We utilise NAIRU in our analysis as this concept shows the long-term potential of the labour market. NAIRU represents a trend variable to which we will relate the actual unemployment rate. The pandemic affected the use of this overall labour market potential. We investigate how the individual measures taken affected the actual unemployment rate and thereby affected the trend variable. We use data from industries for this purpose, as PC and NAIRU at the meso level provide insights into dynamizing processes and their explanations within the economy (Kaderabkova & Jasova, 2011; Jasova & Kaderabkova, 2022). Furthermore, it is advisable to assess whether the counter-pandemic measures applied from March 2020 to March 2022 prevented the spread of the pandemic and, on the other hand, whether the loosening of measures was flexible enough to mitigate the extent of the recession or prevent it from deepening. In this paper, we therefore apply the traditional Tobin NAIRU model (Tobin, 1997) to the conditions of the Czech Republic, where we replace the time series of inflation with the time series of the basic reproduction number R (Kaderabkova & Jasova, 2021). The basic reproduction number R indicates the average number of people who are directly infected by one infected patient (MoH, 2021). This new concept therefore gives us what is called the Non-Accelerating Infection Rate of Unemployment, i.e., NARRU (Non-Accelerating R Rate of Unemployment). NARRU then defines the capacity with which the economy can safely operate in the COVID-19 era. On the one hand, comparing the results of the two concepts gives an indication of where economic performance has been prioritised over the spread of a pandemic, and on the other hand, where the health aspect has overridden the economic aspect. And yet it also helps assess the success of the socio-economic measures taken by government ministries to stem the recession. To this end, a list of the counter-pandemic measures implemented by the government of the Czech Republic against COVID-19 has been compiled. Moreover, the following lists have also been presented: a list of the economic and social measures promoted or proposed by the Ministry of Labour and Social Affairs, a list of economic measures applied by the Ministry of Industry and Trade, and lastly a list of economic measures developed by the Ministry of Finance.

The following section provides an overview of the results of international research assessing the impact of COVID-19 on the concept of NAIRU, PC, and the unemployment gap as well as the new pandemiological concept of NARRU. The second section specifies data sources and the third section covers the estimation methodology. The fourth section provides results comparing estimates of NAIRU, NARRU, unemployment gaps, and PC slopes at the time of the COVID-19 pandemic in the Czech Republic by sector. The last section presents the conclusions, discussion, theoretical contributions, managerial implications, limitations, and opportunities for future research.

Literature Review

Geographical Overview of the Pandemic Topic in the Period 2020–2022

International research at the macro and meso-levels starting from the original impact of COVID-19 (year 2020) on the concepts of NAIRU, PC, and the unemployment gap has identified both potential triggers of inflation and the behaviour of inflationary pressures and PC during the closure and reopening of the economy (Ebrahimy et al., 2020). Studies have monitored the growing role of the government in managing the economy (Freund & Rendahl, 2020). Attention has been devoted to downward and upward pressures on inflation (Leandro & Jimeno, 2020) and comparisons of PC with core inflation (Brooks & Fortun, 2020). At the same time, research has also produced the construct of alternative NAIRU (Gadhia, 2020), the inclusion of uncertainty in the reaction function of a central bank (European Parliament, 2020), and a new form of the link between inflation and economic activity (Zandweghe, 2020). Bannister et al. (2020) confirm that NAIRU moves to higher values after recessions triggered by supply shocks.

The short-run costs of a pandemic are particularly high in the hospitality, food services, and recreational services sectors. The level of sectoral reallocation of employment is the largest of the past 20 years. Sectoral reallocation permanently increases NAIRU as the mismatch between desired and actual skills in the labour market increases. A higher NAIRU is mainly associated with a permanent increase in unemployment benefits. Bodnar et al. (2020) argue that a more sustained shock and a possible reduction in support policies could lead to the development of hysteresis, leading to a further increase in NAIRU. One difference between earlier crises and the current crisis is, for example, that NAIRU has dropped markedly in recent years due to more flexible labour markets as a result of reforms in several euro area countries. Unlike the current shock, the Global Financial and Economic Recession impacted construction and industry but affected market services to a lesser extent. Robinson & Zollner (2021) estimated several alternative models that suggest NAIRU is somewhere around 4 %. Some industries (e.g., construction) could see wage increases due to strong demand. Lim et al. (2021) report that an estimated NAIRU of around 4.75 percent became a liability for the Reserve Bank of Australia due to fiscal contraction at a time when the economy was weak. The FED considers the relationship between unemployment and inflation to be less obvious in recent decades. There is speculation that global trends (e.g., an aging population) will reduce the savings rate and increase pressure on inflation and wages, which will increase estimates of international NAIRU. Structural changes induced and/or accelerated by the COVID-19 shock may have an impact on the level of NAIRU. Reasons that help explain the decline in the NAIRU in advanced economies include increased competition in goods markets, an increase in services provided internationally, technological progress, and changes in labour supply and labour market regulation. Brown & Lundblad (2021) consider the sustained shift towards jobs requiring certain, primarily technical, skills to be a challenge facing households.

The period of the subsequent impact of COVID-19 (using the year 2021 up to no later than the first 3 months of 2022 due to the initial impacts of other phenomena – the military conflict in Ukraine, the energy crisis and rampant inflation, the R indicator ceasing to be published) on NAIRU, PC, and the unemployment gap, according to international and Czech research, was characterised by the finding that PC at the regional level did well during the COVID-19 era (Higgins, 2021). Binder and Kamdar (2022) recall that economists have long debated the importance of inflation expectations for economic outcomes. Catiforis (2022) confirms that the PC still survives, but its slope has flattened over time. Babecka, et al. (2022) confirmed the cyclical dynamics of inflation according to the PC for the Czech economy as well. Bishop and Greenland (2021) find strong evidence that the wage PC is indeed a curve rather than a straight line.

Hronova, et al. (2021) draw attention to the fact that the indicators of the inflation rate and the unemployment rate are still necessary to evaluate the trend of the difference in their values over time. Ruberl et al. (2021) report that when updating the model, the authors considered a number of alternative specifications for estimating the wage PC. Reis (2021) uses applications using expectations data from the United States in 2021 to confirm the utility of measuring the inflation anchor in real time. Ball et al. (2022) find that it is possible to forecast inflation by specifying the path of unemployment and the future behaviour of the Beveridge curve and inflation expectations.

Fukao and Shioji (2022) propose a reaction function that determines the level of economic activity depending on a state of infection that excludes the possibility of an infection explosion. Kobayashi (2022) points out that the correlation between the number of infections and the output gap is analogous to the relationship between the PC. Friedrich and Selecuk (2022) confirmed that with the onset of COVID-19 both globalization and digitization experienced changes in their trajectory. An analysis by the International Monetary Fund (2022) suggests the critical role of the expectations formation process in shaping the wage and price outlook. According to Daly (2021), the PC was the key tool for the old normal in the economy. In the new normal there is still some of the PC, but it is hard to say where.

The quantitative information of the Czech authors, which serves to verify the empirical results from the analysis performed, including recommendations for economic policy makers, flows from Babecka, et al. (2022) that PC behaves perfectly when inflation expectations are included. The initial assessment of the pandemic shock estimated a large negative output gap (-14.0 %). However, the dynamics of inflation in 2020 did not fall in line with intuition and the macroeconomic story as a whole; the output gap was reassessed to milder negative values (-5.2 %). Zubikova and Smolak (2022) confirm the indirect relationship between the unemployment rate and the harmonised index of consumer prices in the period between March 2020 and December 2021. According to the new government methodologies, "support COVID" subsequently amounted to less than 9 % of expenses in December 2021.

Baba et al. (2023) analysed data in the period of Q1 2000 – Q2 2022 for 24 developed European economies (AE) and 7 emerging European economies (EE). The authors wanted

to understand the trend of inflation in 2021-22 using the PC concept. The inflation process in EE is more backward-looking. Inflation across Europe has been more dependent on food prices since the onset of the COVID-19 pandemic. Krulický et al. (2022) found in data from 2000 to 2021, that their estimated PC for the Czech Republic has a completely different shape and slope than the traditional PC. The PC for the Czech Republic will thus continue to move away from the short-term PC. CEIC (2023) uses the Kalman filter to estimate the NAIRU for the Czech Republic at 3.9 % in 2022 (2021 3.8 %; 2020 3.8 %; 2019 3.9 %). The unemployment gap was -0.439 p.p. in 2022; -0.364 p.p. in 2021; -1.364 p.p. 2020; -1.917 p.p. 2019.

The conclusions of the authors' research in the region can be used due to the incomparable intensity of the impact of the pandemic (the Czech Republic was declared "Best in COVID-19 in the whole world" three times by the International Health Organization) only to illustrate the impact of the pandemic in the monitored region. For example, CEIC (2023) Kalman-filtered estimate of Lithuania's NAIRU in 2022 at 6.680 %; 2021 6.683 %; 2020 6.687 %; 2019 6.692 %. Unemployment gap in 2022 + 0.915 p.p.; 2021 + 1,466 p.b.; 2020 + 1,803 p.b.; 2019 – 0.437 p.p. Simionescu (2022) states that the COVID-19 pandemic accelerated the digital transformation and helped cyber students to better integrate into the Romanian labour market. Zieliński (2022) links the relatively small response of the V4 labour markets to the COVID-19 pandemic with a relatively shallow recession and recovery in 2021. In addition to the recovery of economic activity, the increase in the unemployment rate is determined by developments in Slovakia. In other countries, employers were aware of small imbalances in the labour market and tried not to reduce employment for fear of difficulties in rehiring employees.

Gadhia (2020) attempted to link the pandemic to the economy in an effort to provide an answer to the question of when and how to mitigate or remove constraints while keeping infection rates low. The author proposes substituting the basic reproduction number R for inflation in the PC, where there is traditionally an inverse relationship between inflation and unemployment. This would thereby consist of the relationship between pandemics and unemployment. The goal of economic policy is to avoid a new wave of pandemic, which can be achieved by keeping R below 1 while maintaining a certain amount of economic activity. A value above 1 leads to another cycle of exponential transfer, requiring greater closure of the economy. The higher the value of R, the longer and harsher the lockdown, and thus its economic impact. An unemployment rate that does not accelerate the infection rate, i.e., NARRU, is therefore a new concept. NARRU defines the capacity with which an economy can securely operate in the COVID-19 era. The government influences the new equilibrium in real time, and therefore any loosening of measures must be gradual in order to track the basic reproduction number R through testing and hospitalization. A government should differentiate between restrictions in its measures, as it is essential in an economy to address multiple equilibria between R and unemployment. As with the PC, the shape and position of the NARRU curve will change over time as the pandemic evolves and as measures are implemented that are designed to push R below 1. Contact testing and monitoring and the measures associated with it will shift the NARRU curve to the left, see *Figure 1*, and allow the economy to operate at a higher level of activity, i.e., with a lower unemployment rate.

