THE EFFECTIVENESS OF GOVERNMENT MEASURES IN THE FIRST WAVE OF COVID-19 PANDEMIC

EMILIE JASOVA, BOZENA KADERABKOVA

Abstract:

The aim of the article is to use empirical analysis to confirm the applicability of NAIRU and NARRU concepts to evaluate the adequacy of measures against Covid 19. While higher NAIRU than NARRU throughout the coronavirus pandemic period confirmed the achievement of an epidemic-economic balance in the labor market at the cost of spreading the epidemic, a lower positive unemployment gap in the NAIRU concept indicated a milder recession than the epidemic in society would require. The Czech government should have either introduced a stricter lockdown or should have provided enough respirators, tests, and vaccines. The application of the NAIRU concept also confirms its suitability for use in economic and political practice in an unstable period.

Keywords:

Phillips curve, NAIRU, NARRU, economic cycle

JEL Classification: E24, E32, E37

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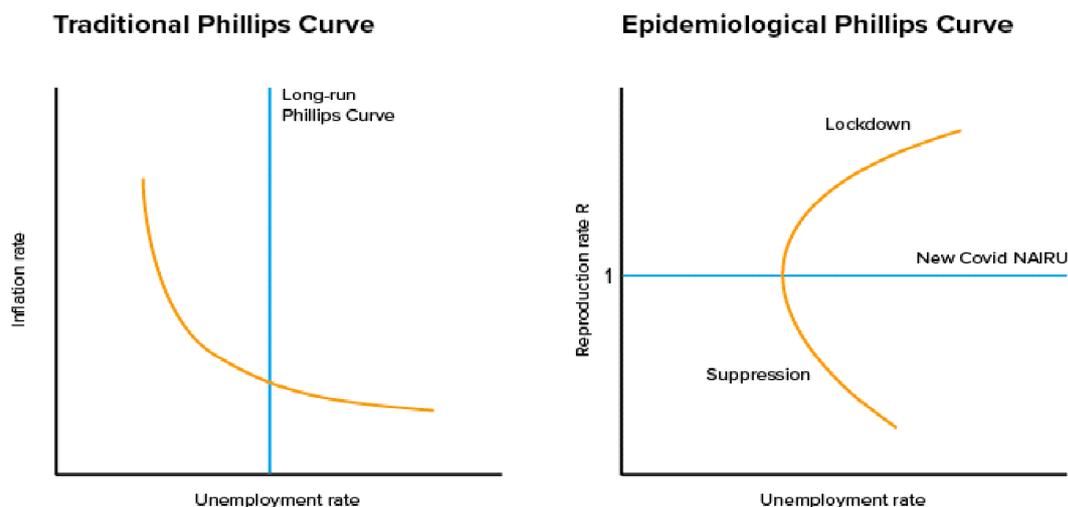
Introduction

This article seeks to answer the question of whether a relationship can be found between the intensity of the COVID-19 epidemic and its economic impact on the labor market, the development of which determines macroeconomic variables in the national economy, and whether the well-known Phillips curve (PC) and the NAIRU concept can be used. And through them to assess the measures of the Czech government in the period March 2020 - February 2021. In the article, we apply the findings of world research to the conditions of the Czech Republic. And in Tobin's traditional NAIRU model (Tobin, 1997) we replace inflation with the reproduction number R (similarly Kadeřábková and Jašová, 2021). In the new concept, it is the unemployment rate that does not accelerate the infection, i.e. NARRU (Non-Accelerating R rate of unemployment). NARRU thus defines the capacity with which the economy can function safely during the Covid 19 era. A comparison of the results from the two concepts will indicate when economic performance was achieved at the cost of spreading the epidemic. And when, on the contrary, anti-epidemic measures could have eased more quickly, which would not accelerate the pandemic and would help reduce the recession in the labor market. The following part of this article provides an overview of the results of international research in the field of impact assessment of Covid 19 on the NAIRU concept, PC, and the unemployment gap and the new epidemiological concept of NARRU. The second part presents an overview of anti-coronavirus measures decided by the Czech government. The third part specifies the data sources and methodology of their analysis. The fourth part compares the values of NAIRU, NARRU, the unemployment gap, and the slope of the PC during the Covid 19 pandemic in the Czech Republic by region. The last part presents the results and recommendations for economic policy.

1.   Conclusions of international research in the field of NARRU, NAIRU, PC, and the unemployment gap during the pandemic

The 60-year history of the relationship between inflation and unemployment, started by Phillips (1958), has led to the creation of concepts with considerable explanatory power, with new theoretical starting points and political-economic applicability. This allows, despite criticism of the PC in the last third of the 20th century, the concepts of PC and NAIRU to maintain their position, both in theory and in economic practice. The applicability of the PC and NAIRU concepts over the last 10 years is also supported by the findings of authors who assessed the impact of the global recession (Gordon, 2013; Coibion and Gorodnichenko, 2015; Rusticelli, 2014; Andrle, Brůha and Solmaz, 2013; Blanchard, 2016; McLeay and Tenreyro, 2019; Zandweghe, 2019), as well as proposals to improve existing practices (OGrady, 2019; Gilchrist and Zakrajšek, 2019; Zweig, 2020; Jacob and Florenstein Mulder, 2019; Mihajlović and Marjanović, 2020; Liargovas and Psychalis, 2020; Duca, 2018; Gagnon and Collins, 2019) and their combination of procedures for economic evaluations (Vlekke, Koopman and Mellens, 2020; Crump et al. 2019; Jašová and Kadeřábková, 2019). Research since the first impact of Covid 19 on the NAIRU concept, the PC and the unemployment gap has identified both potential triggers for inflation, behaviour of inflationary pressures, and the PC at the time of closing and reopening the economy. Furthermore, the research identified reasons for reviving the importance of PC (Ebrahima, Igan and Peria, 2020), the growing role of government management (Freund and Rendahl, 2020), and comparing downward and long-term inflationary pressures, as well as defining the importance of fiscal and monetary policy measures for gradual inflation growth (Leandro and Jimeno, 2020, or Čermáková, Filho, 2021), but also a comparison of the PC with the core inflation indicator (Brooks and Fortun, 2020) and a conditional prediction of the VAR model. At the same time, research has also brought about the construction of an alternative NAIRU (Gadhia, 2020), the inclusion of uncertainties in the central bank's reaction function (European Parliament, 2020) and a new form of link between inflation and economic activity (Zandweghe, 2020 and Čečrdlová, 2021).

