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*Gordana Marjanović**, *Vladimir Mihajlović**

AN ANALYSIS OF THE FACTORS OF NAIRU DYNAMICS IN SELECTED OECD COUNTRIES

Unemployment represents one of the major problems in modern economies. In order to create appropriate measures for its reduction, it is necessary to know the exact relationship between the NAIRU (Non-Accelerating Inflation Rate of Unemployment) and the actual unemployment rate. Therefore, this paper examines the impact of various factors on change in the NAIRU rate using the example of selected OECD countries. The impact of the actual unemployment rate on the NAIRU is analyzed by examining the presence of hysteresis in unemployment rates, while the second part of the analysis examines the impact of the long-term unemployment rate and trade union density on the NAIRU. The results show that the hysteresis hypothesis is confirmed in almost all the countries when the analysis is applied to the individual, but not to the panel data. On the other hand, changes in the rate of the long term unemployed explain a high percentage of change in the NAIRU, while the impact of the trade union density varies considerably from country to country. The main conclusion is that institutional reforms, which affect the labour market and especially the sources of long-term unemployment, might be successful in the reduction of unemployment rate and its fluctuations.

Keywords: NAIRU, hysteresis, long-term unemployment, trade union density
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1. INTRODUCTION

The concept of NAIRU (Non-Accelerating Inflation Rate of Unemployment) has been attracting the attention of economists for several decades. Unemployment is the biggest problem of modern economies, and the NAIRU concept offers the possibility for an economic policy which will reduce unemployment without significant inflationary pressures. In this sense, it is certainly most important to identify the factors that determine the change in the NAIRU and to determine the character of their impact with great certainty.

According to some economists, the concept of the NAIRU represents only a higher level of the development of the Natural Rate of Unemployment (NRU), formulated by Friedman (1976) and Phelps (1968). The transitional form of this

* University of Kragujevac, Faculty of Economics, Kragujevac, Republic of Serbia

model was the so-called Non-Inflationary Rate of Unemployment (NIRU) developed by Modigliani and Papademos (1975). However, some authors (Tobin, 1980; Stiglitz, 1997), rightfully point to the need to distinguish these two concepts: the NAIRU is not an equilibrium concept like the NRU, in terms of establishing Valras' equilibrium, it represents involuntary unemployment as opposed to voluntary unemployment within the NRU, the NAIRU is subject to frequent changes and, in relation to the NRU which can be analyzed at the micro and macro level, it is a purely macroeconomic concept (Tobin, 1997; Bozani and Drydakis, 2011).

The theoretical analysis of the factors that determine the level and change of the NAIRU is also a matter of considerable controversy. Thus, some economists point out the attitude that the concept of the NAIRU should be treated as endogenous, i.e. the NAIRU is determined by the movements of the actual unemployment rate, which is the main feature of the hysteresis theory (Blanchard and Summers, 1988; Lavoie, 2004; Stockhammer, 2004). Hysteresis can be represented as follows (Snowdon and Vane, 2005, p. 405):

$$U_{Nt} - U_{Nt-1} = a\left(U_{t-1} - U_{Nt-1}\right) \tag{1}$$

If the actual rate of unemployment in the previous period (U_{t-1}) is greater than the NAIRU in the previous period (U_{Nt-1}), the NAIRU in the current period (U_{Nt}) will be greater than U_{Nt-1}. In other words, the actual unemployment rate „pulls" the NAIRU in the same direction.

The hysteresis theory is based on the microfoundations provided by an "insider-outsider" view of labour markets. The wages are negotiated by employed workers (insiders) to ensure the continued employment of the currently employed. In that sense, unemployed persons (outsiders) can not affect the level of wages and have little chance to be employed. On the macroeconomic level, equilibrium unemployment is equal to the last period's value of actual unemployment and shows no tendency to return to any fixed equilibrium value (Blanchard and Summers, 1986).

