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Abstract

The main goal of the paper is to estimate the NAIRU for Croatian economy and to discuss the implications of this indicator. The paper provides time-varying estimates of the NAIRU for 2000q1-2011q1 period, which were obtained by applying the Kalman filter method. The results reveal that the average estimated value was 12.6 percent, which on average is below the average registered unemployment rate. The dynamics of the estimated NAIRU points to the ability of the NAIRU to reveal underlying structural misbalances in a national economy. Specifically, the approaching crises effect has been detected, as well as previously documented inflationary pressures, thereby confirming the potential usefulness of the NAIRU estimation for economic policy decision making process in Croatia.

Key words: *NAIRU, Kalman filter, Croatia*

JEL classification: *C22, E24, E31*

1. Introduction

The main focus of this paper is the estimation of the macroeconomic indicator NAIRU (non-accelerating inflation rate of unemployment) for Croatian economy during the 2000s. NAIRU estimates are not available for Croatia, thus making the empirical results the main contribution of present paper. The search for Croatian NAIRU is, however, not straightforward. This is also evident in other countries, as the international publications review reveal many unresolved issues associated with assessing the value of this unobservable macroeconomic structural indicator.

Since NAIRU is a structural indicator, which the literature frequently finds hard to estimate for European economies characterized by unemployment persistence, it

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seems interesting to assess it for Croatian economy. The main reason is that Croatian economy has been facing relatively high unemployment rates, with also high structural unemployment. Potential use of this indicator is to provide information about the level of unemployment at which inflation remains stable. When economies are suffering from high unemployment and enjoying relatively stable inflation, the cost of maintaining this situation comes into focus. The revival of the interest in the NAIRU during the 1990s and 2000s in the economic literature[2] is related to the increased central banks independence and their reliance on low inflation targeting policies (Madsen, 2005). In such circumstances, when inflation is relatively stable, the interesting question remains whether the focus on low inflation rate is paid by the high unemployment cost. The NAIRU indicator should, at least theoretically, also indicate whether there are inflationary pressures in the economy. If a country's rate of unemployment is lower than the NAIRU, than there are inflationary pressures present in the economy and the central bank as well as government should take some policy actions accordingly. In the policy context, it can be even argued that when actual unemployment rate is higher than NAIRU, expansionary monetary and/or fiscal policy is expected (Hsing, 2009).

Although NAIRU indicator can potentially provide very useful information to policy makers, the problem that it is unobservable and has to be inferred from the data makes it relatively less attractive for transition economies, where the data sources are usually scarce and frequently judged as less reliable than in advanced market economies. This is probably the main reason why a heated discussion on existence and the level of NAIRU indicator present in the market economies has not spilled over to the transition economies literature earlier. The main goal of the paper is to provide estimates of Croatian NAIRU and thus fill the existing literature gap. The underlying assumption is that NAIRU estimates for Croatia could provide useful information for policy makers, in particular related to the recent crises effects, which is expected to incite the structural changes in the economy.

NAIRU is a macroeconomic indicator that on a macroeconomic level connects the two separate segments of the economic policy – monetary policy and labour market policies, i.e. monetary and real sector. The first years of Croatian transition, similar to other transition countries, was characterised by a surge of unemployment rates and inflation rates. Since the stabilization programme in the 1990s, Croatia was enjoying a period of relatively low inflation rates, accompanied by high unemployment rates. Some authors question whether NAIRU can even be econometrically identifiable in such circumstances and additionally if it could, whether the estimates could have

[2] As a consequence, NAIRU has been estimated for a wide range of coutnries. A non-exhaustive list of examples includes Gianella et. al. (2008), Nishizaki (1997), Szeto and Guy (2004), Wanningeng (1998), Fabiani and Mestre (2000), Rasi and Viikari (1998), Garz (2010), Kadeřábková and Jašová (2011), Hatzinikolaou and Kammas (2010), Gomes and da Silva (2009), Hurnik and Navrátil (2005), Albu (2004), Guichard and Rusticelli (2011).

meaningful interpretation. The main hypothesis of the paper is that by estimating a structural indicator such as NAIRU, policy makers can even in a situation which is not a typical textbook case, gain useful insight into the fundamental changes of Croatian economy.

The paper is organized as follows. The next section summarizes very briefly the main findings in the literature. Section 3 explains the methodological framework for estimation in Croatian case. Section 4 presents the estimation strategy. Section 5 discusses the implications of the results. The last section brings the main conclusions.