Gadhia (2020) tried to connect the epidemic and the economy to answer the question of when and how to ease or remove restrictions while keeping the infection rate low. The author proposes to combine the reopening strategy with the use of the reproduction number R in PC, where there is traditionally an inverse relationship between inflation and unemployment. It would thus be a substitution between the epidemic and unemployment. Inflation is replaced by the reproductive number R, which indicates the average number of other persons who are directly infected by one infected patient (MZ, 2021). The aim of economic policy is to avoid a new wave of pandemics, which can be achieved by keeping the number R below 1 while maintaining some economic activity. A value above 1 leads to another cycle of exponential growth requiring greater economic closure. The higher the number R is, the longer and stricter the lockdown will be, and thus the economic impact. The new concept is therefore an unemployment rate that does not accelerate the infection rate, which means NARRU. NARRU defines the capacity with which the economy can operate safely during Covid 19. Before lifting the lockdown, the government will determine the level of economic activity in line with keeping the number R below 1. The government is affecting the new balance in real-time, so each release must be gradual so that the reproductive number R can be tracked through testing and hospitalization. The government should have differentiated restrictions in its measures because in the economy it is necessary to address multiple balances between R and unemployment. In economic policy, it is a combination of elements of central management with market forces in order to minimize the impact on the economy and society. The shape and position of the NARRU curve, as well as the PC, will change over time as the epidemic develops and with measures designed to keep R below 1. Testing and monitoring contacts and the associated measures will shift the NARRU curve to the left and allow the economy to work at a higher level of activity, which means a lower unemployment rate. Gadhia (2020, https://www.cnbc.com/2020/04/29/coronavirus-uk-britain-needs-an-economic-model-for-lockdown-easing.html) specifically writes: "In order to help calibrate the re-opening strategy, it may be helpful to repurpose the Phillips Curve (see Graf 1). The shape and position of the curve will change over time — both with evolving epidemiology and, also measures designed to suppress R while operating the economy below 1. It is here that tracking, testing and contact tracing become mission critical. It will shift the curve to the left and allow the economy to operate at a higher level of activity consistent with the new Covid NAIRU. A reproduction rate above 1 leads to another cycle of exponential transmission requiring suppression once again, with the curve of unemployment bending back on itself as the economy shuts down."

Graph 1 Comparison of the NAIRU concept and the NARRU concept

Source: Gadhia (2020, https://www.cnbc.com/2020/04/29/coronavirus-uk-britain-needs-an-economic-model-for-lockdown-easing.html

2.   Overview of anti-coronavirus measures adopted by the Government of the Czech Republic

The course of the last year shows the development of the Covid 19 pandemic and possible reasons why Czechia has been one of the most affected countries in the World. According to the authors, the measures were often taken hesitantly and slowly or chaotically and unsystematically. The government behaved irrationally, which means that they failed to learn from previous waves and prepare for the next waves of the pandemic. An overview of epidemiological measures implemented by the government in individual months (March 2020 to February 2021), including the R value, is summarized in Chart 1.

Chart 1 Overview of epidemiological measures, including an estimate of the intensity and value of R in the period from March 2020 to February 2021

Epidemiological measures	R (Average per month)	Intensity of restrictions
At the beginning of March 2020, the first case of the disease was discovered in the Czech Republic. Two weeks later, the government declared a state of emergency (e.g. closed theatres, restaurants, stadiums, borders, restricted free movement, face masks are mandatory).	2,04	5,0
In April 2020, the government extended the state of emergency, there are still the same restrictions, and borders have gradually reopened to at least some countries.	0,90	5,0
In May 2020, shopping malls and restaurant gardens opened, and the state of emergency ended.	0,92	1,5
In June 2020, it is not mandatory to wear face masks, Czechia is ready for the second wave, and national measures will no longer be introduced.	1,13	1,5
The Chamber of Deputies meets **in July 2020** and thoroughly evaluates how the country has managed the first wave and how it is prepared for a possible second one.	1,06	1,5
In August 2020, the Institute of Health Information estimated the reproductive number of the virus at 1.26, which indicates a dangerous increase in the number of infected people in the coming months. Mandatory wearing of face masks indoors is first ordered and then cancelled.	1,08	1,5
In September 2020, the system of tracing infected people is collapsing, the government refuses to introduce more significant measures, face masks in all indoor areas of the Czech Republic, face masks in companies (The exception applies only if the distance between attendants is at least 2 meters), limited mass events indoors, wearing face masks at outdoor events with more than 100 people.	1,31	2,5

In October 2020, after the declaration of a state of emergency, the government introduces restrictions, the Czech Republic is the country with the most new cases per million people in the World, a 30-day state of emergency, professional sports will be played without spectators, and there will be no big concerts. Distance learning at secondary schools, a maximum of 6 people in restaurants at the table, a maximum of two people in shops, all schools are closed, except kindergartens.	1,26	5,0
In November 2020, the Minister of Health introduces a new anti-epidemic system (PES), increasing restrictions on shopping in stores (around one customer per 15 m2), the beginning of testing.	0,83	5,0
In December 2020, at the beginning of December, the government refused to tighten measures more significantly (despite the sharply rising numbers of infected), and, despite warnings from experts before Christmas, relaxed the regulation. After 14 days, however, the restaurant closed again, the vaccination campaign fails to start, the night curfew ends, it is possible to consume alcohol in public, canteens can open, there must be only 1 person per 15m2 in shopping malls (distance between attendants is at least 2 meters). New measures will come into force: the opening hours of restaurants and clubs will be reduced to 20:00, the dining windows will be closed together with restaurants and alcohol consumption will be banned in public. The ski lifts have also been closed since 27 December. Beginning of vaccination.	1,10	4,0
In January 2021, only 1st and 2nd grade pupils will return to schools, the others will continue distance learning, the retail segment will expand (stationery stores, children's clothing and footwear stores, underwear stores).	0,97	1,5
In February 2021, services are closed and movement is restricted, a new state of emergency is declared, work on the pandemic law begins, measures are tightened for fear of spreading the British mutation (restrictions on movement, travel only to one's own leisure facilities, accommodation services for business travellers only), respirators in driving schools, more tests by state, in the districts of Trutnov, Cheb and Sokolov the movement of people is restricted, respirators of class FFP2 or KN95 and higher in places where there is a higher concentration of people).	1,06	5,0