The econometric analysis of the hysteresis effect is mainly based on tests of stationarity, more precisely on unit root tests. If a data series is stationary, it means that it has no unit root. This can be represented by the following equation (based on Snowdon and Vane, 2005, p. 301):

$$U_t = g_t + bU_{t-1} + \varepsilon_t \tag{2}$$

where U_t and $U_{t\text{-}1}$ represent the unemployment rate in the current and previous period, respectively; g_t is the trend component (the average

unemployment rate in a certain period); b is a coefficient which measures the impact of unemployment rate in a previous period on the current unemployment rate, and ε_t represents random shocks. In cases when $b = 1$, the rise of the unemployment rate in the previous period will completely affect the unemployment rate in the current period – that is, there is a unit root, and the series is non-stationary; the shock will be transmitted forward in time, generating serial correlation. In cases when $0 < b < 1$, the impact of previous unemployment rates on current rates will eventually die and the unemployment rate will return to its trend value (NAIRU rate), the series is stationary. In other words, this situation represents the absence of the hysteresis effect. Therefore the objective is to test the null hypothesis (H_0) that the series has a unit root ($b = 1$; the series is non-stationary and there is hysteresis) against the alternative hypothesis (H_1) that series is stationary ($0 < b < 1$).

Apart from the analysis of the influence of the hysteresis effect on the NAIRU rate, many economists have emphasized the impact of labour market characteristics on the level of the rate. These characteristics may be related to the strength of trade unions (the level of labour market monopolization), unemployment benefits, the level of competition in the goods market, the share of the long-term unemployed in the total labour force, and so on. In this sense, the NAIRU in the labour market (as a result of negotiations between trade unions and employers) can be represented as follows (Sørensen & Whitta-Jacobsen, 2010, p. 341):

$$U_N = \frac{1}{\frac{m^w}{m^w - 1}\left(1 - m^p b\right)} \tag{3}$$

where: U_N – is the NAIRU; m^w – the market power of the subjects in the labour market; m^p – the market power of firms in the goods market; b – unemployment benefits. As can be seen, the NAIRU is higher if the level of monopolization in the labour market is higher, which is associated with a lower elasticity of labour demand. In addition, a higher value of m^p implies that the lower price elasticity of demand in the goods market causes a higher NAIRU. Finally, higher unemployment benefits result in a higher NAIRU, since the unemployed are willing to look for a suitable job for a longer period of time.

Since the key issue is related to the factors that determine the level of the NAIRU and cause its changes, the paper will examine the impact of the

actual unemployment rate on the NAIRU (hysteresis hypothesis), as well as the impact of the long-term unemployment share in the labour force (hereinafter referred to as LTU), and the union density (as an indicator of labour market monopolization) on the NAIRU (hereinafter referred to as UD), using the example of selected OECD countries. The LTU is the rate of the unemployed for one year or longer in the labour force. The UD is the percentage of workers who are union members. The main research goal of the paper is to explore which group of factors (endogenous or exogenous) is crucial for an explanation of the dynamic pattern of the NAIRU rate in the observed OECD countries. The research hypotheses are as follows:

H_1: Actual unemployment rate increase causes the increase in the NAIRU (there is an hysteresis effect);

H_2: The LTU increase tends to increase the NAIRU;

H_3: The UD increase tends to increase the NAIRU.

Depending on which hypothesis will be accepted, recommendations for an economic policy to reduce unemployment will be different. If the first hypothesis is accepted, it will mean that, in the observed countries, the NAIRU rate is affected by the actual rate of unemployment, and the economic policy directed to the demand side of the economy will be effective. On the other hand, accepting the second and/or the third hypothesis will mean that institutional reforms affecting the labour market characteristics might be more successful in the reduction of the NAIRU rate.

2. OVERVIEW OF THE LITERATURE

The analysis of the factors which determine the unemployment rate and changing of the NAIRU rate has been the subject of many papers. Because the research in this paper is twofold – it contains an analysis of the impact of actual unemployment on the NAIRU rate (hysteresis) and the impact of labour market characteristics on the NAIRU – the overview of the relevant literature will be related to both aspects.

The most commonly used tests for testing the hypothesis on the presence of hysteresis are the standard unit root tests (Augmented Dickey-Fuller test – ADF or Phillips-Perron test – PP). The presence of a unit root is a signal that the data series on unemployment rates is non-stationary, i.e. that it does not seek its long-term arithmetic mean, which suggests hysteresis. In the context of the NAIRU concept, this means that the actual unemployment rate does not seek the NAIRU, but its value changes together with the NAIRU.