Chronological Overview of the Effects of the Pandemic on the Czech Republic

The course of the last 365 days not only shows the trend of the COVID-19 pandemic but suggests possible reasons as to why the Czech Republic was among the most affected countries in the world. A list of the pandemiological measures enforced by the government in each month (March 2020 to March 2021), together with the values of R and the numbers of counter-pandemic phases, is presented in *Table 1* in the Appendix. In the course of the fight against COVID-19, the government has undertaken a number of measures (legislative, non-legislative, and technical/organizational) and proposals for further action in preparation for a possible subsequent wave of the spread of the disease, and yet it has repeated the mistakes of the previous wave of the pandemic. *Table 2* in the Appendix presents the economic and social measures that the Ministry of Labour and Social Affairs (hereinafter MoLSA) has enforced or proposed in each month (March 2020 to February 2021). The Ministry of Industry and Trade (MoIT) provided compensation for specific entities; a list and summary of specific economic measures is provided in the Appendix in *Table 3*. The Ministry of Finance (MoF) also prepared a wide range of support measures for companies, entrepreneurs, and private individuals in response to the COVID-19 pandemic. A list of specific economic measures taken by the MoF to combat COVID-19 in each month (March 2020 to March 2021) is given in the Appendix in *Table 4*.

In the period from April 2021 to March 2022, the government relaxed education, trade, and services in April. Registration for vaccination was gradually opened to people over 30 years of age at the end of May. In June, the pandemic continued to weaken, the government decided to cancel workplace testing. In July, the number of cases increased again, the government cancelled the recognition of the first dose of vaccination as proof of being "infection-free". In August, the government increased the maximum capacity at events and swimming pools. In September, COVID-19 started to spread slowly. The government only decided on three rounds of testing at the beginning of the school year.

At the beginning of October, the Czech Republic was mainly alive with elections; after these only a few measures. In November, the number of infected surpassed the worst figures from the past. In January, the new on variant spread massively. The government cancelled the decree on compulsory vaccination for people over 60 and some professions. In February, the pandemic began to weaken; an amendment is made to pandemic law. In March, it was decided that most anti-pandemic measures should end by March 13.

The economic and social measures of the Ministry of Labour and Social Affairs in the period from April 2021 to February 2022 included, for example, the following: in April, the Antivirus program would be continued until May; an extraordinary allowance for employees ordered to quarantine would continue until mid-2021; in June the

Kurzarbeit passed the Senate; in October, the Ministry was prepared to sustain jobs in the automotive industry; in November, an extraordinary contribution was re-introduced for employees ordered to quarantine; in December, an emergency nursing home fee of 80 percent was approved.

For example, in April, the Ministry of Industry and Trade published a call for the new compensation program COVID – Uncovered Costs; in May, all the remaining segments of retail trade and most of the services that had been closed were now able to open; in June, Call 3.4 from the COVID program Culture was published; in July, support was granted from the COVID III guarantee program also for projects of an investment character; in November, the subsidy programs COVID – 2021 were introduced.

The Ministry of Finance also prepared a wide range of support measures in response to the COVID-19 pandemic: in November, it was prepared to continue accepting requests for compensation for cancelled cultural events; entrepreneurs and contractors incurring losses could apply for financial support for two bonus periods (November, December, January 2022) if they met the legal conditions; tax or duty relief was granted and certificates issued for debt-free status or the status of a personal tax account (January to August 2022).

Methodology and Analysis

Specification of Data Sources and their Division into Pandemic Phases

The values of NAIRU, NARRU, unemployment gaps, and PC slopes (character and intensity) by sector could only be examined after calculating the specific unemployment rate (%). As a starting point, the indicator used was last sector and employment of the unemployed (in thousands of persons) and employment in the national economy by sector and employment status (in thousands of persons) per CSO (2021).

Other CSO indicators included gross domestic product deflator, gross value added, import price index (all in annual % changes), composite confidence indicator, business confidence index, and consumer confidence index – basic indices (CSO, 2021). The indicator of average monthly entitlement to unemployment support in CZK was taken from the MoLSA (MoLSA, 2021). The indicators of the forex market exchange rate *of CZK/EUR* (monthly averages), Brent crude oil price (year-on-year change in %), indirect taxes (year-on-year change in %), and financial market inflation expectations (year-on-year change in %) were taken from the Czech National Bank, hereinafter CNB (CNB, 2021). The basic reproduction number R indicator was taken from Seznamzpravy.cz (2021). Expectations regarding trends of the basic reproduction number R were obtained from the records of press conferences of the Institute of Health Information and Statistics of the Czech Republic (hereinafter IHIS) and the Ministry of Health (hereinafter MoH) (MoH, 2021).

The published indicators of average monthly entitlement to unemployment benefits in CZK and forex market CZK/EUR exchange rate were converted to annual % changes. Annual changes were calculated in percentage points from the indicators of the basic reproduction number R and the composite confidence indicator, which includes the business confidence index and consumer confidence index. Lastly, the implicit GDP deflator (annual % change) and the basic reproduction number R were adjusted to reflect adaptive expectations. In this analysis covering the period of the COVID-19 pandemic, the interval has been set to a period of one quarter (i.e., the difference between the annual change at time t and the annual change at time t-1). In addition to these numerical variables, a time series was constructed from two categorical variables: sector and phase of the pandemic/economic cycle. The categorical variable of cycle phase, which was intended to capture the impact of the pandemic in a time series of specific unemployment rates and, by extension, in the economy as well, was derived from the anti-coronavirus restrictions adopted between 1 January 2020 and the end of March 2021.

Specifically, the entire period under study was divided into five (pandemic) phases according to the intensity of the counter-pandemic restrictions implemented by the Government of the Czech Republic (Kaderabkova et al., 2020). The first phase consisted of the months from January to March 2020, which were characterised by a greater proportion of periods without COVID-19 (January and February 2020) and by a hard lockdown (March 2020). The second phase included the months from April to June 2020, as these are the months in which society and the economy experienced a period predominantly characterised by a loosening of restrictions (May and June 2020) in addition to hard lockdown (April 2020). The third phase consisted of the months of July to September 2020, when a loosening (July and August) and a mild tightening (September 2020) were implemented. The fourth phase was dominated by a hard lockdown (October and November 2020), which was accompanied by a loosening (first half of December 2020) and a slight tightening (second half of December 2020). The fifth phase was characterised predominantly by a hard lockdown (February and March 2021) and also by a loosening (January 2021). *Figure 1* shows that Phase 1 can be considered the phase with the lowest intensity of restrictions, followed by Phase 3, Phase 2 (medium intensity of restrictions), and Phase 5, whereas the highest restrictions were imposed on the economy and society in Phase 4.

To complement the context of the comprehensive analysis of the impact of COVID-19 in the Czech Republic, there were 4 more (pandemic) phases in the period from April 2021 to March 2022. In the first of these (April to August 2021), the pandemic situation gradually improved and loosened. In the second phase (September and October 2021), COVID-19 began slowly spreading again and several measures were subsequently taken that did not slow down the spread of the virus. In the third phase (November 2021 to January 2022), a whirlwind of government negotiations followed the initial hesitation, the massive spread of the new omicron variant, and lastly the daily additions of the infected at the highest values since the beginning of the pandemic. In the fourth phase (February and March 2022), the coronavirus pandemic began to subside and it was decided that most of the anti-pandemic measures should end by March 13.

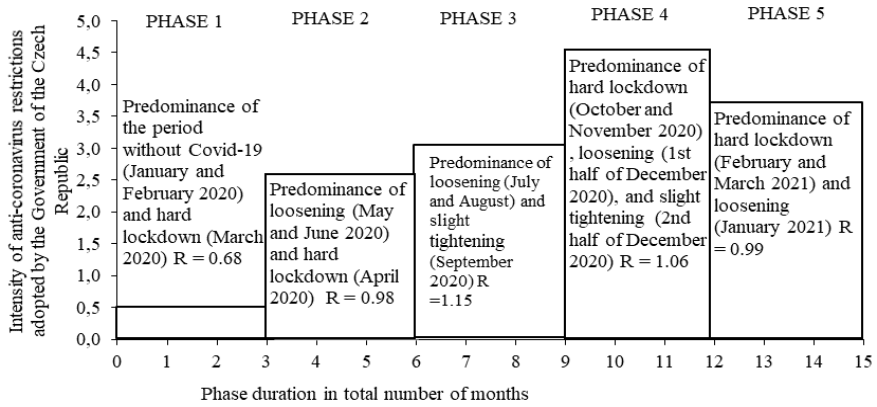

Figure 1. Timeline of Anti-Pandemic Measures Taken by the Government of the Czech Republic by Degree of Restriction

Source: Author representation based on data from the IHIS, the MoH, and Bartonicek et al. (2021).

Estimation Methodology

The standard Sekhon model for estimating inflation was expanded to include a proxy chosen for institutional labour market factors (average monthly unemployment benefit claims, Cermakova & Jasova, 2019), a proxy for psychological factors on the demand side (consumer confidence index), and a proxy for these factors on the supply side as well (business confidence index). We then created an alternative to the NAIRU concept according to the predictions of Gadhia (2020) by including an indicator of the pandemiological situation, referred to as the basic reproduction number R, in the place of the consumer price index in the standard Sekhon inflation model.

Since we needed to track the trend of NAIRU, NARRU, the unemployment rate gap, and PC across pandemic/ economic phases without reducing the number of observations or reducing the validity of the estimates, we modified the single-equation model method previously used to include a categorical variable for phase of the pandemic/economic cycle. The actual estimate of the required unobservable variables was performed using multiple linear regression applied to a database of 80 observations. The inflation equation and the infection equation were then estimated using the least squares method. We extracted the NAIRU, NARRU, and PC slope in a detailed grouping drawn from different perspectives by defining categorical variables in their interaction with unemployment rates by sector. This allowed us to identify the NAIRU, NARRU, and the PC slope, in terms of both character and intensity, and to confirm or refute the substitutability of the implicit GDP deflator or the basic reproduction number R with the specific unemployment rate by sector but also by phase of the pandemic/economic cycle altogether.

The specific computation of NAIRU and subsequently NARRU values is based on the linear regression inflation equation mentioned above (Sekhon, 1999), dividing the value of the constant by the regression coefficient of the specific unemployment rate by sector and also by phase. The gap in the specific unemployment rate, which characterises the trend of the business cycle and subsequently the pandemic/economic cycle in the labour market, was then obtained by subtracting our calculated NAIRU and NARRU from the actual sector-specific unemployment rate.

The highest predictive power of the model (where the R^2 observed was highest) and the individual variables in it (where the p-value obtained was lowest) were determined by the number of lags of the explained variable behind the explanatory variables. The most appropriate model to approximate the analysed data was selected using the Akaike information criterion. A summary of the parameters, standard errors, t-statistics, p-values, and selected statistics of the models for Chapter 4 (without distribution by categorical variables) is presented in the Appendix in *Table 5*. The stationarity of all time series used was assessed using the augmented Dickey–Fuller test (ADF). The normality of residuals was tested using the Jarque-Bera test, the autocorrelation of residuals using the LM test (Breusch-Godfrey test), and heteroskedasticity using the White test. The severity of multicollinearity is measured in this paper using the variance inflation factor (VIF). The failure of normality tests of the residuals due to fluctuations in the trend of some segments of the explained variable, and the year-on-year changes calculated from them in the case of a large number of observations, allow us to assume the validity of the central limit theorem, which states that t tests are asymptotically valid. Thus, the point estimates will not break and remain unskewed. Unemployment gaps are created by subtracting the NAIRU and NARRU from the actual specific unemployment measures.