Source: our own extension and modification, Bartoníček et al. (2021)
https://zpravy.aktualne.cz/domaci/casova-osa-covid/r~fd4c3f7e0ec511eb9d470cc47ab5f122/ a
Seznamzpravy.cz. (2021) https://www.seznamzpravy.cz/clanek/ pdrobna-mapa-kde-je-v-ceske-
republice-koronavirus-93746

3.   Specification of source data and methodology of their analysis

NAIRU, NARRU values, unemployment gaps and PC slopes were examined by using the indicator of the share of unemployed persons (%) by region and were taken from the Ministry of Labor and Social Affairs, MPSV (MPSV, 2021), as well as average monthly entitlement to financial support in unemployment in CZK. The indicators consumer price index, import price index, industrial production, construction output (all in month-on-month changes in %), aggregate confidence indicator, business confidence indicator and consumer confidence indicator (basic indexes) were published by the Czech Statistical Office, ČSÚ (ČSÚ, 2021). The indicators CZK / EUR exchange rate (monthly averages), Brent crude oil price (year-on-year change in %), indirect taxes (month-on-month change in %) and financial market inflation expectations (year-on-year change in %) were taken over from the Czech National Bank, hereinafter referred to as ČNB (ČNB, 2021). The indicator reproduction number R is regularly published on the website SeznamZprávy (Seznamzpravy.cz, 2021). Expectations about the development of the reproductive number R were obtained from the Records from the press conferences of the Institute of Health Information and Statistics of the Czech Republic (hereinafter referred to as ÚZIS) and the Ministry of Health - hereinafter referred to as MZ (2021).

The published indicators of the average monthly entitlement to financial support in unemployment in CZK and the exchange rate of the CZK / EUR foreign exchange market were converted into month-on-month changes in %. The Brent oil price indicator was then converted to month-on-month changes in p.p. From indicators: reproduction number R, aggregate confidence indicator incl. the business confidence indicator and the consumer confidence indicator, month-on-month changes in points were calculated. Finally, the consumer price index (month-on-month change in %) and the reproduction number R were adjusted to reflect the adaptive formation of expectations. In this analysis, the period (covering the Covid 19 epidemic) is an interval of a quarter of a year (i.e. the difference between the month-on-month change at time t and the month-on-month change at time t-3).

In addition to the above numerical variables, time series of two categorical variables were compiled: regions and phases of the epidemiological-economic cycle. The categorical variable phase of the cycle, which was supposed to capture the unemployment rate in time series and, indirectly, in the economy, the impact of the pandemic, was derived from the adopted anti-coronavirus restrictions in the period from the 1st of January 2020 to the end of February 2021. Sekhon's standard model for estimating inflation is extended by a selected representative of institutional labor market factors (average monthly entitlement to financial support in unemployment, similarly Čermáková and Jašová, 2019 and Čermáková, 2020), by a representative of psychological factors on the side of demand and by a representative of these factors on the side of supply (business confidence indicator). We will create an alternative to the NAIRU concept according to Gadhia's (2020) assumption by adding to the standard Sekhon's inflation model an indicator of the epidemiological situation - the reproduction number R instead of the consumer price index.

The observed period was divided into five phases according to the intensity of anti-epidemiological restrictions implemented by the Government of the Czech Republic (similarly in the economic cycle analysis see Kadeřábková, Jašová, and Holman, 2020), which alternated over time, but because they always showed the same features, they have the same characteristics. **The first phase** thus consists of January and February 2020, when no case of Covid 19 has yet occurred in the Czech Republic. **The second phase** includes the months of March 2020, April 2020, October 2020, November 2020 and February 2021, because the economy and society went through a period of hard lockdown. **The third phase** includes the months of May 2020, June 2020, July 2020, August 2020 and January 2021, when the Government of the Czech Republic decided to loosen the imposed anti-epidemiological restrictions. **The fourth phase** covers only the month of September 2020, as it was a period of a slight reduction in people's contacts. The fifth phase relates to December 2020, when first there was a great loosening of restrictions in the economy and society, followed by a slight

reduction in contacts, which ultimately resulted in the introduction of tough anti-epidemiological restrictions by the Czech Government (Chart 2).

Graph 2 Timeline of anti-epidemiological measures taken by the Czech government according to the degree of restrictions
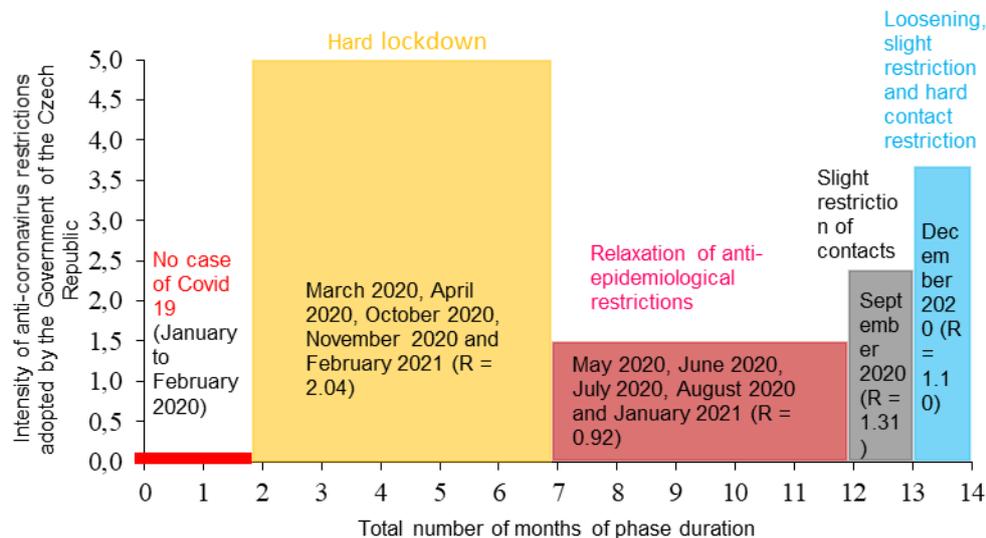
Source: our own representation based on information from ÚZIS, MZ and Bartoníček et al. (2021)

Because we need to monitor the development of NAIRU, NARRU, the gaps between the share of unemployed persons and PC in individual epidemiological-economic phases without reducing the number of observations and reducing the validity of estimates, we modify the previously used one-equation model method with a categorical variable of the epidemic-economic cycle. We will estimate our own unobservable variables using multiple linear regression, which is applied to a database of 1694 observations. Inflation and infection equations are estimated by using the least squares method. NAIRU, NARRU and the slope of the PC in a detailed classification from various perspectives will be extracted by defining categorical variables in an interaction with the share of unemployed persons by region. In this way, we can find out NAIRU, NARRU, the tendency of PC, its character, intensity and confirm or refute the substitutability of the consumer price index, respectively the reproduction number R by the share of unemployed persons by region but also by the phase of the epidemiological-economic cycle together.