Analysis of this type was used in a number of pioneering publications in the field (e.g. Blanchard and Summers, 1986; Mitchell, 1993; Røed, 1997). For example, Mitchell (1993), applied unit root and near unit root tests alternatives for the exploration of unemployment persistence in OECD countries. The results show that there is large extent of unemployment persistence and that economic policy could be effective.

The development of research in the field has led to the introduction of new tests for the presence of hysteresis, as well as the analysis of panel data instead of individual data. León-Ledesma (2002), analyzed the presence of hysteresis in unemployment in the United States and the European Union by applying the panel unit root test. The results showed the existence of hysteresis in European countries, while the natural rate hypothesis was more adequate for the USA. Khim-Sen Liew et al. (2009) arrived at similar results analyzing monthly unemployment rates for 14 OECD countries, but only in the case of analyzing individual countries, while the tests in the panel data did not confirm the presence of hysteresis. Ener and Arica (2011) also showed an absence of hysteresis in Turkey and 15 other European countries based on the panel approach.

Loageay and Tober (2005) investigated the presence of hysteresis in the euro area, based on the unemployment data processed by the Kalman filter. The results of the ADF and Elliott-Rothenberg-Stock DF-GLS test confirmed that the hysteresis effects are present in these countries, especially in Germany. Ball (2009) also came to the conclusion that there is hysteresis by analyzing annual data that are processed by the HP (Holdrick-Prescott) filter on unemployment rates in 20 developed countries. Chou and Zhang (2012) analyzed data on the unemployment rate in the G-20 countries by applying a non-linear panel unit root tests, and came to the conclusion that in the case of nine countries the hypothesis on hysteresis existence can be rejected.

In addition to exploring the impact of changes in the actual unemployment rate on the NAIRU, a significant number of papers dealt with the analysis of labour market characteristics as determinants of the NAIRU. Nickel et al. (2005) investigated the causes of unemployment in the OECD countries in the period between 1960 and 1990 and concluded that much of the change in the unemployment rate can be explained by the changes in labour market institutions. As the primary cause of rising unemployment they emphasize the unemployment benefits, regulation relating to the minimum wage rate and the safety of employees, and the power of labour unions. Gianella et al. (2008), based on panel data for the OECD countries,

showed that the regulation of the goods market, the union density in the labour market, and the presence of unemployment benefits have a significant role in explaining the changes in the NAIRU. Based on data for 19 European countries in the period between 1973 and 1999, Holden and Wulfsberg (2007) came to similar conclusions: the low downward flexibility of nominal wages as one of the factors of the NAIRU, is more emphasized in countries where the union density and level of employment protection are greater. Tulip (2004) showed that changes in the minimum wage represent a significant factor of changes in the NAIRU in the USA and the OECD countries. Berger and Everaert (2008) analyzed data on unemployment rates in the USA and the euro area, and came to the conclusion that, in the case of European countries, structural factors are the main cause of unemployment. Although cyclical shocks in European countries are relatively permanent, their impact on unemployment is more pronounced in the USA.

Besides the analysis of hysteresis effects in unemployment in normal conditions, there are many papers dealing with the impact of the economic downturn on the NAIRU rate. In a publication of the European Commission (European Economy, 2009) it is stated that a large rise in actual unemployment (as a result of an economic crisis), will cause an increase of the short-term NAIRU. These effects will be transitory except when there are generous unemployment benefits which can produce lasting increases in structural unemployment (long-term NAIRU). Guichard and Rusticelli (2011) analyse the impact of the economic crisis on the NAIRU rate in OECD countries and conclude that the NAIRU have increased during the crisis mainly as a result of the hysteresis effects. Micaleff derived estimates of the NAIRU rate in Malta by using a multivariate filter and found that the crisis had no permanent impact on the NAIRU. The impact of institutions on structural unemployment in times of crisis is analysed by Furceri and Mourougane (2009). By using the Autoregressive Distributed Lags model on the panel of 30 OECD countries from 1970 to 2008, they came to the conclusion that downturns have, on average, a significant positive impact on the level of the structural unemployment rate. Different institutions influence the adjustment process of the economy, as well the extent of the initial shock.