Table 6 in the appendix provides a summary of the estimated values of NAIRU, NARRU, PC slope, and the unemployment gap (henceforth UG) in the national economy and in the sectors used for estimation. In this appendix, as in the figures in the empirical part of the text, the names of the industries are replaced with their abbreviations as follows: Manufacturing (ZpracPrum), Construction (Staveb), Wholesale and Retail Trade, Repair of Motor Vehicles (Obchod_Oprav), Transportation and Warehousing (Doprav_Sklad), Hospitality, Food and Beverage (Ubyt_Strav_Poh), Administrative and Support Activities (AdministrCinn), Public Administration and Defence, Social Security (VerSprav_Obr_SocZab), Health and Social Assistance (Zdrav_SocPec).

Because the specific unemployment rate was strongly distorted by the system of aid, our findings on the relationship between R and the specific unemployment rate were also assessed through the prism of the economic and social measures against COVID-19 of selected ministries.

The application of multiple linear regression, which was used in the comprehensive analysis to estimate unobservable variables, was supplemented with ad hoc analysis including verification with published data (graphic representation of a linear line) in the period from April 2021 to March 2022 (e.g. Zubikova & Smolak, 2022; Krulicky *et al.*, 2022). However, it consisted primarily of a regression estimation of PC shifts on a rolling basis (Baba *et al.*, 2023) and a Break model (Jasova & Kaderabkova, 2012). The rolling regression estimate indicates several possible shifts in the PC coefficients over this period. This is an alternative to more formal ways of obtaining evidence, which will need to be confirmed in further research by estimating the PC on the full data set by applying more sophisticated methods.

Results

A Comparison of NARRU to NAIRU

A comparison of NARRU to NAIRU in the entire national economy for the period from January 2020 to March 2021 (*Table 7* below) shows that both were atypically negative, consistent with the conclusions of earlier research (e.g., Jasova & Kaderabkova, 2012) on an unstable environment similar to that of an economy in transition or a global financial and economic recession. The average value of NARRU for the Czech Republic over the entire period under review was higher than NAIRU by 5.8 p.p., indicating a predominance of negative pandemic pressures over inflationary pressures on the labour market. Meanwhile, the GDP deflator increased the y-o-y growth rate in the period under review over 2019 by only 0.5 p.p. (4.7 % vs. 4.2 %); pandemic pressures indicated the community spread of the pandemic (R=1.2). Gross value added then declined by an average of 4.9 % y-o-y over the period under review, whereas in 2019 it had grown by 2.5 % y-o-y. The actual specific unemployment rate showed the same trend, reaching 3.3 % and increasing by 1.3 p.p. compared to 2019. Thus, it can be reasonably assumed that the government's counter-pandemic measures were not sufficient to the depth of the COVID-19 pandemic's impact on the labour market and the real economy.

Table 7

Estimated NAIRU and NARRU Trends in the Entire National Economy

Indicator	Entire period	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
NAIRU in NE (%)	-1,6	-0,7	-1,1	-4,0	-0,7	-1,5
NARRU in NE (%)	-7,4	-3,3	2,0	-8,2	-5,2	-22,3

Source: Author calculation based on data from the MoLSA, CSO, CNB, IHIS, and MoH.

In terms of sectors, only NAIRU in the administrative activities sector (0.6 %) was classically positive. NARRU recorded the highest margin above NAIRU for the entire period in administrative activities and the lowest in transportation and storage (*Figure 2* below).

A similar conclusion was also found for average NARRU in the first period (the phase with a greater proportion of months without COVID-19), which was higher than NAIRU by 2.6 pp. (*Table 7* above). The predominance of negative pandemic pressures over inflationary pressures on the labour market is confirmed by the indicator R, which reached 2.0. Inflationary pressures were represented by the actual y-o-y GDP deflator growth of 4.3 %, whereas in Q4 of 2019 these were equal to 4.4 %. Gross value added declined by an average of 0.5 % y-o-y over the period under review, whereas in Q4 of 2019 it had grown by 2.0 % y-o-y. The specific unemployment rate stagnated at 2.1 % in both periods. While the government's counter-pandemic measures eliminated the impact of the pandemic on the labour market, they failed to prevent a drop in company performance. By sector, only the NAIRU in manufacturing, construction, administrative activities, public administration, and health care recorded a positive value. The greatest predominance of NARRU (*Figure 2)* was in the administrative activities sector, while the greatest predominance of NAIRU was in hospitality and food services.

The value of NARRU in the second period (i.e., the phase dominated by loosening and hard lockdown) was positive (2.0 %), while NAIRU remained atypically negative (-1.1 %). Here, again, a higher NARRU value indicated the presence of a negative impact of the pandemic on the labour market, whereas the model indicated that inflationary pressures were under control. The real GDP deflator trend increased to 4.7 % (+0.4 p.p.), but the indicator of R fell sharply to 1.0, contrary to the conclusion of the model. Given that the annual decline in gross value added accelerated to 11.0 % and the specific unemployment rate increased compared to the previous period by 1.0 p.p. (to 3.1 %), the government's economic measures can be considered to have been effective, but should have been spread over a longer period of time as they led to restriction of economic growth. The only effect was to accelerate inflationary pressures and subsequent inflation expectations in the economy. In terms of sectoral position, the classical positive value was mostly achieved by NARRU (in all sectors), while for NAIRU it was only in the sectors of administration, public administration, and health care. The greatest predominance of NARRU (*Figure 2*) was in the health care sector, while the greatest predominance of NAIRU was in manufacturing.

The average value of negative NARRU in the third period (i.e., the loosening and moderate tightening phase) was higher than the negative NAIRU by 4.2 p.p. Here, again, a higher NARRU value indicated the presence of a negative impact of the pandemic on the labour market, whereas inflationary pressures were once again under control. The real GDP deflator increased to 4.9 % (+0.2 p.p.) but the R indicator increased to 1.2 and thus, in line with the model, the pandemic began to spread. Even though gross value added declined substantially y-o-y to 5.5 % and the specific unemployment rate increased by only 0.1 p.p. (to 3.2 %), the government’s economic measures can still be regarded as economically inefficient expenditure. In part, government spending also suppressed money spent by households and companies, which increased inflationary pressures in the economy. In terms of the pandemic, there was a need for more strict measures, as the community spread of the

pandemic was beginning. By sector, only the NAIRU in manufacturing, construction, and administration reached a classical positive value. The greatest predominance of NARRU (*Figure 2*) was in administration, whereas the greatest predominance of NAIRU was in transport.

The average value of the negative NARRU in the fourth period (i.e., the phase with a predominance of hard lockdown accompanied by loosening and moderate tightening) exceeded the negative NAIRU even more (by 4.5 p.p.). This trend indicated a further deepening of the negative impact of the pandemic on the labour market; inflationary pressures were kept under control. The real GDP deflator increased to 5.7 % (+0.8 p.p.) and the R indicator fell to 1.1, but the community spread of the pandemic continued. Gross value added reduced a year-on-year decline only marginally (to 5.1 %) and the specific unemployment rate rose compared to the previous period by a full 0.6 p.p. (to 3.8 %). The resources invested must continue to be considered economically inefficient. The government's measures were thus increasingly suppressing domestic aggregate demand from households and companies, which increased domestic inflation potential. From a pandemic perspective, it appears that the tightening of measures only slightly slowed the community spread of COVID-19. By sector, only NAIRU reached a classical positive value, and that was in construction, trade, transportation, and hospitality. The greatest predominance of NARRU (*Figure 2*) was in the construction sector.

The average negative value of NARRU in the fifth period (i.e., the phase with a predominance of hard lockdown and loosening) was sharply above the negative value of NAIRU by 20.8 p.p. This finding confirms the presence of a pronounced pandemiological imbalance in the labour market. In line with the model's estimates, the actual trend of the GDP deflator fell to 3.9 % (-1.8 p.p.) and the R indicator fell to 1.0, thus halting the pandemic's community spread. Gross value added fell by only 2.5 % y-o-y (-2.6 p.p.), but the specific unemployment rate also rose by 0.5 p.p. compared with the previous period. (to 4.3 %). The government had already substantially reduced the acceleration of substitution of domestic aggregate demand with its measures, as reflected in a reduction in domestic inflation potential and a substantial reduction in the decline in gross value added. On the pandemiological side, the community spread of the pandemic in the country was halted. By sector, only the NAIRU in the public administration and health care sectors reached a classical positive value. The greatest predominance of NARRU (*Figure 2*) was in administration.

Ad hoc analysis and regression estimation of PC shifts on a rolling basis and the Break model in the period from April 2021 to March 2022 placed the first pandemic phase in the period April to August 2021. As the pandemic situation gradually improved and loosened during this interval, both the NAIRU and NARRU were typically positive. The pandemic situation was fully under control (R=0.8), gross value added decreased year-on-year (by 2.2 %), and thus the NAIRU was above the NARRU value.

In the second phase (September and October 2021), when COVID-19 starts to spread again and the several measures taken do not slow down the spread of the virus, both NAIRU and NARRU are already taking atypically high and negative values due to the instability of the environment. Since R was 1.1 and the gross value added indicator increased year-on-year (by 9.8 %), the NAIRU was below the NARRU. In the third phase (November 2021 to January 2022) there was massive spread of the new micron variant and deepening insecurity in society continued to maintain negative NAIRU and NARRU values. The R-value stood at 1.2 and gross value added lowered year-on-year growth (3.2 %), which continued to push the NAIRU below the NARRU.

In the fourth phase (February and March 2022), the pandemic was already waning and most anti-pandemic measures ended in mid-March. Both NAIRU and NARRU were again typically positive. As R reached 1.0 and the special unemployment rate showed a slight increase from the previous period (to 2.3 %), the NAIRU was above the NARRU. As these are preliminary results, it will be necessary in further research to confirm the estimate on the full data set by applying a more sophisticated method.

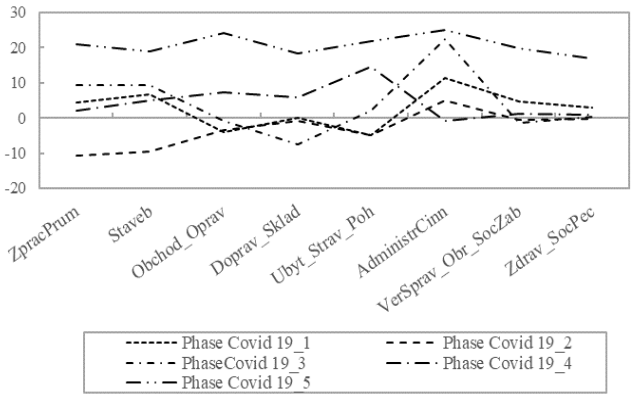

Figure 2. Comparison of NARRU and NAIRU Trends in the Different Phases of Pandemic Restrictions by Sector in the Czech Republic (in p.p.)