2. Literature review

The first mention of the NAIRU in the literature is attributed to Modigliani and Papademos (1975), who define it as that measure of unemployment under which inflation has no tendency to increase or to decrease. The original acronym was NIRU, with the first author using the NAIRU was, according to Espinosa-Vega and Russell (1997) probably Tobin. Since then, the literature on the indicator has become very large, whether concentrated on its theoretical concept, empirical methods of estimation, or the usefulness in conducting economic policy, in particular monetary policy (Ball and Mankiw, 2002; Steiger, Stock and Watson, 1997; Fair, 2000; Bårdsen and Nymoen, 2003; Meyer, Swanson and Wieland, 2001; Stiglitz, 1997).

General NAIRU concept can be defined within a broader macroeconomic model that brings together the interconnections between the nominal and real macroeconomic variables (Layard, Nickell and Jackman, 1991). In their closed economy model setting, wage setting and price setting mechanisms are extremely relevant for understanding the inflation generation process as well as determinants of unemployment rate in the case of labour market imperfections (Pichelmann and Shuh, 1997).

However, NAIRU is most frequently both theoretically and empirically identified within a Phillips curve concept, which is in more general macroeconomic models utilized as an aggregate demand function (Woodford, 2003). However, Phillips curve has become a generic expression for almost any type of relation between the changes in inflation or wages and the level of aggregate demand intensity, which ranges from unemployment rate, output gap to capacity utilization. Thus, it is empirically possible to have various estimates of both Phillips curve and NAIRU for the same economy.

Historically[3], the first attempts to empirically estimate NAIRU were based on the simple OLS estimation of the Phillips curve, and from the related coefficients of the estimated equation, a simple constant was calculated as the ratio between the

[3] See Bozani and Drydakis (2011) for a recent theory-related literature review.

estimated constant and the coefficient of the unemployment variable, which was then named either NAIRU or even the natural rate of unemployment. This approach was confronted with at least two problems. The first is related to the idea that the natural rate of unemployment should be a Walrasian equilibrium concept, i.e. that rate of unemployment that corresponds to all the other markets being in balance (Friedman, 1968). If the estimates are obtained from a single reduced equation, which does not even consider other markets or their equilibrium, then we cannot honestly refer to this number as a natural rate of unemployment. The other is a famous Lucas (1972) critique, which actually argues that if the economic policy changes, then the underlying structural indicators should change as well. Even though this critique was present and influential in the literature, the constant NAIRU estimates lingered in a literature up until Gordon (1997), mostly due to the inability to provide adequate econometric techniques.

The reason for such long period between the theoretical critique and empirical answer is the fact that NAIRU is unobservable variable, which is expected to change according to the changes in the economic policy and the current state of the economy. This is the precisely reason behind coexistence of authors that argue that NAIRU is not a relevant indicator as well as those that claim that it is essential for economic policy makers. The literature is far from reaching consensus on whether NAIRU exists or not (Espinosa-Vega and Russell, 1997), what its precise definition is (Rogerson, 1997) and whether it is useful or not for the economic policy (Franz, 2005; Storm and Naastepad, 2007; Cross and Lang, 2011; Wanningen, 1998). The authors that do agree on the indicator's relevance maintain the work on developing appropriate methods for its estimation (Richardson et al, 2000; Rodenburg, 2007; de la Serve and Lemoine, 2011). Richardson et al (2000) have grouped the methods in:

– Structural methods, which basically imply estimating a structural model of the economy. Although this method would include the most relevant relations in the economy to estimate this unobservable indicator, it would also be most costly in terms of data usage. In addition, in case of Croatia, where statistical database is still underdeveloped, and some important variables are available only for a short time span, estimating a fully fledged macroeconomic model to obtain NAIRU estimates would be too expensive in terms of time and thus not useful for economic policy. However, this method is mostly related to the underlying theoretical concepts and enables the analysis of the effects of various macroeconomic shocks on the variables of interest.

– Statistical methods simply decompose the observed variable (unemployment rate) into cyclical and trend component, with the last one being identified as NAIRU. The rational for using such a simple approach is that if there is no long-run trade-off between inflation and unemployment, unemployment should on average oscillate around NAIRU. The most commonly method used in the literature is the Hodrick-Prescott filter, but there are other options such as

Watson (1986) or Beveridge and Nelson (1981). These methods have been also recently used in case of transition economies, due to the data unavailability issues (for example Camarero, Carrion-i-Silvestre and Tamarit, 2005).