3. DATA AND METHODOLOGY

The research involved twelve OECD countries: Austria, Belgium, Denmark, Finland, France, Italy, Germany, the Netherlands, Norway, Portugal, Great Britain, and the USA. In analyzing the impact of hysteresis

effects on the NAIRU, we used monthly unemployment data (as suggested by Gustavsson and Österholm, (2006) and Khim-Sen Liew et al. (2009)) from the OECD database in the period between 1990M1 and 2013M1. The unemployment data include the percentage of unemployed persons in the total civilian labour force. The examination of hysteresis in this paper was conducted using the following tests: the Augmented Dickey-Fuller test – ADF (Dickey and Fuller, 1979), the Phillips-Perron test – PP (Phillips and Perron, 1988), and the Kwiatkowski-Phillips-Schmidt-Shin test – KPSS (Kwiatkowski et al., 1992). In the parametric ADF test, as well as in the alternative non-parametric PP test, the null hypothesis is that the data series (unemployment rates) has a unit root. This means that this is a non-stationary series, i.e. it does not seek a long-term arithmetic mean (long-term NAIRU). In the ADF test, the presence of a unit root, with the appropriate level of significance, is treated as sufficient proof of the existence of hysteresis. On the other hand, the KPSS test complements the ADF test, which tests the null hypothesis that the time series is stationary. The reason for the application of this test lies in the greater robustness of the results. Also, greater reliability of the results was achieved with the application of several panel unit root tests: Levin, Lin and Chu test (Levin et al., 2002), in which it is assumed that there is a common unit root process (autoregression coefficients are identical in cross-sectional data), as well as the Im, Pesaran, and Shin test (Im et al., 2003), the Fisher-ADF and the Fisher PP test (Maddala and Wu, 1999, Choi, 2001), in which the values of autoregressive coefficients are allowed to vary. All of these tests examine the null hypothesis that the data series has a unit root.

However it must be borne in mind that the explained unit root tests are only a special case of tests utilising random walk. There are many other tests for stationarity. Additionally, there are some other factors that have an influence on the NAIRU rate and are not involved with the hysteresis effect, which might be the basis of some future research.

The value of the NAIRU is obtained from annual data on the unemployment rate from the EuroStat database (for the period between 1970 and 2011) applying the HP filter (Holdrick and Prescott, 1981), which is often used for these purposes (e.g. Ball and Mankiw, 2002; Blouin, 2007). It is assumed that the data series U_t (unemployment rate) consists of a trend component U_{Nt} (NAIRU) and a cyclical component c_t (deviation of actual unemployment rate from the NAIRU), so that $U_t = U_{Nt} + c_t$, for t = 1, 2, ..., T. The HP filter isolates the cyclical component, according to the following formula:

$$\min_{U_N}\left(\sum_{t=1}^{T}\left(U_t - U_{Nt}\right)^2 + \lambda\sum_{t=2}^{T-1}\left[\left(U_{Nt+1} - U_{Nt}\right) - \left(U_{Nt} - U_{Nt-1}\right)\right]^2\right) \qquad (4)$$

where: λ is the so-called parameter of trend line "smoothness". The value of λ in this paper is 100, which is the standard for annual data.

Factors whose influence is monitored in such a calculated NAIRU are the LTU and the UD, and their values are obtained from the OECD database. The impact of these factors is measured via two correlation coefficients: Pearson's parametric and Spearman's nonparametric correlation rank test. In the case of Pearson's coefficient, based on the set research hypotheses, the degree of quantitative agreement between the values of the NAIRU, the LTU, and the UD is examined. Specifically, it examines whether the maximum values of the NAIRU were in the years in which there was the maximum value of the LTU and the UD. On the other hand, Spearman's coefficient examines whether there is a monotonic relationship among the observed variables. More specifically, it examines the correlation between the ranks of years where the ranking was performed according to the value of the LTU, the UD, and the NAIRU. For each country, the years covered by the observed interval are ranked as follows: the year with the highest value of the LTU gets rank 1, the next one gets 2, to *n*, and so on for the UD and the NAIRU. Then the correlation between the rank series is calculated according to the value of the LTU and the NAIRU, and the UD and the NAIRU, according to the following formula:

$$r_s = 1 - \frac{6\sum_{i=1}^{n} d_i^2}{n\left(n^2 - 1\right)} \qquad (5)$$

where: d_i is the difference between the ranks of years based on the value of the NAIRU, the LTU, and the UD, and n – the number of years in the observed interval for each country.