The specific calculation of NAIRU and then NARRU values is based on the above-mentioned linear regression inflation equation (Sekhon, 1999), while the value of the constant is divided by the regression coefficient of the share of unemployed persons by region and also by phases. The gap of the share of unemployed persons, which characterizes the development of the economic cycle and later also the epidemic-economic cycle on the labor market, is then obtained by subtracting our calculated NAIRU and NARRU from the actual share of unemployed persons. The highest explanatory power of the model (established R2 was the highest) and the individual variables in it (the obtained p-value was the lowest) determined the number of delays of the explanatory variable after the explanatory variables. The most suitable model for the approximation of the analyzed data was selected by using the Akaike information criterion. The stationarity of all time series used was assessed by using the Augmented Dickey-Fuller test (hereinafter referred to as ADF test). Residue normality was tested by Jarque Ber's test, residue autocorrelation by LM test (Bresuch-Godfrey test) and heteroscedasticity by White's test. The acceptability of the multicollinearity is measured in this work by the Variable Inflation Factor (hereinafter referred to as VIF). Failure of residue normality tests due to fluctuations in the development of some segments of the explained variable and the calculated

year-on-year changes in the case of a large number of observations allows us to assume the validity of the central limit theorem, which says that the tests are asymptotically valid. The reason for the presence of heteroskedasticity in the model is the same as for abnormality. Thus, point estimates will not be disturbed and will still be unbiased.

4.   Comparison of NAIRU, NARRU, unemployment gaps and PC slope during the pandemic in the Czech Republic by region

In the graphs of the empirical part of the text, the names of the regions are replaced by the following abbreviations: Hlavní město Praha (KHmP), Středočeský (KSČ), Jihočeský (KJČ), Plzeňský (KPl), Karlovarský (KKa), Ústecký (KÚs), Liberecký (KLi), Královéhradecký (KKH), Pardubický (KPa), Vysočina (KVy), Jihomoravský (KJM), Olomoucký (KOl), Zlínský (KZl) and Moravskoslezský (KMS).

We are aware that the calculation of the R value changed during the pandemic, however, a value of one as key for the epidemic condition was maintained. We are also aware that the unemployment rate has been severely distorted by the financial support system. Without them, our conclusions about the relationship between R and the unemployment rate would be much more demonstrable.

Comparison of NAIRU and NARRU development

A comparison of the values of NARRU with NAIRU from the point of view of regions in the period January 2020 to February 2021 shows that the average value of NARRU for the whole period was lower than NAIRU by 0.24 p.p. (in the Moravian-Silesian region lower by 0.56 p.p. and in the Pardubice region by 0.18 p.p.). The result indicates the achievement of epidemic-economic balance on the labor market in the spread of the epidemic, especially in the Moravian-Silesian region.

The estimation of these variables in the individual phases, which differ in the intensity of the applied restrictions against the Covid 19 epidemic, provides the following findings: the **NARRU value in the first period (ie the phase without any Covid 19 impact)** exceeded the NAIRU by 0.70 p.p. (in the Moravian-Silesian Region, an excess of 0.74 p.p. and in the Capital City of Prague, by 0.39 p.p. - Graph 3). The conclusion points to anchored inflation expectations mainly in the Moravian-Silesian and Ústí regions.

The average value of the Czech **NARRU in the second period (ie the hard lockdown phase with restrictive measures against Covid 19)** is lower than the NAIRU by 0.48 p.p. (in the Moravian-Silesian Region lower by 0.71 p.p. and in Hradec Králové by 0.36 p.p). The reason for the epidemic-economic balance on the labor market, which accelerated the epidemic, was the development mainly in the Ústí nad Labem and Moravian-Silesian regions.

The average value of the Czech **NARRU in the third period (ie the phase of loosening of restrictive measures against Covid 19)** gained negative values as well as the NAIRU, and thus it may be a period of instability with structural shifts and also a period of instability with movements / occasional changes between decades and semi-decades, which is our case. Specifically, NARRU was 0.81 p.p. higher. (in the Moravian-Silesian Region higher by 1.22 p.p. and in the Capital City of Prague by 0.64 p.p.). The analysis of the reproduction number R shows its decrease compared to the 2nd phase, while the share of unemployed persons continues to grow. At this stage, therefore, it is not possible to speak with certainty about the arrival of structural shifts in the labor market, but rather about fluctuations caused by developments outside the observed substitution (the first signs of a change in oil prices). However, the analysis of the consumer price index indicates a month-on-month increase with the share of the unemployed growing. Thus, for now, the arrival of structural shifts in the labor market and fluctuations caused by developments outside the observed substitution are still in.

The average value of the Czech **NARRU in the fourth period (ie the phase of mild tightening using epidemiological measures against Covid 19)** was again positive (0.55%). However, the average NAIRU value also remained negative in phase 4, and even increased by 1.57 p.p. (highest NARRU in the Moravian-Silesian Region + 0.83% and lowest in the

Capital City of Prague + 0.37%, lowest NAIRU in the Pardubice Region -2.14%). For NARRU, even phase 3 shows more signs of a period of instability with movements / occasional changes between decades and semi-decades. This conclusion is in harmony with the continuation of substitution between the reproduction number R and the share of unemployed persons. In the case of the NAIRU concept, the consumer price index rose slightly month-on-month and the share of unemployed persons slightly decreased; improvements in the economy were confirmed by the consumer confidence index together with entrepreneurs and the price of oil. At this stage, therefore, the first indications of pressure to establish structural shifts in the labor market are already emerging, indirectly due to the negative NAIRU.

The average value of **NARRU and NAIRU in the fifth period (ie the phase of substantial loosening of measures, gradual reduction of contacts and tough measures against Covid 19)** has a positive sign. Nevertheless, NARRU is by 1.99 p.p. lower than NAIRU (in the Moravian-Silesian region lower by 3.26 p.p., in the Pardubický region by 1.28 p.p.). The acceleration of the epidemic in reaching the epidemic-economic balance at a time when a reasonable tightening of restrictions would not escalate the recession on the labor market is evident, especially in the case of the Moravian-Silesian Region.