Source: Author calculation based on data from the MoLSA, CSO, CNB, IHIS, and MoH.

A Comparison of the Gaps

A comparison of the gaps in specific unemployment rate for the entire period shows a positive gap, which confirms the recession phase, whereas it amounts for the NARRU concept to 10.7 p.p. and for the NAIRU concept to 4.9 p.p. (*Table 8* below). Thus, the models indicate the emergence of a pandemic/economic imbalance due to pandemic pressures; economic pressures should be under control. Consistent with the models' estimate of an R of 1.2, the community spread of the pandemic was confirmed and the growth rate of the GDP deflator increased only slightly. And yet on the other hand, gross value added shifted from y-o-y growth to a y-o-y decline and the actual specific unemployment rate increased to 3.3 %. The counter-pandemic measures were thus inadequate from the point of view of public health, i.e., they should have been addressed by more massive use of home offices but also by more employment support at a time of company closures (Antivir).

Table 8

Estimates of the Trend of Unemployment Gap by NAIRU and NARRU across the National Economy

Indicator	Total period	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Unemployment gap in NE by NAIRU (p.p.)	4,9	2,8	4,2	7,2	4,4	5,8
Unemployment gap in NE by NARRU (p.p.)	10,7	5,4	1,0	11,4	8,9	26,5
Unemployment gap in NE by NAIRU-NARRU (p.p.)	-5,8	-2,6	3,1	-4,2	-4,5	-20,7

Source: Author calculation based on data from the MoLSA, CSO, CNB, IHIS, and MoH.

From a sectoral perspective, the recession phase was confirmed for both concepts in all sectors. A larger intensity of the gap for the NARRU concept was found (*Figure 3*) in all sectors, with the administration sector being the most affected (by 5.0 p.p.).

The average value of the unemployment gap in the labour market in the first period (i.e., the phase with a greater proportion of months without COVID-19) had a positive sign for both concepts (+2.8 p.p. for NAIRU and +5.4 pp for NARRU) and consisted of a recessionary period. The higher value for NARRU implies the emergence of a pandemic/economic imbalance due to pandemic pressures, while economic pressures remained under control. The model estimates are consistent with the data for the specific unemployment rate, which was lower than average for the entire period (2.1 %). These estimates are supported by the virtual stagnation of gross value added in the national economy (down by 0.5 % y-o-y). The same can be said of the R indicator, which stood at 2.0 over the period, representing the uncontrolled spread of the pandemic in society. From a public health perspective, the counter-pandemic measures should have been adhered to more closely. Their setting and use by companies and workers were optimal given the economic situation in the real economy and the labour market. This conclusion is also confirmed by the below-average high growth of the GDP deflator indicator (by 4.3 %). Only in the construction, manufacturing, and health care was a negative unemployment gap found in the NAIRU, signalling a boom phase. There was a higher positive gap for NARRU than for NAIRU in manufacturing, construction, administration, public administration, and health care. This was particularly the case in the administration sector (by 11.4 p.p.). For NAIRU, this consisted of trade, transportation, and above all the hospitality sector (by 5.0 p.p.).

The average unemployment gap in the second period (i.e., phases of predominant loosening and hard lockdown) was again positive (NAIRU +4.2 p.p. and NARRU +1.0 p.p.), thus extending the recessionary phase in the labour market for both concepts. However, the higher value of NAIRU implied the emergence of a pandemic/economic imbalance due to economic pressures; pandemic pressures, on the other hand, were under control. The estimates of the models are consistent with the data for the specific unemployment rate, as it increased by 1.0 p.p. y-o-y compared to the first period (to 3.1 %). Gross value added in the national economy even fell by a full 11.0% y-o-y. The trend of R, which fell to 1.0 in the period, is also in line with the estimates. While this level confirms the halt in the community spread of the pandemic, the severity of the measures introduced devastated the labour market and, above all, the real economy. The subsequent increase in the growth rate of the GDP deflator (up to 4.7%) shows the ineffectiveness of their use, as the market allocation of financial resources in the economy became for the most part blocked. Within the sectors, a negative gap and boom phase was confirmed in administration according to NAIRU (5.2 p.p.) and in administration (0.1 p.p.) and public administration (0.3 p.p.) according to NARRU. An exceeding was mapped for the NAIRU concept in all sectors except public administration. The highest was found in manufacturing (by 10.7 p.p.). NARRU exceeded NAIRU only in public administration, by a mere 0.1 p.p.

In the third period (i.e., the loosening and moderate tightening phase), the average unemployment gap in the labour market continued to be positive, with the gap widening substantially (NAIRU 7.2 p.p. and NARRU 11.4 p.p.). The higher value for NARRU implied the emergence of a pandemic/economic imbalance due to pandemic pressures, while economic pressures remained under control. The models' estimates are consistent with the published figures for the specific unemployment rate, which increased only slightly compared to the previous period (+0.1 p.p.). On the other hand, the y-o-y decline in gross value added in the national economy is much more favourable than in the previous period (5.5 p.p. improvement). The model's estimates are also in line with the trend of the R indicator, which reached 1.2, which reinstated the community spread of the pandemic in the community. Y-o-y GDP deflator growth increased slightly

(+0.2 p.p.). In summary, it can be concluded that the counter-pandemic measures could have been more vigorous, as they would have protected the health of citizens, while mitigating fluctuations in the real economy that made it difficult for households and companies to form expectations about future developments. Furthermore, the government should have overseen the use of measures to preserve jobs in the labour market. It should also have evaluated the targeting of measures to households and companies in need, so as to avoid suppressing household and company funds with government funds. By sector, all gap values were positive for both concepts, signalling a recessionary phase in all sectors. For NARRU, the positive gap was higher in manufacturing, construction, hospitality, health care, and above all administration (by 22.2 p.p). Conversely, the gap for NAIRU was higher than NARRU in trade, public administration, and particularly transportation (by 7.4 p.p).

The average positive value of the unemployment gap in the labour market in the fourth period (i.e., the phase with a predominance of hard lockdown accompanied by loosening and moderate tightening) for both the NAIRU and NARRU concepts (4.4 p.p. and 8.9 p.p., respectively) decreased relative to the previous phase. The higher value for NARRU suggested the presence of a pandemic/economic imbalance due to pandemic pressures, while economic pressures remained under control. The model estimates are inconsistent with published data for the specific unemployment rate, which increased by 0.6 p.p. relative to the previous period. The subsequent improvement over the previous period for gross value added in the national economy (by 0.4 p.p.) still represents a y-o-y decline of 5.1 %. However, the model's estimates are consistent with the negative trend of the R indicator, even though it declined to 1.1, it still represented community viral spread in the community. In the case of the GDP deflator, there has been an acceleration of y-o-y growth compared to the previous period (by 0.8 p.p.). Thus, overall, it is clear that counter-pandemic measures should have been more closely upheld in order to reduce transmission of infection. On the other hand, the measures should have been better targeted, as they supported the labour market and company's business activities only minimally, due to the acceleration of inflationary pressures. From a sectoral perspective, all gap values were positive for both concepts, confirming the recession phase in all sectors. NARRU exceeded NAIRU in all sectors except administration. The highest was then found in the hospitality sector (by 14.6 p.p.). NAIRU was higher than NARRU in administration by 0.9 p.p.

The average positive value of the unemployment gap in the fifth period (i.e., the phase with the predominance of hard lockdown and loosening) for both the NAIRU and NARRU concepts (5.8 p.p. and 26.5 p.p., respectively) escalated sharply relative to the previous phase. The higher value for NARRU suggests the creation of a pandemic/ economic imbalance due to pandemic pressures; economic pressures are under control. The estimated models are not consistent with published data for the specific unemployment rate, as it had again increased substantially (+0.5 p.p.) compared to the previous period. Continued improvement came from gross value added in the national economy, which was now declining by only 2.5 % y-o-y. The model's estimates are also not supported by the trend of the R indicator, which decreased to 1.0, halting the community spread of the virus in the country. The GDP deflator indicator then substantially reduced y-o-y growth (by 1.8 p.p.). In summary, sufficiently vigorous counter-pandemic measures protected the health of citizens. However, companies made insufficient use of home offices and preferred to lay off employees. On the other hand, the measures allowed companies to do business without fluctuations in their production. Also, the efficiency of the application of the measures increased during this period, reducing suppression of the funds of households and companies. According to the sectoral analysis, all the gap values were positive for both concepts, and thus a recession phase occurred in each sector during this period. In all sectors, the NARRU concept also exceeded the values of the NAIRU concept. The highest excess was in administration (by 25.0 p.p.), while the lowest was in health care (by 0.9 p.p.).

Ad hoc analysis and regression estimation of PC shifts on a rolling basis and Break model in the period from April 2021 to March 2022 evaluated the first pandemic phase (April to August 2021) as a recession. While in the case of NAIRU, its intensity was higher, which implies the emergence of pandemiological-economic imbalance due to economic pressures, pandemic pressures were fully under control (R is 0.8). However, the intensity of the introduced measures led to a year-on-year decrease in gross added value of 2.2 %.

In the second phase (September and October 2021), COVID-19 started to spread again and several measures taken to spread the virus did not affect the output as it was in the boom phase. This time, the unemployment gap according to NARRU was higher than according to NAIRU, i.e. the government's non-systemic pandemic measures did not threaten the economy (e.g. gross value added increased by 9.8 % year-on-year, the specific unemployment rate decreased to 2.4 %), but the number of infected people increased (R=1.1). In the third phase (November 2021 to January 2022), the NARRU unemployment gap continued to be above the NAIRU. There was a massive spread of the new - 522 -micron variant, but thanks to the measures implemented by the government, the number of infected increased only slightly (R=1.2). At the same time, there was only a decrease in the year-on-year growth of added value from the previous quarter (to 3.2 %), the specific unemployment rate has not been affected for the time being. The labour market was in a boom phase.

In the fourth phase (February and March 2022), the pandemic had already weakened and most of the anti-epidemic measures had been relaxed. The gap according to NAIRU exceeded NARRU, and thus the pandemic situation was under control (R decreased to 1.0). However, the labour market was in a recession phase; the trend of regular declines in the specific unemployment rate reversed (2.3 %).

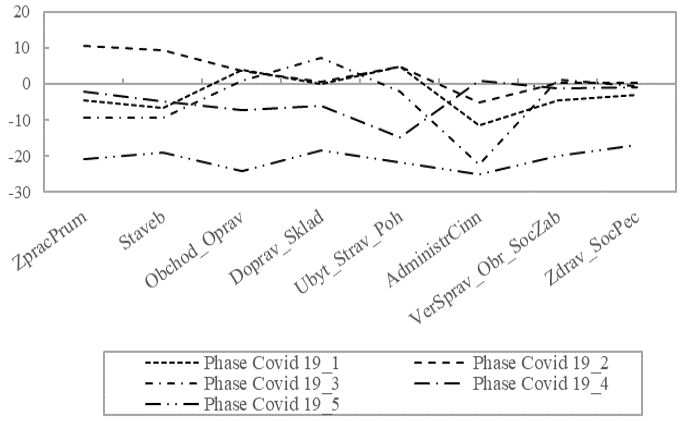

Figure 3. Differences in the Trend of the Two Unemployment Gaps in the Different Phases of the Application of Pandemic Restrictions by Sector in the Czech Republic (in p.p.)