In addition to correlation, the paper uses linear regression based on the OLS (Ordinary Least Squares) method, in order to show what percentage of variations in the NAIRU can be explained by variations of the independent variables. Prior to this Granger causality testing (Granger, 1969) was conducted, in order to statistically confirm the division of the involved variables into independent variables (LTU and UD) and dependent variable (NAIRU).

4. RESULTS

The results of the summary statistics of monthly unemployment rates are shown in Table 1. As we can see, their mean values differ significantly from country to country, but the differences in the standard deviation in most countries are not that discernible. The results of the Jarque-Bera test should be pointed out, which show that the distribution of the unemployment rate is non-normal for all the countries except Germany, which can be a signal that priority in the analysis should be given to non-parametric tests.

Table 1

Descriptive statistics of monthly unemployment rates between 1990M1-2013M1

Country	Mean	Median	Max.	Min.	Std. dev.	Skewness	Kurtosis	Jarque -Bera	p-value	Obs.
Austria	4.58	4.40	6.92	3.40	0.80	1.07	3.75	59.31	0.000	277
Belgium	8.02	7.90	9.90	6.30	1.03	0.19	1.97	13.83	0.001	277
Denmark	6.01	5.60	9.90	3.20	1.67	0.31	2.10	13.74	0.001	277
Finland	9.82	9.00	17.60	2.90	3.37	0.58	2.90	15.36	0.000	277
France	9.51	9.50	11.30	7.40	1.05	0.02	1.87	14.81	0.001	277
Germany	8.17	8.20	11.50	5.30	1.56	-0.03	2.38	4.50	0.105	277
Italy	9.11	8.80	11.70	5.80	1.57	-0.08	1.99	11.99	0.002	277
Netherlands	4.59	4.70	7.10	2.50	1.16	0.17	2.40	5.51	0.064	277
Norway	4.19	3.70	6.80	2.30	1.27	0.62	2.13	26.52	0.000	277
Portugal	7.54	7.10	17.50	3.90	3.05	1.20	4.10	80.73	0.000	277
GB	6.85	6.70	10.40	4.60	1.70	0.39	1.93	20.14	0.000	277
USA	6.08	5.60	10.00	3.80	1.63	0.86	2.76	34.67	0.000	277

Source: OECD Database, authors' calculations

Table 2 displays the results of the ADF, KPSS, and PP tests applied to the original monthly data (1990M1-2013M1) and their first differences, which are calculated according to the formula: $\Delta U_t = U_t - U_{t-1}$. According to the ADF test, the presence of the unit root in data series on unemployment rates is confirmed in all the countries except Belgium, Finland and the Netherlands. The KPSS test results confirmed the non-stationarity of unemployment rates in all the countries except Belgium, France and Germany, while the PP test confirmed the existence of hysteresis in all the countries. We can see from the table that the first differences of almost all data series are stationary.

The presence of hysteresis can also be examined on panel data, except in the case of individual data on unemployment rates, in order to determine whether the inclusion of the interdependence between the unemployment

Table 2

The results of unit root tests (stationarity) for the analysed countries

Country	Levels			First Differences		
	ADF	KPSS	PP	ADF	KPSS	PP
Austria	-2.254 (0)	0.457 [14]*	-2.511 [6]	-15.595 (0)***	0.049 [5]	-15.602 [4]***
Belgium	-3.461 (9)***	0.217 [14]	-1.856 [8]	-2.952 (8)**	0.154 [7]	-9.631 [11]***
Denmark	-2.076 (7)	0.589 [14]**	-1.318 [10]	-4.001 (5)***	0.206 [10]	-8.899 [0]***
Finland	-3.777(3)***	0.611 [14]**	-2.123 [14]	-2.131 (2)	0.385 [14]*	-4.308 [9]***
France	-2.434 (6)	0.284 [14]	-1.769 [11]	-3.681 (5)***	0.152 [11]	-10.024 [8]***
Germany	-1.848 (3)	0.336 [14]	-0.991 [13]	-4.507 (1)***	0.360 [13]*	-9.114 [10]***
Italy	-1.312 (15)	0.725 [14]**	-0.694 [10]	-2.794 (14)*	0.381 [10]*	-18.862 [10]***
Netherlands	-2.663 (9)*	0.492 [14]**	-1.475 [13]	-2.106 (8)	0.187 [13]	-14.211 [12]***
Norway	-1.580 (5)	1.241 [14]***	-1.476 [9]	-5.559 (4)***	0.163 [9]	-15.298 [8]***
Portugal	1.618 (7)	1.390 [14]***	3.196 [8]	-3.417 (6)**	0.720 [10]**	-8.068 [15]***
GB	-1.426 (12)	0.674 [14]**	-1.127 [13]	-3.781 (11)***	0.218 [13]	-12.925 [12]***
USA	-2.272 (7)	0.497 [14]**	-1.351 [12]	-3.680 (5)***	0.110 [12]	-16.581 [12]***