Graph 3: Comparison of the development of NARRU and NAIRU in individual phases of pandemic restrictions by regions in the Czech Republic
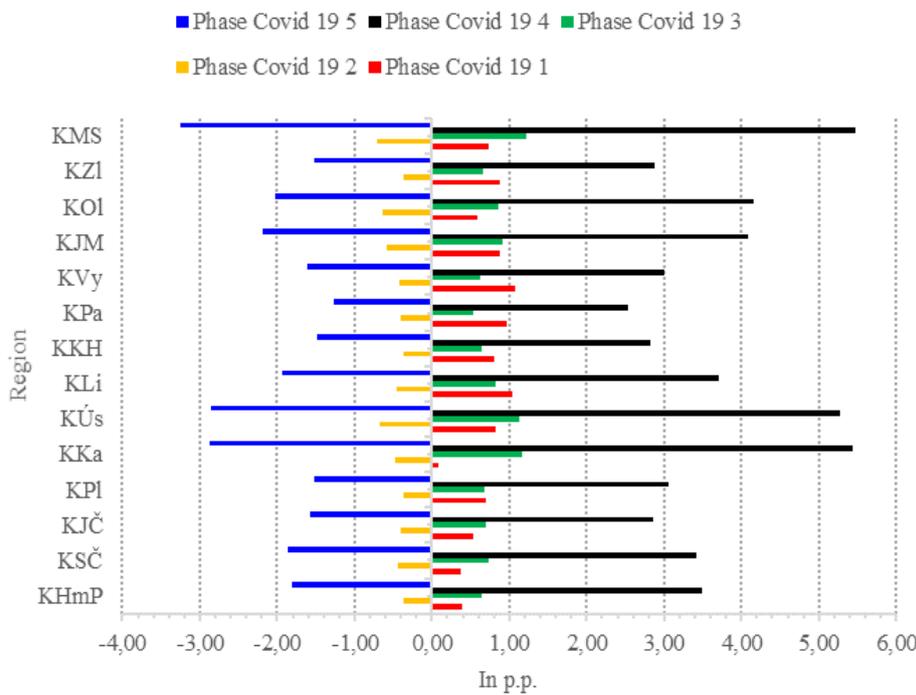
Source: our own calculation based on data from MPSV, ČSÚ, ČNB, ÚZIS and MZ

Comparison of the development of the gap in the share of unemployed persons according to NAIRU and NARRU

The positive **gap in the share of unemployed persons** applies **for the whole period**, which confirms the phase of the recession, while NARRU is higher than NAIRU by 0.24 p.p. (in the Moravian-Silesian region higher by 0.56 p.p. and in the Pardubice region by 0.18 p.p.)

The average value of **the unemployment gap** on the labor market **in the first period (i.e. the phase without the impact of Covid 19)** was negative for both concepts and it was a boom period (e.g. the construction output increased by 1.7% month-on-month and the industrial production by 0.4 %, the share of unemployed persons stagnated at 2% at the end of 2019).

The NARRU concept was more intense, by 0.70 p.p. higher than the NAIRU concept (in the Moravian-Silesian region there was an excess of 0.74 p.p. - see Graph 4). The localization of the economic boom on the labor market is in line with the month-on-month increase in construction and industrial production (+ 0.4%), but also with information on the development of the COVID 19 epidemic, which hit the Czech Republic in March 2020 and thus in the following epidemic-economic phase.

The average value of **the unemployment gap** in the labor market **in the second period (i.e. the hard lockdown phase with restrictive measures against Covid 19)** was positive, and thus the labor market confirms the recession phase in both concepts. According to NARRU, the gap was 0.48 p.p. higher (in the Ústí nad Labem region the NAIRU concept exceeded by 0.66 p.p. and in the Pardubice region by 0.40 p.p.). The recession was the result of a month-on-month decline in industrial production by 6.1% and also a decline of the consumer confidence indicator (by 8.4 points) and entrepreneurs (by 5.4 points). The reproductive number R also increased from zero to 1.2.

In the third period (ie the phase of loosening of restrictive measures against Covid 19), the average value of **the unemployment gap** in the labor market was again positive. In the case of NARRU, however, the gap was by 0.81 p.p. lower (in the Moravian-Silesian region lower by 1.22 p.p. and in the Pardubice region by 0.53 p.p.). As the reproduction number R decreased compared to the 2nd phase with the growth of the share of unemployed persons, the NARRU concept can be expected to fluctuate in the development of e.g. oil prices than in the onset of systemic change in the labor market (prevented by the financial support system). In the case of the NAIRU concept, the consumer price index grew month-on-month together with an increase in the share of unemployed persons. The conclusion is in accordance with, for example, the month-on-month decline in construction output, the decline in entitlement to financial support in unemployment, but also the appreciation of the exchange rate and the rise in the price of oil.

The average positive value of **the unemployment gap** in the labor market **in the fourth period (ie the phase of slight reduction of contacts/meetings through epidemiological measures against Covid 19)** for the NARRU concept decreased with the growth of NAIRU, which led to an exceeding of NARRU by 3.73 p.p. (in the Ústí nad Labem region NAIRU was higher than NARRU by 5.28 p.p. and in the Pardubice region by 2.54 p.p.). The growth of the reproductive number R during a decrease in the share of unemployed persons compared to the previous phase and a decrease in the intensity of the recession on the labor market in this phase assured us about the correctness of the evaluation of phase 3 of the NARRU concept as a one-off fluctuation. This fluctuation could be caused, for example, by the development of oil prices, which reduced the level of decline in the first two phases, then turned into a slight month-on-month increase in the third phase, only to increase month-on-month in the 4th phase. The month-on-month decline in the consumer price index, together with the decline in the share of unemployed persons, confirmed the correctness of the assessment of phase 3 of the NAIRU concept as a structural shift adequate to the period of economic transformation and global financial and economic recession. And it brought its first indications. The sudden acceleration in oil prices has also indicated that it may not be as long as the two previous phenomena.