Source: Author Calculation Based on Data from the MoLSA, CSO, CNB, IHIS, and MoH.

A Comparison of the PC Slope

In the case of comparing the PC slope, it can be noted that the average value of the NAIRU and NARRU for the entire Czech Republic has an atypical positive slope with very weak substitutability of the basic reproduction number R and the GDP deflator by the specific unemployment rate (0.018 and 0.030, respectively; *Table 9* below). In this case as well, the chosen econometric method attempts to use negative and unrealistically low positive PC values to accommodate the unstable post-pandemic environment and countermeasures.

Table 9

Estimated PC Slope Trend by NAIRU and NARRU across the Entire National Economy

Indicator	Total period	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
PC slope in the NE for NAIRU	0,018	-0,421	0,501	-0,186	-0,038	0,234
PC slope in the NE for NARRU	0,030	0,536	-1,080	0,289	0,342	0,066

Source: Author calculation based on data from the MoLSA, CSO, CNB, IHIS, and MoH.

The highest positive PC slope for NAIRU was found in transportation (1.489), while for NARRU it is in health care (0.148). A typical negative slope for NAIRU was mapped in construction, administration, public administration, and health care. For NARRU, this consisted only of the transportation sector.

According to *Table 9*, the average value of the PC slope in the first period (i.e., the phase with a greater proportion of months without COVID-19) was typically negative for the NAIRU concept (-0.421) and positive for the NARRU concept (+0.536). The intensity of substitutability of the replacement number R and the GDP deflator by the specific unemployment rate is weak. The highest negative PC slope was found for NAIRU in public administration (-1.603), whereas no classic PC slope was found for NARRU. An atypically positive slope was located for NAIRU only in the trade, transportation, and hospitality industries. For NARRU, it is present in all sectors, especially transportation (+1.014).

The average value of the PC slope in the second period (i.e., the predominant loosening and hard lockdown phases) was typically negative this time for the NARRU concept (-1.080) and positive for the NAIRU concept (+0.501). The intensity of the substitutability of the GDP deflator with the specific unemployment rate was weak, while that of the basic reproduction number R was strong and the PC very steep. The highest negative PC slope was for NARRU in transportation (-3.334). For NAIRU, the classic PC slope was found only in public administration (-1.779), health care (-1.529), and administration (-0.156). No atypically positive slope was localised for NARRU at all. For NAIRU, the industries were manufacturing, construction, hospitality, and above all, transportation. The downward movement of PC according to the model was much more pronounced in this volatile period than would have been consistent with financial market inflation expectations (+2.1 %). While the financial market had expected only a reduction in inflation dynamics compared to the previous quarter (by 0.5 p.p.), the model-estimated shift in PC confirmed the economy's fall into deflation (approx. -0.5 %) – see *Figures 4a, 4b*.

The average value of the PC slope in the third period (i.e., the loosening and moderate tightening phase) was typically negative for the NAIRU concept (-0.186) and positive for the NARRU concept (+0.289). The intensity of substitution of the replacement number R and the GDP deflator with the specific unemployment rate is very weak. A negative PC slope was found for NAIRU in construction (-1.294), manufacturing (-0.770), and administration (-0.582), whereas no classic PC slope was found for NARRU. An atypically positive slope was localised for NAIRU in health care, public administration, transportation, trade, and hospitality. For NARRU, it was present in all sectors, especially transportation (+0.931). However, if financial market inflation expectations implied an increase in inflation against the previous period (by 0.2 p.p.), the model

estimated a further deepening of deflation against the second phase (by about 1 p.p. to -1.5 %; *Figures 4a, 4b*).

The fourth period (i.e., the phase with a predominance of hard lockdown accompanied by loosening and moderate tightening) was typically negative for the NAIRU concept (-0.038) and positive for the NARRU concept (+0.342). The intensity of substitution of the replacement number R and the GDP deflator with the specific unemployment rate was very weak. A negative PC slope was found for NAIRU in construction (-1.445), transportation (-0.677), trade (-0.521), and hospitality (-0.258), whereas no classical PC slope was found for NARRU. An atypically positive slope was localised for NAIRU in health care, public administration, manufacturing, and administration. For NARRU it was all sectors, but especially health care and public administration. While experts' expectations for R suggested a slight decline from the previous quarter (by 0.2 to 1.1), the model ruled out a negative impact of R altogether.

The average PC slope in the fifth period (i.e., the phase dominated by hard lockdown and loosening) was atypically positive for both concepts (NAIRU +0.234; NARRU +0.066). The intensity of the substitutability of the GDP deflator and the replacement number R by the specific unemployment rate was very weak. A negative PC slope was only found in public administration (-2.367) and health care (-1.758) for NAIRU; no classic PC slope was found for NARRU. While the financial market's inflation expectations had predicted a drop in inflation compared with the previous period (by 0.1 p.p. to 2.0 %), the model estimated prices in a situation of deepening instability to anchor close to zero (*Figures 4a, 4b*). Ad hoc analysis and regression estimation of PC shifts on a rolling basis and Break model in the period from April 2021 to March 2022 found that the PC in the first phase (April to August 2021) and in the fourth phase (February to March 2022) had typically negative slope. In both cases, this was a period with a waning pandemic, loosening of measures. On the other hand, however, it was also a period of apparent calm (e.g., before the 2021 elections).

In the second (September and October 2021) and third phases (November 2021 to January 2022), the analysis located a PC with an atypically positive slope. The econometric software was thus attempting to deal with an unstable to turbulent environment. This was the result, for example, of the adoption of partial or non-systemic anti-pandemic measures (e.g., only three rounds of testing in schools at the beginning of the school year). It was also the result of too much effort to maintain jobs (e.g., repeated crisis infirmary of 80 %). It is also a period with the number of infected surpassing the worst own numbers from previous waves of the pandemic (R=1.2).

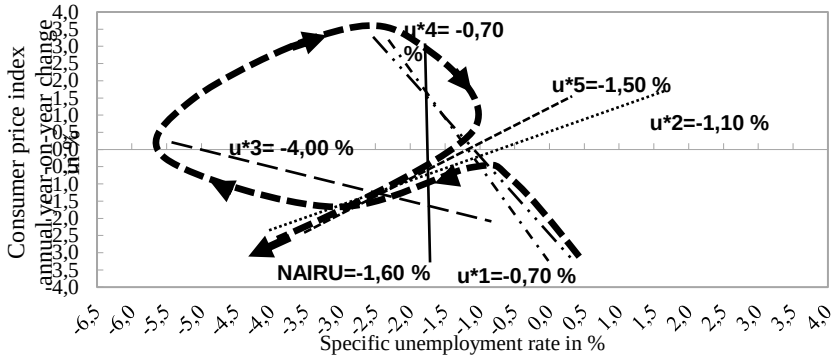

Figure 4a. PC and NAIRU Trend in the Different Phases of the Application of Pandemic Restrictions in the Czech Republic

Source: Author calculation based on data from the MoLSA, CSO, CNB, IHIS, and MoH.

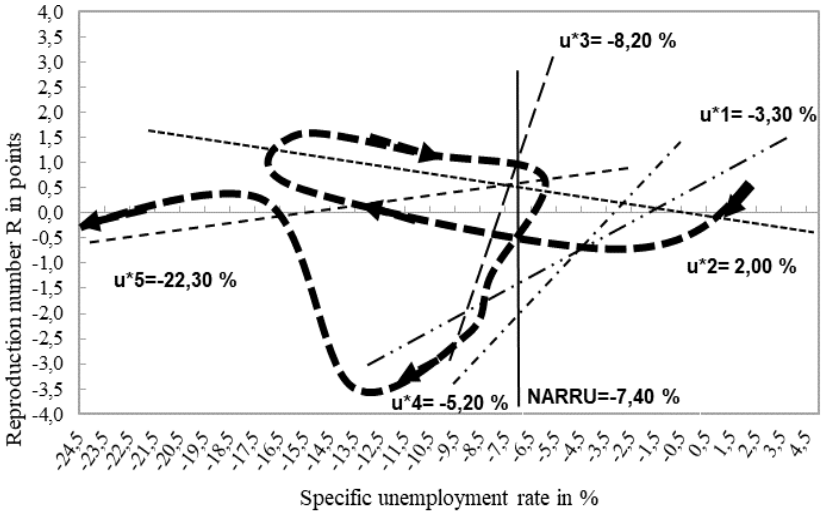

Figure 4b. PC and NARRU Trend in the Different Phases of the Application of Pandemic Restrictions in the Czech Republic

Source: Author calculation based on data from the MoLSA, CSO, CNB, IHIS, and MoH.

Discussion and Conclusions

This research seeks to assess the viability of the historical concepts of PC, NAIRU, and the unemployment gap. It verifies the applicability of the PC and NAIRU concepts in the real-life volatile environment induced by the COVID 19 pandemic. It also questions whether the applied anti-pandemic measures from March 2020 to March 2022 prevented the spread of the pandemic. It further questions whether the loosening of counter-pandemic measures was flexible enough to prevent the recession from escalating or mitigate its extent. The article, therefore, applies the traditional Tobin's NAIRU model to the conditions of the Czech Republic, in which inflation was replaced by the basic reproduction number R, thus creating the NARRU concept. In this section, we further discuss the summary conclusions, including specific results in area of Theoretical Contributions and in area of Managerial Implications. The last area discussed in this section is Limitation and Future Research.

Theoretical Contributions

In summary, it can be said that the PC and the NAIRUas a theoretical concept are not dead even after half a century, even if the macro-level empirical results of this analysis as well as the research of some other authors would suggest so. Indeed, PC and NAIRU at the meso-level provide insight into the dynamizing processes and their explanation within the economy (see earlier research mentioned above). Therefore, it is appropriate to apply them even when evaluating the unstable development of the economy due to the global pandemic and measures against it. The pandemic has confirmed the need for regular modernization of historical concepts due to their applicability to solving the current challenges of the economy and society. The proposed NARRU as a modification of NAIRU brings an alternative view. The comparison of both concepts will then make it possible to distinguish the impact on the economy by locating and quantifying the economic-social imbalance and on the health of society by locating and quantifying the pandemiological imbalance. Specific results that confirm this general conclusion include, for example:

The atypical positive PC slope for both the NAIRU and NARRU concepts over the entire period, which is also related to the fluctuations associated with the COVID-19 pandemic and the measures taken against it, does not support the validity of their application because of the conclusions about the non-functional nature of the NAIRU concept. Doubters of the PC concept, NAIRU, and the unemployment gap include, for example, Kiley (2020), Zweifel (2020), Formaro & Wolf (2020), and Roedl & Dupont (2020). A typical negative slope for NAIRU was mapped in construction, administration, public administration, and health care. For NARRU, only one sector was represented, namely transportation. A positive PC slope for both concepts was also mapped in the fifth period as well (i.e., the phase dominated by hard lockdown and loosening). In terms of sector, a negative PC slope and very strong substitutability was found for NAIRU in public administration and health care, while a classic PC slope was not found at all for NARRU.