Source: OECD Database, authors' calculations

Note: The significance levels: *** - 0,01 ** - 0,05 * - 0,1

For the ADF test, the number in parentheses indicates the lag order selected based on the Akaike information criterion (for measurement of relative quality of a statistical model). The number in brackets (for the KPSS and PP tests) indicate the truncation for the Bartlett Kernel, as suggested by the Newey-West test (1987). For the PP test the one-sided p-values were calculated.

rates in the observed countries affects the results. Table 3 presents the results of some of the panel tests, which suggest that the hypothesis of the presence of unit root (hysteresis) cannot be rejected on the basis of only the Fisher-PP Chi-square test. Thus, most panel tests show that there is no hysteresis in unemployment rates in the countries included in the research, which is consistent with previous research using the example of other countries (e.g. Song and Wu, 1998; León-Ledesma, 2002). In other words, the actual unemployment rate, if we look at the panel data, does not affect the NAIRU and the actual rate of unemployment seeks a long-term mean value. Unemployment persistence, which is present in European countries, in this respect indicates the longevity of this adjustment process.

The second part of the analysis refers to the impact of the LTU and the UD on the NAIRU. The observed time intervals for each country are determined by the availability of data. The correlation coefficients between the values of these factors and the NAIRU (Table 4) show a statistically significant positive correlation between the LTU and the NAIRU in all the countries except Austria. In eight countries the value of the Pearson's correlation coefficient is above 0.7, while in the case of Italy, Portugal, and Great Britain the value is above 0.8, and in the Netherlands above

Table 3

The panel unit root tests for the analysed countries

Method	Statistic	p-value	Cross-sections	Observations
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.371	0.009	12	3229
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-1.851	0.032	12	3229
ADF - Fisher Chi-square	44.590	0.007	12	3229
PP - Fisher Chi-square	17.146	0.842	12	3312

Source: OECD Database, authors' calculations

Note: Probabilities for the Fisher test are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Table 4

The correlation coefficients between the NAIRU and observed factors

Country	LTU				UD (1970-2011)			
	Pearson		Spearman		Pearson		Spearman	
	r	*p–value*	r_s	*p–value*	*R*	*p–value*	r_s	*p–value*
Austria (1994-2011)	-0.236	0.347	-0.280	0.261	-0.932	0.000	-0.996	0.000
Belgium (1983-2009)	0.477	0.012	0.463	0.015	0.726	0.000	0.352	0.026
Denmark (1983-2011)	0.712	0.000	0.687	0.000	0.903	0.000	0.836	0.000
Finland (1983-2011)	0.797	0.000	0.836	0.000	0.921	0.000	0.953	0.000
France (1983-2011)	0.427	0.021	0.401	0.031	-0.911	0.000	-0.647	0.000
Germany (1983-2011)	0.785	0.000	0.826	0.000	-0.659	0.000	-0.730	0.000
Italy (1983-2010)	0.828	0.000	0.681	0.000	-0.277	0.080	-0.185	0.247
Netherlands (1983-2010)	0.927	0.000	0.872	0.000	0.066	0.676	0.198	0.209
Norway (1983-2011)	0.755	0.000	0.700	0.000	0.409	0.007	0.421	0.006
Portugal (1986-2011)	0.808	0.000	0.622	0.001	0.335	0.057	0.160	0.374
GB (1983-2011)	0.875	0.000	0.915	0.000	0.114	0.473	0.170	0.282
USA (1970-2011)	0.603	0.000	0.492	0.001	0.171	0.280	0.192	0.224