The average positive value of **the unemployment gap in the fifth period (i.e. the phase of major loosening of measures, gradual reduction of contacts and tough measures against Covid 19)** increased for the NARRU concept and decreased for the NAIRU, which caused NARRU to dominate by 1.99 p.p. (in the Karlovy Vary region the NAIRU exceeded by 2.87 p.p. and in the Pardubice region by 1.28 p.p.). The estimate of the development of NARRU is confirmed by data on the month-on-month decline in construction output, the reproduction number R remained at a level slightly higher than the recommended maximum. The renewed increase in the intensity of the recession in the labor market at this stage indicates the unpredictability of the epidemic. However, a decrease in the reproductive R in the growth of the share of unemployed persons and also the last significant fluctuations in the oil indicator indicate the variant of a one-off fluctuation in the 5th phase. Reduction of the

month-on-month decline in the consumer price index accompanied by an increase in the share of unemployed persons and a significant reduction in the intensity of the recession on the labor market - all of the above confirmed the legitimacy of the evaluation of Phase 3 of the NAIRU concept as a structural shift in the period of economic transformation and global financial and economic recession with its first symptoms in Phase 4 and uncertainty about its duration. The ambiguity is confirmed by data on growth in industrial production, a decline in construction output, a significant drop in oil prices and an increase in the consumer confidence indicator.

Graph 4 Differences in the development of both unemployment gaps in individual phases of the application of pandemic restrictions according to regions in the Czech Republic
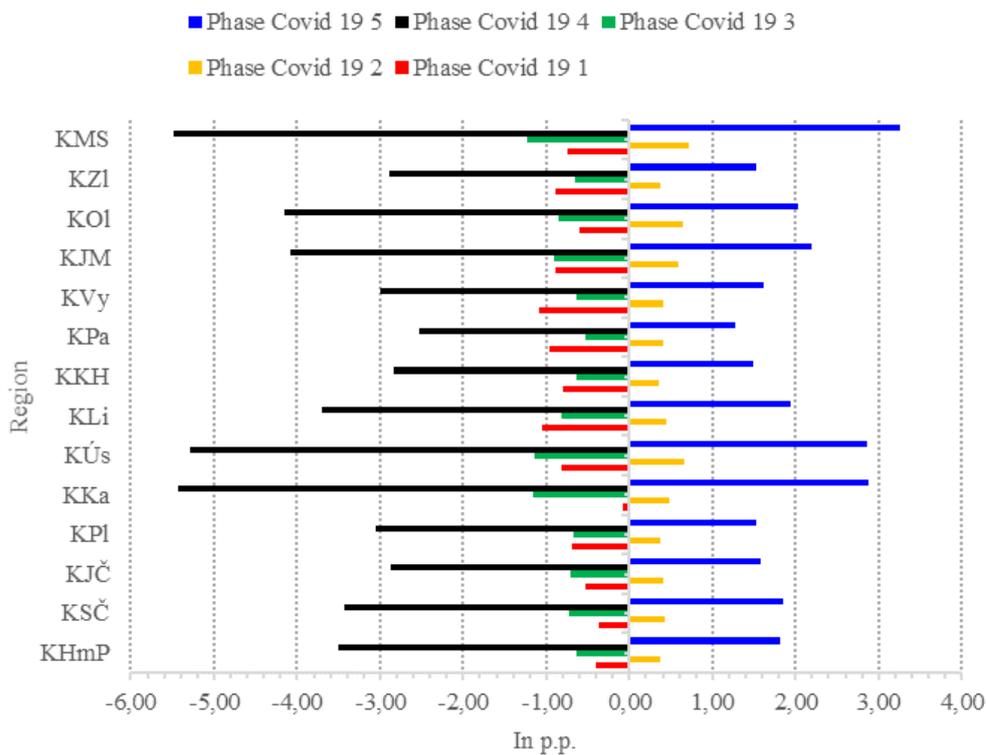
Source: our own calculation based on data from MPSV, ČSÚ, ČNB, ÚZIS and MZ

Comparison of the development of the tendency of the share of unemployed persons according to NAIRU and NARRU

In the case of **the PC slope**, it can be stated that the average value of NARRU and NAIRU **for the whole period** has a negative slope with very weak substitutability of the reproduction number R, respectively of the consumer price index by the share of unemployed persons, while in the case of the NARRU concept it is higher by 0.59 (in the Pardubice region higher by 0.08 and in the Moravian-Silesian region by 0.04).

The average **PC slope value in the first period (ie the phase without any impact of Covid 19)** was typically negative for both concepts, with the slope for NARRU exceeding the slope for NAIRU by 0.33. The intensity of substitutability of the reproduction number R by the share of unemployed persons is medium and PC thus has a medium tendency. The intensity of substitutability of the consumer price index by the share of unemployed persons is very weak and the PC is very flat. In the capital city of Prague, the excess of NARRU over NAIRU was by 0.48 and in the Moravian-Silesian Region by 0.20. The reproduction number, due to the fact that COVID 19 came to the Czech Republic only in March 2020, was not reflected in the PC's inclination at the NARRU concept at this stage.

The average value of the PC slope **in the second period (ie the hard lockdown phase with restrictive measures against Covid 19)** was negative for both concepts, decreased for

NARRU and increased for NAIRU, while the slope for NARRU was lower than for NAIRU by 0.12. The intensity of substitutability of the reproduction number R (NARRU concept) and the consumer price index (NAIRU concept) by the share of unemployed persons is very weak and PC very flat. In the Pardubice region, the excess of NAIRU over NARRU was by 0.16 and in the Moravian-Silesian region by 0.075. The shift in the estimated PC for the NARRU concept to the left upwards compared to the first phase (Graph 5a, 5b) was due, among other things, to the month-on-month decline in oil prices, stagnation in entitlement to unemployment benefits, but also due to the fact that the reproduction number R was higher than internationally recommended. The shift of the estimated PC according to the NAIRU concept to the left down compared to the first phase caused, for example, a month-on-month decline in the consumer price index and stagnation of indirect taxes at the level of the previous period.

The average value of the PC slope **in the third period (ie the phase of loosening of restrictive measures against Covid 19)** was atypically positive for both concepts, while the slope of NARRU is lower by 0.12. At this stage, the theoretically defined trade-off failed. However, the share of unemployed persons in this period increases compared to the 2nd phase and the reproductive number R decreases. On the other hand, the price of oil, after a month-on-month decline in the second phase, is rising again in this phase. This fact therefore rather suggests that in the third phase of the NARRU concept, the labor market was not affected by a structural shift similar to the transformation of the economy and the global financial and economic recession. In the case of the NAIRU concept, the result further underlines the correctness of the third phase as a period when the labor market was affected not only by instability with movements / occasional changes between decades and semi-decades, but also by a structural shift similar to economic transformation and global financial and economic recession. The argument is mainly the current month-on-month growth of the consumer price index and the share of unemployed persons. For example, property market well reflects the different reality of the Covid 19 pandemic recession and previous economic recessions (e.g.2009-13). Hromada et al. (2021) describes sharp increase in property prices (contrary to what was expected by experts at the time of first lockdown) with peaks in major cities, indicating that changes on labor market (home office and online working) did not induce people to move to cheaper property regions (Hromada 2021). From the point of view of regions, the slope of the PC in the capital city of Prague was lower for the NARRU concept than for the NAIRU by 0.14 and in the Ústí nad Labem region by 0.08. The shift in the estimated PC according to the NARRU concept further to the left and down compared to the second phase and the violation of substitution was due, among other things, to a month-on-month increase in industrial production, a decrease in unemployment benefits and a decrease in the reproductive number R compared to the second phase. In addition, a similar shift in the estimated PC according to the NAIRU concept was due to a month-on-month appreciation of the exchange rate.