A negative PC slope for NAIRU only was mapped in the first period (i.e., the phase with a greater number of months without COVID-19). Meanwhile, the NAIRU showed a weak intensity of substitution of the GDP deflator by the specific unemployment rate. Defenders of the concept of PC estimate, NAIRU, and unemployment gap include Ebrahimy et al. (2020), Freund & Rendahl (2020), Leandro & Jimeno (2020), Brooks & Fortun (2020), Panetta (2020), and Zandweghe (2020). The highest negative PC slope and strong substitutability was reported for NAIRU in public administration and health care, whereas no classic PC slope was found for NARRU. The average value of the PC slope in the third period (i.e., the loosening and moderate tightening phase) was typically negative for the NAIRU concept; the intensity of the substitutability of the GDP deflator by the specific unemployment rate was very weak. In terms of sectors, these were mainly the following construction (strong), manufacturing (medium), and administration (weak); again, a classic PC slope was not found for NARRU. In the fourth period (i.e., the phase with predominantly hard lockdown accompanied by loosening and moderate tightening), the PC slope was typically negative for NAIRU (very weak). From a sector perspective, a negative PC slope for NAIRU was found in construction (strong), transportation (moderate), trade (weak), and hospitality (very weak).

A negative PC slope for NARRU only was mapped in the second period (i.e., the phase dominated by loosening and the hard lockdown) and had strong substitutability intensity. In terms of sector, the highest negative PC slope for NARRU was in transportation (very strong), public administration (strong), and health care (strong).

Ad hoc analysis and regression estimation of PC shifts on a rolling basis and Break model in the period from April 2021 to March 2022 found that the PC in the first phase (April to August 2021) and in the fourth phase (February to March 2022) had typically negative slope. In the second (September and October 2021) and third phase (November 2021 to January 2022), the analysis located a PC with an atypically positive slope. Which is related to fluctuations associated with the pandemic and measures against it.

Managerial Implications

By comparing the historical concepts of NAIRU, the PC, and the unemployment gap with the modernised concept of NARRU, it was possible to confirm the applicability in the real economy and society at the time of the impact of the COVID-19 pandemic. For example, it is possible to assess the success of implemented government measures in solving economic-social imbalances in the economy and pandemiological imbalances in society, also in time to detect possible crowding out of private expenses by public expenses, with inflationary consequences. Specific results that confirm this general conclusion include, for example:

The lower value of the positive unemployment gap (recession) for the NAIRU concept than for NARRU over the entire reference period of the coronavirus pandemic (January 2020 to March 2021) implies the emergence of pandemic/economic imbalances due to pandemic pressures; the economic pressures should be under control. Thus, the

government should have been more consistent in its pandemiological restrictions (e.g., longer, more comprehensive, and stricter lockdown – Blatny, 2021). Furthermore, the government should have placed more emphasis on disease prevention (e.g., timely availability of respirators, tests, and vaccines, consistent with the findings of Kulveit, 2021). Also, more support should have been given to employment at the time of business closures, even though numerous economic and social measures by the MoLSA (e.g., Antivirus Program; Isolation), the MoIT (e.g., Kurzarbeit; COVID – Gastro Program), and the MoF (e.g., Great Liberalization Package) supported the economy and society in the fight against the pandemic.

In the first period (January to March 2020) – the phase dominated by months without COVID-19, counter-pandemic measures should have been adhered to more in terms of public health. Due to the administrative sector, the lockdown announced should have been longer and more comprehensive, discussed more with pandemiologists and health professionals, and more reflective of the situation in the regions (see e.g., Blatný, 2021). On the other hand, the counter-pandemic measures of the Ministry of Labour and Social Affairs (e.g., Antivirus Program), the Ministry of Industry and Trade (e.g., Kurzarbeit), and the Ministry of Finance (e.g., compensation bonus) had a positive impact on the economy and citizens.

In the third period (July-September 2020) – a phase of loosening and a slight tightening of the measures against COVID-19 – there was a further acceleration of the pandemic at a time when a reasonable tightening of restrictions would not have escalated the recession in the labour market, mainly in the administrative, manufacturing, and construction sectors. The government should not have loosened the measures so substantially in May and June. The wearing of masks indoors was first ordered and then abolished, and the government refused to introduce more significant measures (e.g., masks indoors). Heger (2021) also points out that society lost trust in the government, which resulted in non-compliance with measures and a consequent increase in morbidity and deaths. On the other hand, a number of economic and social measures by the MoLSA (e.g., abolition of the quarantine period), the MoIT (e.g., the call for participation in the COVID – Rent Program), and the MoF (e.g., the payment of grants to municipalities to offset tax revenues) prevented further escalation of the recession.

In the fourth period (October to December 2020) – the phase with a predominance of hard lockdown in addition to loosening and moderate tightening of COVID-19 measures – the pandemic was further accelerated at a time when a reasonable tightening of restrictions and targeted measures would not have deepened the recession in the labour market, especially in hospitality and trade. In October, the government introduced restrictions (e.g., professional sports to be played without spectators). In November began testing. Vaccinations began from 27 December. On the other hand, a number of targeted economic and social measures by the MoLSA (e.g., CZK 5000 for all pensioners), the MoIT (e.g., Emergency Immediate Assistance MOP COVID-19), and the MoF (e.g., shifting of income tax payments) mitigated an immediate deepening of the recession.

In the fifth period (January to March 2021) – the phase with a predominance of the hard lockdown, as well as a loosening of COVID-19 measures, sufficiently vigorous counter-pandemic measures protected the health of citizens. The measures also allowed businesses to operate without fluctuations in their production. In January, the government returned only 1st and 2nd grade students to schools. In February, services were closed and movement restricted. In March 2021, travel to the outdoors was permitted within the district of residence. Meanwhile, a number of economic and social measures effectively applied by the MoLSA (e.g., Isolation), the MoIT (e.g., a program for all closed establishments), and the MoF (e.g., a VAT waiver on respirators) reduced the immediate impact of the pandemic on citizens and the economy.

On the other hand, **the higher value of the positive unemployment gap (recession) for the NAIRU concept than for NARRU** in the second period (April to June 2020) – the phase with a predominance of loosening and hard lockdown – implies a stopping of the community spread of the pandemic with inadequate restrictions that damage the labour market and the entire real economy. The government extended the state of emergency in April 2020. In May 2020, shopping malls and restaurant gardens opened. In June 2020, it was no longer mandatory to wear masks. Cilkova (2021) sees the error in the continual braking of the pandemic. Moreover, the government still did not have good rules by which the pandemic could be kept at bay by more moderate means (e.g., Klimes, 2021). However, the government also mitigated the recession caused by the pandemic through the more effective use of certain economic and social measures of the MoLSA (e.g., expanding the Antivirus Program), the MoIT (e.g., forgiving advances on social and health insurance for sole proprietors), and the MoF (e.g., entering into a loan agreement with the Council of Europe Development Bank).

Ad hoc analysis and regression estimation of PC shifts on a rolling basis and the Break model in the period from April to August 2021 (gradual improvement of the pandemic situation and relaxation) implies the emergence of an economic-social imbalance and the transition to a recession phase due to the effect of redundant pandemiological measures. In July, for example, the government cancelled the recognition of the first dose of vaccination as proof of being "infection-free".

In the period from September to October 2021 (COVID-19 is starting to spread again and the several measures taken do not slow down the spread of the virus), the government underestimated the pandemiological situation in the country during the economic boom. Specifically, the Government decided, for example, on only three rounds of testing at the beginning of the school year. At the beginning of October, the Czech Republic mainly lived through elections, after which only a few measures came, hospitals were experiencing an increase in patients. The government's economic and social measures, which slightly accelerated the crowding out of cash from the population and companies, can include, for example, efforts to maintain jobs in the car industry.

In November 2021 to January 2022 (massive spread of the new - 526 -micron variant, deepening insecurity in society) the labour market was also in a boom phase. The

reason for the underestimation of the country's anti-pandemic situation may be, for example, the decree cancelled by the government on mandatory vaccination for people over 60 and some professions. The measures supporting the retention of temporarily unused employees on the labour market were helped, for example, by the re-introduction of an extraordinary contribution to employees in the event of an ordered quarantine and the approval of the crisis nursing allowance in the amount of 80 percent.

In February to March 2022 (the pandemic was waning and most anti-pandemic measures ended in mid-March), the labour market was in recession. The extent of overestimation of anti-pandemic measures could have reduced, for example, the earlier and faster pace of their cancellation. It helped dampen growing scepticism about a quick return to pre-pandemic demand Decisions to waive customs arrears, to allow tax or duty relief, or to issue a certificate of debt-free status or the status of a personal tax account helped dampen growing scepticism about a quick return to pre-pandemic demand, e.g. a decision to waive a customs arrears, to grant tax or duty relief.

Limitation and Future Research

In the period from April 2021 to March 2022, the development of the historical concepts of the PC, NAIRU and the unemployment gap was estimated by applying Ad hoc analysis and regression estimation of PC shifts on a rolling basis and the Break model. This ad hoc analysis complemented comprehensive research through multiple linear regression for the period March 2020 to March 2021. It is an alternative to more formal ways of obtaining evidence, which will need to be confirmed in further research and also extended by estimation on the full data set by applying more sophisticated methods.

The first direction of research should be to carry out a comprehensive analysis in the entire period from March 2020 to March 2022. This should be followed by a comparison of the impact of previously conducted research on the period of the global financial and economic recession in 2008 with the impact of COVID-19 on historical concepts. This will be a confirmation of the viability of the historical concepts of NAIRU, the PC, and the unemployment gap at the time of both phenomena and usefulness to economic policy makers.

The second direction of research should be a retrospective analysis on the subject of NAIRU and the development of the economic cycle on the labour market, including assessment of the viability of these fundamental historical concepts in the context of current challenges (the conflict in Ukraine, the Energo crisis, rampant inflation, and possibly the transfer of bank failures from the USA to Europe as well).

Acknowledgment

1. Sources, web pages are listed for all default data files.
2. The characteristics of the two models, the data of which are analysed in the text, are given in the appendix of the article.
3. The data obtained from the models are subsequently averaged for the individual phases of the pandemic.