Source: Eurostat, OECD Database, authors' calculations

0.9 (0.927). According to Spearman's coefficient, the relationship between the LTU and the NAIRU is most evident in the case of Great Britain (0.915), while in eight countries the value of the coefficient is above 0.5. On the other hand, the character of the relationship between the UD and the NAIRU varies by country. The most pronounced positive correlation according to the values of both correlation coefficients is in Finland, while in the case of Austria and France, there is a strong negative correlation, which stems from the fact that in these countries the unionisation rate is low but the bargaining coverage rate is high. According to Pearson's coefficient, there is a

statistically significant correlation between the UD and the NAIRU that is greater than 0.5 only in three countries (Belgium, Denmark, and Finland). The results of Spearman's coefficient show that such a correlation exists only in the case of two countries (Denmark and Finland).

Since for the setup of the regression model, as opposed to the calculation of the correlation coefficients, it is necessary to statistically identify independent and dependent variables, the Granger causality test was conducted before the regression analysis. Table 5 shows the values of the test statistics, where a row for each country is divided into two parts. The upper part gives the results of testing the hypothesis: "the LTU (UD) does not Granger cause the NAIRU rate" and lower: "the NAIRU rate does not

Table 5

The Granger causality test for the analysed variables

Country		LTU		UD	
		F-stat.	*p-value*	F-stat.	*p-value*
Austria	NAIRU rate	12.353 [3]	0.002	8.517 [1]	0.006
		2.047 [3]	0.184	2.455 [1]	0.126
Belgium	NAIRU rate	7.029 [2]	0.005	3.181 [3]	0.038
		0.954 [2]	0.402	3.129 [3]	0.040
Denmark	NAIRU rate	27.990 [2]	9.E-07	7.970 [2]	0.002
		3.284 [2]	0.057	5.624 [2]	0.008
Finland	NAIRU rate	14.616 [2]	7.E-05	9.669 [1]	0.004
		5.693 [2]	0.009	0.096 [1]	0.759
France	NAIRU rate	18.869 [2]	2.E-05	135.122 [1]	1.E-13
		1.613 [2]	0.222	41.946 [1]	2.E-07
Germany	NAIRU rate	23.024 [2]	4.E-06	26.803 [1]	8.E-06
		6.081 [2]	0.081	7.211 [1]	0.011
Italy	NAIRU rate	71.686 [2]	8.E-10	104.530 [1]	2.E-12
		2.992 [2]	0.073	33.217 [1]	1.E-06
Netherlands	NAIRU rate	14.586 [1]	0.001	77.693 [1]	1.E-10
		0.309 [1]	0.584	5.151 [1]	0.029
Norway	NAIRU rate	26.502 [2]	1.E-06	25.133 [1]	1.E-05
		5.738 [2]	0.010	0.214 [1]	0.647
Portugal	NAIRU rate	35.603 [2]	4.E-07	0.057 [2]	0.944
		7.471 [2]	0.004	3.558 [2]	0.043
GB	NAIRU rate	51.513 [2]	5.E-09	9.514 [2]	0.001
		6.094 [2]	0.008	5.491 [2]	0.008
USA	NAIRU rate	21.675 [3]	8.E-08	20.726 [2]	1.E-06
		3.831 [3]	0.019	2.991 [2]	0.063

Source: Eurostat, OECD Database, authors' calculations

Note: the numbers in brackets represent the numbers of lags

Granger cause the LTU (UD)". Based on the p-values it can be seen that in the case of all the countries the changes in the LTU and the UD provide statistically significant information on the movement in the NAIRU.

On the basis of the causality test, Table 6 shows the parameters of the regression model. The coefficient of determination shows that the changes in the LTU in eight countries can explain a significant percentage of the variations in the NAIRU (over 50%), mainly in the case of the Netherlands (86%). On the other hand, changes in the UD in five countries can explain over 50% of the variations in the NAIRU. P-values in all of these cases are extremely low, which might indicate the strong statistical significance of the results. In other words, the results show that the impact of long-term unemployment is more prominent in the observed countries in comparison with the union density, which recommends the application of an economic policy aimed at increasing the employability of the long-term unemployed.