In **the fourth period (ie the mild tightening phase of meeting other people with epidemiological measures against Covid 19),** the average **PC** of the NARRU concept returned to a negative value, but the NAIRU concept remained non-standardly positive, although its value decreased. The PC slope of the NARRU concept was higher by 0.28 than that of the NAIRU concept. This fact suggests that in phase 3, the NARRU concept only involved instability with movements / occasional changes between decades and semi-decades. This corresponds to the trade-off between the development of the share of the unemployed persons and the reproduction number and the escalation of the price of oil. In the NAIRU concept, the arrival of a structural shift to phase 4 confirms the violation of substitution between the consumer price index (month-on-month decrease of 0.6%) and the share of unemployed persons (decrease compared to phase 3 by 0.1 p.p.). From the point of view of regions, the slope of the PC was higher by 0.34 in the capital city of Prague for the NARRU concept and by 0.18 in the Moravian-Silesian region. The shift in the estimated PC to the right and up compared to the third phase in the NARRU concept was due, among other things, to the month-on-month increase in unemployment benefits, the month-on-month rise in Brent oil prices, and the reproduction number R increased compared to phase 3. The shift of the PC to

the left upwards compared to the third phase and the violation of substitution in the NAIRU concept, for example, caused a month-on-month increase in industrial production, a month-on-month increase in the business and consumer confidence indicator and a month-on-month exchange rate depreciation.

The average **value of the PC slope in the fifth period (i.e. the phase of substantial loosening of measures, gradual reduction of contacts and tough measures against Covid 19)** was again typically negative for both concepts and then accelerated. The slope of the NARRU concept was higher by 0.04 than that of the NAIRU concept. The intensity of substitutability of reproduction number R, resp. of the consumer price index by the share of unemployed persons is very weak and PCs are thus very flat. In the case of the NARRU concept, phase 3 was just instability with movements / occasional changes between decades and semi-decades. This confirms the trade-off between the development of the unemployment rate and the reproduction number and the return of Brent oil prices to a month-on-month decline. The NAIRU concept still needs to avoid definitive conclusions about the short duration of the last structural shift. Namely, the presence of a structural shift also in the 5th phase induces a transition from a month-on-month decline in the consumer price index to a practical stagnation with a substantial increase in the share of unemployed persons. From the point of view of regions, the slope of the PC in the Pardubice region in the NARRU concept is higher by 0.04 than in the NAIRU concept and in the Moravian-Silesian Region by 0.03. The shift in the estimated PC for the NARRU concept to the left and down compared to the previous phase was due, for example, to the month-on-month growth in industrial production, the month-on-month stagnation in entitlement to unemployment benefits and the month-on-month decline in oil prices. But also a reduction in the reproduction number R compared to phase 4. Compared to the previous phase, for example, the month-on-month decline in construction output and the month-on-month growth of indirect taxes contributed to the shift of the estimated PC for the NAIRU concept to the right and upwards.

Graph 5a: Development of PC and NAIRU in individual phases of application of pandemic restrictions in the Czech Republic
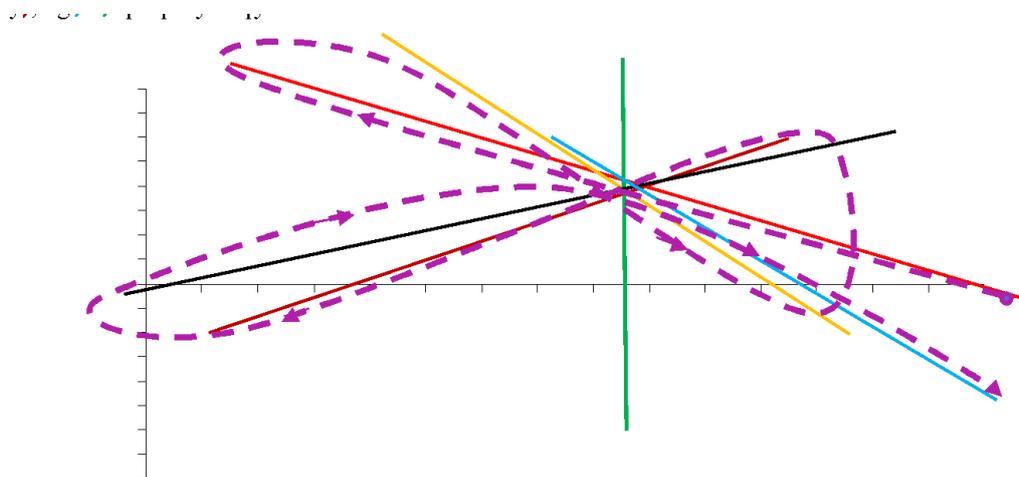
Source: our own calculation based on MPSV, ČSÚ and ČNB data

Graph 5b Development of PC and NARRU in individual phases of application of pandemic restrictions in the Czech Republic
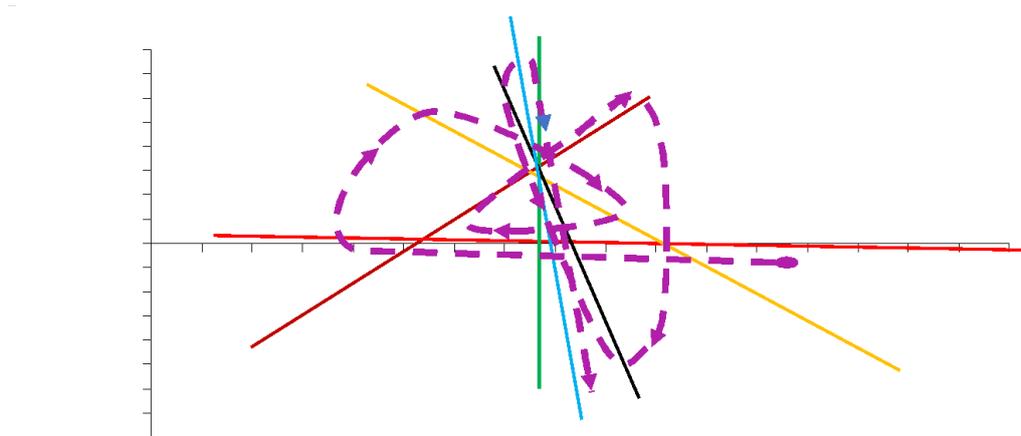
Source: our own calculation based on MPSV, ČSÚ, ČNB, ÚZIS and MZ data