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Annexes

Table 1

Counter-Pandemic Measures and Values of R between March 2020 and March 2021, Including their Assignment to Phases by intensity of Restrictions

Counter-epidemic measures for combating Covid-19	R (Average per month)	Phase number
At the beginning of March 2020 the first case of infection was discovered in the Czech Republic. Two weeks later, the government declared a state of emergency (e.g. closed theaters, restaurants, stadiums, and borders, restricted free movement, made masks mandatory).	2,04	1.
In April 2020 the government extended the state of emergency, the restrictions in place remained in place, the borders were gradually reopened at least to some countries.	0,90	2.
In May 2020 shopping malls and restaurant gardens opened, the state of emergency ended.	0,92	2.
In June 2020 it was no longer mandatory to wear masks, the Czech Republic was prepared for the second wave, blanket measures would no longer be introduced.	1,13	2.
In July 2020 the Chamber of Deputies met to thoroughly assess how the country had coped with the first wave and how prepared it was for a possible second wave.	1,06	3.
In August 2020 the Institute of Health Information in data for the government estimated the reproduction number of the virus at 1.26, indicating a dangerous increase in the number of infections in the coming months. The wearing of masks indoors was first ordered and then abolished.	1,08	3.
In September 2020 the contact tracking system collapsed, the government refused to implement stronger measures, masks were required in all indoor areas in the country, masks were mandatory in businesses except during social distancing, restricted indoor mass events, wearing of masks at outdoor events with more than 100 people.	1,31	3.
In October 2020 after declaring a state of emergency, the government imposed restrictions; the Czech Republic became the country with the most new cases per million people in the world, a state of emergency was declared for 30 days, professional sports were played without spectators, no large concerts, distance learning in secondary schools, no more than 6 people at a table in restaurants, no more than two people per group in shops and establishments, all schools except kindergartens were closing.	1,26	4.
In November 2020 the Minister of Health introduced a new counter-epidemic system (*protiepidemický systém*, PES), limitations for shopping in stores (approx. one customer per 15 m2) increased, testing began.	0,83	4.
In December 2020 the Government refused to tighten measures significantly early in December despite severely worsening infection numbers, having relaxed them before Christmas despite warnings from experts. But after 14 days, restaurants were closed again, the vaccination campaign had failed to take off, the evening curfew was ending, alcohol could be consumed in public, dining establishments could open, shopping centers had to have one person per 15 square meters of floor space and two-meter social distancing was to be observed. New measures would come into force: restaurants and clubs would reduce their opening hours to 8:00 p.m., takeaway windows would close along with restaurants, and the consumption of alcohol in public would be banned. The ski lifts would also stop operating from 27 December. Vaccinations began.	1,1	5.
In January 2021 only pupils in grades 1 and 2 returned to school, others continued distance learning; the retail segment (stationery shops, children's clothing and shoe stores, lingerie shops) opened.	0,97	5.
In February 2021 services were closed and movement restricted, a new state of emergency was declared, work began on a pandemic law, measures were tightened in fear of a spread of the British mutation (restriction of movement, travel only to one's own holiday properties, accommodation for business travelers only, respirators in driving schools, more paid tests, restricted movement in the districts of Trutnov, Cheb, and Sokolov, respirators of FFP2 or KN95 class and above in places with a higher concentration of people).	1,06	5.
In March 2021 only travel to the countryside in the district of residence is allowed. Thus far, people had only been able to go outdoors within their cadastral municipality. The state of emergency was also extended until 11 April 2021.	0,96	5.

Source: Adapted and expanded from Bartonicek et al. (2021) https://zpravy.aktualne.cz/domaci/casova-osa-covid/r~fd4c3f7e0ec511eb9d470cc47ab5f122/ and Seznamzpravy.cz. (2021) https://www.seznamzpravy.cz/clanek/podrobna-mapa-kde-je-v-ceske-republice-koronavirus-93746.

Table 2

Economic and Social Measures to Combat COVID-19 Put in Place or Proposed by the Ministry of Labour and Social Affairs between March 2020 and February 2021, Including their Assignment to Phases by Intensity of Support

Economic and social measures to combat the impact of Covid-19 Ministry of Labor and Social Affairs	Date of issue	Phase number
Antivirus program - To help companies protect jobs: This program compensated companies through the Labor Office for funds paid. The measure helped manage the situation without redundancies. Employers with endangered activities would be provided with a contribution for full or partial payment of wage compensation for obstacles on the part of the employee (quarantine order) or on the part of the employer (obstacle: closure of an establishment due to a government order to close the establishment).	19.3.2020	1.
The State release sole proprietors from part of their mandatory pension insurance: Many manufacturing and service professions had been forced to suspend or reduce their activities.	23.3.2020	1.
Benefits up to the 13th birthday and for the entire duration of the closure of schools: Employees would now be reimbursed for the entire period of closure of schools and other facilities. The entitlement to a nursing allowance is also extended to all children under the age of 13.	24.3.2020	1.
The Labor Office had thus far processed over 76% of claims for the wage replacement allowance: All contact points of the Labor Office throughout the country were involved in receiving and processing applications on an almost round-the-clock basis.	20.4.2020	2.
An expansion of the Antivirus Program was intended to help protect hundreds of thousands more jobs: This was referred to as Mode C of the Antivirus Program, i.e. forgiveness of social insurance payments for companies with up to 50 employees.	25.5.2020	2.
The Antivirus A program would be extended until the end of August: This served to compensate employers whose employees had been ordered to quarantine or that had to partially or completely limit their operations. The reason for the extension was the ongoing emergency government measures, which resulted in some work sectors remaining stagnant (fairs, cultural festivals, etc.).	8.6.2020	2.
The Ministry of Social Services would supplement the social services with CZK 1 billion for increased operating costs related to Covid-19: The extraordinary subsidy for social services would cover shortfalls in payments from clients, increased staff costs, or purchases of protective equipment. All registered providers would be eligible.	15.6.2020	2.
The lifting of the withdrawal period contributed to the containment of the Covid-19 epidemic: Staff did not need to attend work sick due to fears of lost income. The lifting of the withdrawal period thus contributed to improving the financial situation of patients as well as limiting the spread of the disease.	1.7.2020	3.
Social services could apply for subsidies for additional costs during Covid-19: Application launched for submitting requests for financial support of increased costs. Providers would be able to apply for subsidies for 3 areas of support (operating costs due to quarantine, wages and salaries, making up resource shortfalls from unrealized services).	12.8.2020	3.
The MoLSA supported social services with more than 473 million in the second subsidy call: Providers of social services could apply for assistance to help them fund increased costs related to the Covid-19 epidemic.	23.9.2020	3.
The MoLSA distributed CZK 21 million for extraordinary bonuses to social workers in municipalities: The rewards were be paid to more than 1,000 social workers for their help in helping seniors, citizens with disabilities, families with children and others get through the challenging crisis period.	1.10.2020	4.
The MOP Covid-19 emergency immediate assistance program helped those in need during the second wave as well. And this time it was even more accessible: People with financial problems related to the payment of necessary expenses were given the opportunity to apply for the MOP COVID-19 Emergency Immediate Assistance benefit.	16.10.2020	4.
CZK 5000 for all pensioners was also supported by the Senate. The allowance was to be paid by the end of the year: Payment of a one-time allowance of CZK 5,000 to all pensioners. The goal was to quickly help elderly persons who had been very negatively impacted by the effects of the Covid-19 pandemic.	13.11.2020	4.
Income losses during quarantine would be patched up by "insulation: Payment of an extraordinary allowance of up to CZK 370 per day to replace the income of employees in quarantine or isolation. From 1 March 2021, employees would not have to worry about a significant drop in their income in the event of quarantine or Covid-19.	11.2.2021	5.
The Antivirus Program will not end in March! It will continue to protect jobs: Compliance with public aid rules due to Covid-19 and ensuring the continued operation of the program by extending what was called the Interim Framework. It would be provided for a longer period of time and to a wider range of employees.	22.2.2021	5.

Source: MoLSA (2021), https://www.mpsv.cz/web/cz/tiskove-zpravy-mpsv.

Table 3

Economic Measures to Combat COVID-19 Put in Place or Proposed by the Ministry of Industry and Trade between January 2020 and March 2021, Including their Assignment to Phases by Intensity of Support

Economic measures to combat the impact of Covid-19 Ministry of Industry and Trade	Date of issue	Phase number
The Government approved further steps to support entrepreneurs and sole proprietors: 1) So-called "kurzarbeit", i.e. financial compensation for employers who are prevented by the current situation from assigning work to employees due to quarantine or childcare orders for a significant proportion of their employees. 2) Assistance for farmers affected by the coronavirus epidemic (possible acceptance of deferred repayments on commercial loans granted by the the Agricultural and Forestry Support and Guarantee Fund). 3) COVID Loan interest-free loans with a one-year deferment of repayments. 4) The COVID II Program, which responded even more to the continuously announced needs of entrepreneurs. A financial allowance for sole proprietors for each day they quarantine/treat a family member (similar to employee sick pay).	24.3.2020	1.
Hack the crisis! A virtual hackathon was announced to help in the fight against coronavirus. The state would offer companies funding, mentoring, and free capacity: The concept brought together the state, regions, universities, companies, and associations with the goal of accelerating the implementation of selected projects reflecting our country's priorities in the fight against the coronavirus. Companies could offer and request spare capacity, materials, and services, in addition to other benefits.	6.4.2020	2.
Compensation for sole proprietors: In addition to relief from advances on social and health insurance, the introduction of "sick leave" for sole proprietors, the deferral of certain tax obligations, compensation for the wages of potential employees, and interest-free loans (now also for sole traders/self-employed persons), an allowance of CZK 25,000 per month would be provided for small entrepreneurs/ sole proprietors.	21.4.2020	2.
Additional assistance to companies, sole proprietors, and employees: The MoIT began accepting applications for subsidies as part of the Covid-19 Technology Program. This program was intended support growth and strengthen the competitiveness of small and medium companies that manufacture medical devices and personal protective equipment or dispose of infectious waste.	7.5.2020	2.
The government proposed a reduction in VAT on accommodations and travel tickets and decided to open all rail and road crossings with Germany and Austria: Organizers of sporting and cultural events, as well as hospitality businesses, could save five per cent on VAT, while truckers could save as much as a quarter on road tax.	25.5.2020	2.
Call for the COVID - Rent Program: This special subsidy program was for businesses that had to temporarily close their retail and customer service establishments due to crisis emergency measures.	26.6.2020	2.
The government wanted to extend the abolition of the obligation to use EET until the end of 2022 and pay a compensation bonus to small sole proprietors: 1) Under the proposed measure, businesses would not have to record sales via electronic sales registration. 2)The government approved a draft law on a compensation bonus for entrepreneurs affected by the crisis measures.	16.10.2020	4.
With the closure of shops and other establishments, support for entrepreneurs was extended: It expanded support for entrepreneurs, both for applicants and the allocation of the 2nd call of the COVID - Rent program.	21.10.2020	4.
COVID - SPORT program: Assisted entrepreneurs in the sports sector who had to reduce their businesses due to the coronavirus.	6.11.2020	4.
The Government approved a new program for all closed venues: The goal was to mitigate the negative impact of restrictions associated with the Covid-19 pandemic disease measures on businesses that had been directly restricted from doing business as a result of the emergency measures taken, causing a drop in sales and thus liquidity. Support would be provided for the operation and maintenance of a business, such as personnel costs, material and service costs, depreciation, taxes and charges, loan repayments, overhead, etc.	4.1.2021	5.
The Government approved support for closed ski resorts: Support from the COVID - SPORT III Ski Resorts Program was earmarked for owners and operators of ski resorts and for the implementation of the program.	11.1.2021	5.
COVID - Gastro - Closed establishments: The call for applications for the COVID - Gastro program was extended. The limit for the support granted was increased.	15.1.2021	5.