Table 6

The regression model parameters on the basis of the OLS method
(the NAIRU is dependent variable)

Country	Constant		Independent (LTU)		F-stat	R^2	Constant		Independent (UD)		F-stat	R^2
	β	*p-value*	*β*	*p-value*			*β*	*p-val.*	*β*	*p-val.*		
Austria	4.572	0.000	-0.542	0.347	0.941	0.056	7.562	0.000	-0.093	0.000	259.811	0.869
Belgium	6.733	0.000	1.517	0.012	7.349	0.227	-29.85	0.000	0.740	0.000	42.472	0.528
Denmark	4.830	0.000	2.481	0.000	27.780	0.507	-19.768	0.000	0.354	0.000	167.263	0.815
Finland	5.959	0.000	2.044	0.000	52.282	0.635	-24.752	0.000	0.453	0.000	218.277	0.848
France	7.635	0.000	0.744	0.021	6.019	0.182	12.773	0.000	-0.404	0.000	179.442	0.829
Germany	4.983	0.000	1.439	0.000	43.300	0.616	15.164	0.000	-0.298	0.000	29.893	0.434
Italy	5.653	0.000	1.677	0.000	56.806	0.686	12.972	0.000	-0.098	0.000	3.229	0.076
Netherlands	2.715	0.000	2.329	0.000	159.312	0.860	4.995	0.007	0.026	0.676	0.177	0.004
Norway	3.324	0.000	2.102	0.000	33.498	0.570	-11.52	0.033	0.265	0.007	8.050	0.168
Portugal	3.964	0.000	2.057	0.000	45.122	0.653	6.127	0.000	0.021	0.259	1.320	0.041
GB	4.714	0.000	1.422	0.000	88.333	0.766	5.509	0.003	0.033	0.473	0.526	0.013
USA	5.646	0.000	1.812	0.000	22.895	0.364	5.778	0.000	0.033	0.280	1.199	0.029

Source: Eurostat, OECD Database, authors' calculations

The results also indicate that the values of F-statistic are very high for all the countries except for Austria, when the impact of the LTU on the NAIRU is considered. On the other hand, the results that represent the impact of UD on the NAIRU are statistically significant at the level of 0.01 for all countries except for the Netherlands, Portugal, Great Britain and the USA.

CONCLUSIONS

A key problem with the concept of NAIRU lies in the fact that its value is not subject to direct observation, and it is difficult to determine with reasonable confidence which factors, and to what extent, will affect its change. The paper shows that the hypothesis on the impact of unemployment rate on the NAIRU in twelve OECD countries (H_1) can be accepted in the case of the analysis on data for individual countries, but not on the panel data. The potential cause lies in the interdependence between the rates of unemployment in these countries, which is closely related to the high degree of synchronization of their business cycles. Some of the future research might include other countries whose unemployment rates are not so much characterized by interdependence, in order to obtain more valid results on the possible presence of hysteresis. Additionally, it would be worth examining the relationship between the NAIRU and the actual unemployment rate in periods of economic crises and economic growth.

The obtained results about the absence of hysteresis in the observed countries (when the analysis is applied to panel data) make it possible to draw certain conclusions about the formulation of economic policy. When the hysteresis effect is present in unemployment data, it is advisable to apply economic policy measures that affect the demand side of the economy to reduce the unemployment rate. On the contrary, in the case when hysteresis hypothesis is rejected (this is the case in this paper), these measures may cause inflation, and some institutional reforms concerning the labour market might be more appropriate.

On the other hand, the results in the paper show that the impact of selected labour market characteristics (LTU and UD) on the movement in the NAIRU varies from country to country. For the majority of countries the hypothesis that higher LTU leads to higher NAIRU (H_2) can be accepted, but it should be taken into account that the Granger test showed that in most countries there is a two-way causality. However, the economic policies that reduce the bargaining power of the employed and increase the employability of the long-term unemployed (such as various training programmes and prequalification) could improve the situation in the labour market.

Contrary to that, the impact of the UD on the NAIRU is less evident, which can be explained by the fact that in some countries there is a low UD, but that unions affect the wages of many workers (the bargaining coverage rate is high). In that sense, the values of the correlation coefficients may be high but negative. Thus, the hypothesis that the UD increase reflects the

NAIRU increase (H_3) cannot be accepted in the case of most countries, if we observe the impact of the UD in isolation from other complementary factors. Some of the future research, incorporating this variable as well, could provide more complete results. With the increasing availability of data, the analysis could include other countries as well, such as the countries in South Eastern Europe, countries in transition, and so on.

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