Conclusions

The higher value of NAIRU than NARRU in the entire monitored period of the coronavirus pandemic confirms the achievement of epidemic-economic balance in the labor market at the cost of spreading the epidemic. The lower value of the positive unemployment gap (recession) in the NAIRU concept then implies less impact on the labor market by anti-epidemic measures than would be required by the epidemic spreading in society. The government should have thus been more consistent in its epidemiological restrictions (e.g. longer, more complex and stricter lockdowns, agreement with Blatný's (2021) conclusions). In addition, the government should have placed more emphasis on disease prevention (e.g. having sufficient respirators, tests and vaccines in time, in line with the conclusions of Kulveit (2021). **In the second period (March, April, October, November 2020 and February 2021) - the phase of hard lockdown with restrictive measures against Covid 19** the declared lockdown should have been longer and more complex, more discussed with epidemiologists and health professionals, more reflecting the situation in the regions, see for example Blatný (2021), who confirmed that the closure of districts limited the mobility of the population and the number of risky contacts. **In the fifth period (December 2020) - a phase of major loosening, gradual reduction of contacts and tough measures against Covid 19,** the epidemic-economic balance was reached at the cost of accelerating the epidemic at a time when adequate tightening of restrictions would not escalate the labor market recession. The government should not have loosened the measures so much before Christmas Day. In this context, Bartoníček et al. (2021) state that the government at the beginning of December refused to tighten the measures, which the government loosened despite warnings from experts before Christmas. Heger (2021) points out that society has lost confidence in the government, which has been reflected in the fact that people didn't comply with the measure and the consequence was an increase in morbidity and death in the first months of 2021.

On the contrary, with **a lower value of NAIRU than NARRU in the first period (January and February 2020) - the phase without any impact of Covid 19,** the government did not have to worry about inflationary pressures because inflation expectations were fully under control. The larger negative value of the unemployment gap in the labor market, and thus the more intense boom in the NARRU concept, indicated better starting conditions for dealing with the upcoming COVID 19 epidemiological challenge in the Czech Republic from the following month. **In the third period (May, June, July, August 2020, and January 2021) - the phase of loosening of restrictive measures against Covid 19,** it was then possible to reach an

epidemiological and economic balance by faster loosening of measures that would moderate the labor market recession, especially for women. The government began to loosen the restrictions too late and slowly. Cílková (2021) sees a mistake in constantly slowing down the epidemic. **In the fourth period (September 2020) - a phase of slight reduction of the meeting with other people with epidemiological measures against Covid 19** there was a hasty tightening of anti-epidemiological restrictions, which deepened the recession in the labor market, especially for women, at a time of low epidemic in society. For example, the government did not have to limit mass events indoors. The government also still did not have good rules according to which the pandemic can be controlled by milder means, see e.g. Klimeš (2021). At the same time, it requires a new anti-epidemic system that determines what the government must do at what number of people infected per 100,000 inhabitants.

The higher value of the negative slope of the PC for the NARRU concept **for the whole period** confirms the legitimacy of its application when it questions the conclusions about the flatness and thus the non-functioning of the NAIRU concept. This is very weak substitutability of the consumer price index, resp. reproduction number R by the share of unemployed persons. People defending the concept, PC estimate, NAIRU, and the unemployment gap include Ebrahima, Igan and Peria (2020), Freund and Rendahl (2020), Leandro and Jimeno (2020), Brooks and Fortun (2020), Panetta (2020), and Zandweghe (2020). **In the first period,** the substitutability of the consumer price index is very weak and the PC is very flat, the substitutability of the reproduction number R is medium and the PC has a medium slope. The slope of the PC **in the fourth period** was normally negative only for the NARRU concept, which confirms the advantages of the application of the alternative NARRU concept by economic policymakers, especially for women. **In the fifth period,** the advantages of applying the alternative NARRU concept are confirmed by the lower negative slope of the NAIRU. The intensity of substitutability of the consumer price index, resp. of the reproduction number R is very weak and PCs are very flat. On the contrary, **the higher average value** of the negative slope of PC **in the second period** at NAIRU for both sexes does not confirm the advantages of the application of the alternative concept of NARRU to economic policymakers. The average value of the PC slope **in the third period** was atypically positive for both concepts. At this stage, the theoretically defined trade-off for both concepts failed. And it could prove the doubters about the concept of PC, NAIRU, and the unemployment gap, for example, Kiley (2020), Zweifel (2020), Formaro and Wolf (2020), Roedl and Dupont (2020).

The shift of the PC in the NARRU concept to the left upwards compared to the first phase was caused, for example, by the month-on-month decline in the price of oil. Furthermore, the shift to the left and down compared to the second phase was caused, for example, by a month-on-month increase in industrial production and construction (Hromada,Čermáková 2021). The shift to the right and up compared to the third phase was caused, for example, by a month-on-month increase in entitlement to financial support in unemployment. And the shift to the left and down compared to the fourth phase was caused, for example, by the month-on-month growth of industrial production. The reproduction number R was higher than the internationally recommended value at the first shift, then decreased compared to phase 2, then increased compared to phase 3, and finally decreased compared to phase 4.

The shift of the PC according to the NAIRU to the left down compared to the first phase was caused, for example, by a month-on-month decline in the consumer price index. Subsequently, the shift to the left and down compared to the second phase was caused, for example, by the month-on-month appreciation of the exchange rate. The shift to the left upwards compared to the third phase was caused, for example, by the month-on-month growth of the business and consumer confidence indicator. The last shift to the right and up compared to the fourth phase was the result of, for example, a month-on-month increase in indirect taxes.

From a theoretical point of view, it can be said that the PC and the NAIRU concept are not dead for half a century and can be well used to evaluate the development of the economy. The NARRU concept then brings an alternative view and the possibility of making the assessment of the government's actions in borderline situations more accurate.

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