Source: MoIT (2021), https://mpo.cz/cz/rozcestnik/pro-media/tiskove-zpravy/stranka-669.

Table 4

Economic Measures to Combat COVID-19 Put in Place or Proposed by the Ministry of Finance between March 2020 and March 2021, Including their Assignment to Phases by Intensity of Support

Economic measures to combat the impact of Covid-19 Ministry of Finance	Date of issue	Phase number
Compensation bonus for entrepreneurs: This was the most important assistance program, targeted to support sole proprietors, partners of small limited liability companies, and citizens working on FTE and medical disability.	20.3.2020	1.
The MoF concluded a loan agreement with the Council of Europe Development Bank. An advantageous loan helped in the fight against coronavirus: The loan was to be used to finance health care expenditures to combat the spread and mitigate the impact of the coronavirus.	19.6.2020	2.
The MoF disbursed contributions to municipalities, receiving a total of 13.4 billion: The contributions were intended to compensate municipalities for the drop in tax revenues related to the payment of state aid to sole proprietors and partners of small limited liability companies.	10.8.2020	3.
The Ministry of Finance prepared a large liberalization package: This was a deferral of tax obligations for all businesses whose activities were immediately restricted or prohibited by government regulations. Businesses whose predominant activities were targeted by government prohibitions or restrictions now had all VAT payments automatically deferred until the end of the year and advance payments of income tax and road tax waived.	10.10.2020	4.
The Ministry of Finance deferred the payment of third quarter VAT for businesses: This was in the retail and services sector. The payment of VAT for Q3 and September 2020 would effectively be extended to 31 December 2020 for these subjects (by waiving interest on late payment of tax).	23.10.2020	4.
The Ministry of Finance provided CZK 140 million to the regions from reserves for crisis mitigation: The funds would be used primarily to cover extraordinary expenses, especially those related to the planned massive vaccination of the Czech population against the COVID-19 disease.	13.1.2021	5.
The Ministry of Finance prepared the possibility of providing a compensation bonus for bankrupt persons: Negotiations with the Commission currently aimed at allowing the payment of the compensation bonus retroactively to such persons. The solution was the preparation of an amendment to the Compensation Bonus Act to ease this restriction for bankrupt individuals.	15.1.2021	5.
Taxes were to be paid on profits, not on COVID aid: Operating subsidies were income that had to be taken into account in determining potential tax liability. At the same time, the combination of the ability to claim at least a flat rate expense, the tax deductibility of the costs on which these subsidies were used, and tax credits and deductions generally resulted in zero tax for injured persons.	25.2.2021	5.
The declaration and payment of income tax was postponed by one month and VAT on respirators was waived until 3 June: Due to the increasing consumption of respirators, which were now required on public transport and in shops, for example, there was a need to keep protective equipment as affordable as possible for the general public.	8.3.2021	5.

Source: MF (2021), https://www.mfcr.cz/cs/vyhledavani?q=opat%C5%99en%C3%AD+covid.

Table 5

List of Parameters, Standard Errors, t-Statistics, p-Values, and Selected Model Statistics for Chapter 4
(not broken down by the individual categorical variables)

Name of method	Dependent/independent variables	Parameters and their statistics				Selected model statistics			
		Value	Standard error	*t*-Statistics	*p*-value	Number of observations	Adjusted R^2	Durbin-Watson statistic	*p*-value *F* statistic
NAIRU									
	GDP deflator (*t*)								
	Constant	1,563869	0,596816	2,620352	0,012800				
	Specific unemployment rate (*t*-3)	-0,921376	0,406763	-2,265142	0,029600				
	Brent crude oil price (*t*-3)	0,130812	0,022206	5,890840	0,000000				
	Gross value added (*t*-2)	0,114585	0,062950	1,820244	0,077000				
	Business confidence index (*t*-2)	-0,124228	0,041400	-3,000711	0,004900				
	Model characteristics					80	0,895622	1,795903	0,000000
NARRU									
	Reproduction number R (*t*)								
	Constant	1,420038	0,340866	4,165974	0,000200				
	Specific unemployment rate (*t*-4)	0,503121	0,216251	2,326559	0,025600				
	Reproduction number R (*t*-2)	0,499522	0,211951	2,356779	0,023800				
	Brent crude oil price (*t*-1)	0,052518	0,012939	4,058830	0,000200				
	Model characteristics					80	0,836733	2,250274	0,000000

Source: Author calculation based on data from the MoLSA, CSO, CNB, IHIS, and MoH.

Table 6

NAIRU, NARRU, PC, and Unemployment Gaps in the National Economy and in Sectors

Czech Republic, regions and Covid-19 phase	NAIRU in %	PC_NAIRU Slope	UG_NAIRU in p.p.	NARRU in %	PC_NARRU Slope	UG_NARRU in p.p.
CZ average	-1,60	0,018	4,87	-7,40	0,030	10,67
ZpracPrum	-1,66	0,183	4,18	-6,90	0,059	9,42
Staveb	-1,30	-0,526	3,82	-7,39	0,053	9,91
Obchod_Oprav	-3,20	0,419	6,07	-7,78	0,069	10,64
Doprav_Sklad	-1,90	1,489	4,18	-5,12	-0,186	7,41
Ubyt_Strav_Poh	-3,80	0,228	12,32	-9,54	0,033	18,06
AdministrCinn	0,57	-0,025	4,41	-12,01	0,032	16,99
VerSprav_Obr_SocZab	-0,95	-0,932	2,28	-5,74	0,036	7,06
Zdrav_SocPec	-0,58	-0,692	1,74	-4,72	0,148	5,89
COVID-19 Phase 1	-0,68	-0,421	2,82	-3,30	0,536	5,43
COVID-19 Phase 2	-1,12	0,501	4,18	2,01	-1,080	1,05
COVID-19 Phase 3	-4,00	-0,186	7,15	-8,25	0,289	11,40
COVID-19 Phase 4	-0,67	-0,038	4,43	-5,18	0,342	8,94
COVID-19 Phase 5	-1,54	0,234	5,79	-22,29	0,066	26,54
Phase COVID 19 1_ZpracPrum	1,70	-0,921	-0,03	-2,82	0,503	4,49
Phase COVID 19 1_Staveb	3,63	-0,430	-2,07	-3,00	0,474	4,56
Phase COVID 19 1_Obchod_Oprav	-6,68	0,234	8,64	-2,69	0,527	4,65
Phase COVID 19 1_Doprav_Sklad	-1,47	1,063	2,84	-1,40	1,014	2,77
Phase COVID 19 1_Ubyt_Strav_Poh	-8,60	0,182	12,56	-3,60	0,394	7,56
Phase COVID 19 1_AdministrCinn	3,95	-0,396	0,37	-7,48	0,190	11,80
Phase COVID 19 1_VerSprav_Obr_SocZab	0,98	-1,603	0,43	-3,63	0,392	5,03
Phase COVID 19 1_Zdrav_SocPec	1,04	-1,497	-0,21	-1,79	0,793	2,62
Phase COVID 29 2_ZpracPrum	-8,95	0,175	11,31	1,80	-0,791	0,57
Phase COVID 29 2_Staveb	-7,80	0,201	10,64	1,74	-0,817	1,10
Phase COVID 29 2_Obchod_Oprav	-1,62	0,967	3,86	1,94	-0,734	0,30
Phase COVID 29 2_Doprav_Sklad	-0,29	5,437	2,11	0,43	-3,334	1,39
Phase COVID 29 2_Ubyt_Strav_Poh	-2,26	0,691	9,74	2,49	-0,570	4,99
Phase COVID 29 2_AdministrCinn	10,03	-0,156	-5,16	4,99	-0,285	-0,12
Phase COVID 29 2_VerSprav_Obr_SocZab	0,88	-1,779	0,17	1,30	-1,090	-0,26
Phase COVID 29 2_Zdrav_SocPec	1,02	-1,529	0,77	1,39	-1,018	0,40
Phase COVID 39 3_ZpracPrum	2,03	-0,770	0,76	-7,38	0,192	10,17
Phase COVID 39 3_Staveb	1,21	-1,294	0,52	-8,22	0,173	9,95
Phase COVID 39 3_Obchod_Oprav	-9,47	0,165	12,98	-8,58	0,166	12,08
Phase COVID 39 3_Doprav_Sklad	-8,95	0,175	11,25	-1,52	0,931	3,82
Phase COVID 39 3_Ubyt_Strav_Poh	-9,96	0,157	17,23	-11,99	0,118	19,25
Phase COVID 39 3_AdministrCinn	2,69	-0,582	2,98	-19,57	0,073	25,24
Phase COVID 39 3_VerSprav_Obr_SocZab	-5,32	0,294	6,26	-4,03	0,353	4,97
Phase COVID 39 3_Zdrav_SocPec	-4,21	0,372	5,26	-4,68	0,303	5,74
Phase COVID 49 4_ZpracPrum	-2,18	0,718	4,89	-4,38	0,324	7,09
Phase COVID 49 4_Staveb	1,08	-1,445	2,07	-3,78	0,376	6,94
Phase COVID 49 4_Obchod_Oprav	3,00	-0,521	0,33	-4,30	0,330	7,64
Phase COVID 49 4_Doprav_Sklad	2,31	-0,677	0,26	-3,68	0,386	6,25
Phase COVID 49 4_Ubyt_Strav_Poh	6,05	-0,258	5,35	-8,55	0,166	19,96
Phase COVID 49 4_AdministrCinn	-12,04	0,130	16,40	-11,11	0,128	15,48
Phase COVID 49 4_VerSprav_Obr_SocZab	-1,97	0,796	3,40	-3,13	0,453	4,57
Phase COVID 49 4_Zdrav_SocPec	-1,64	0,953	2,73	-2,48	0,573	3,57
Phase COVID 59 5_ZpracPrum	-0,91	1,714	3,96	-21,72	0,065	24,77
Phase COVID 59 5_Staveb	-4,61	0,339	7,96	-23,67	0,060	27,02
Phase COVID 59 5_Obchod_Oprav	-1,25	1,252	4,52	-25,25	0,056	28,53
Phase COVID 59 5_Doprav_Sklad	-1,08	1,448	4,44	-19,43	0,073	22,80
Phase COVID 59 5_Ubyt_Strav_Poh	-4,24	0,368	16,72	-26,06	0,054	38,53
Phase COVID 59 5_AdministrCinn	-1,78	0,879	7,45	-26,87	0,053	32,55
Phase COVID 59 5_VerSprav_Obr_SocZab	0,66	-2,367	1,13	-19,22	0,074	21,01
Phase COVID 59 5_Zdrav_SocPec	0,89	-1,758	0,17	-16,05	0,088	17,12

Source: Author calculation based on data from the MoLSA, CSO, CNB, IHIS, and MoH.

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