– Reduced equation methods, under which most relevant are those that enable estimation of the time-varying NAIRU. One of the most relevant is Elmeskov method (see Elmeskov and Mac-Farland, 1993), which produces estimates of NAWRU (non-accelerating wage rate of unemployment), an indicator regularly published by Eurostat for EU member states. Another example is structural time series/unobservable components model under which data generation process of the unobservable variable is assumed and its dynamics is fitted into the dynamics of the observable estimates of the economy behaviour. This method is followed in the present paper.

As evident from the literature, NAIRU concept is strongly related to the Phillips curve discussions (Phillips, 1958), the evolution of which has been recently nicely summarized by Gordon (2011). The full discussion on the Phillips curve issue is beyond the scope of this paper. The Croatian Phillips curve estimates can be found in Šergo and Tomčić (2003), Pivac and Grčić (2005), Družić, Mamić and Tica (2006), Aljinović, Pivac and Šego (2009), Basarac (2010). The implications of the literature are not straightforward, neither on the existence of Croatian Phillips curve, its functional form nor the inclusion of shock variables. Therefore, since the NAIRU estimates rely on the Phillips curve framework, we have to emphasize that no strong prior assumptions were introduced in the estimations provided in this paper. Instead, the fairly standard procedure is followed, which has been documented for NAIRU estimation in other countries. The estimates as well as conclusions for Croatia were drawn based on following "let the data speak" approach.

3. Basic concepts and methodology

The main focus of this article is to provide estimates of the Croatian NAIRU. Since this indicator is not frequently assessed for Croatian economy[4], the methodology followed in this paper mostly relies on the mainstream approaches in the literature. The goal is, thus, to provide *basic* NAIRU estimates for Croatia, respecting the key features of Croatian economy. Deviations from the mainstream literature in terms of alternative specifications are left for future research. The theoretical assumptions of the NAIRU are widely discussed in the literature. The methodology applied in the paper is, hence, only briefly presented in this section.

[4] To the best knowledge of the author, this is the first attempt to publish the NAIRU estimates for Croatia.

To estimate the time-varying NAIRU, we rely on the standard ''triangle model'' approach that includes various measures of supply and demand shocks in the specification of the Phillips curve (Gordon, 1997). In such framework, the generic Phillips curve has the following form:

$$p_t = a(L)p_{t-1} + b(L)(U_t - U_t^N) + c(L)z_t + e_t \quad (1)$$

where p_t indicates the rate of inflation, L is the lag operator, U refers to the unemployment rate, and the superscript N is reserved for NAIRU. Lagged values of inflation are included to describe the level of inflation inertia in the economy, but are also interpreted as an adaptive process of inflation expectation mechanism. The difference between the unemployment rate and the NAIRU is assumed to measure the degree of demand pressures on inflation. The degree of supply pressures is included in the specification through the vector of supply side variables (z), which are all normalized to express the supply side shocks. The e has the usual interpretation.

The time-varying NAIRU is assumed to follow an unobserved stochastic process, with the usual pre-specification of its path ranging from autoregressive to random walk or random walk with a drift. In case when the random walk is assumed, the NAIRU is described by a following expression:

$$U_t^N = U_{t-1}^N + \eta_t, \qquad E(\eta_t) = 0, Var(\eta_t) = \sigma_{\eta_t}^2 \quad (2)$$

This model can be estimated by Kalman filter, which is a recursive procedure that enables obtaining the estimates of the model's unobserved components (Chui and Chen, 2009). The method was, among others, applied by Staiger et al (1997), Apel and Jansson (1999), Schumacher (2008), Laubach (2001), Fabiani and Mestre (2004), Richardson et al (2000) to produce NAIRU estimates for a wide set of economies.

The obtained NAIRU estimates are sometimes erratic, since there is a trade-off between the variances of the Phillips curve equation and the NAIRU equation, which is called signal-to-noise ration. For the practical purposes, signal-to-noise ratio is sometimes fixed and if the NAIRU estimates are still highly volatile, they are additionally filtered (by Hodrick-Prescott or similar filters) in order to obtain smoother results. As Gordon (2011) explains, the requirements to smooth the NAIRU can be traced back to the Friedman (1968) NAIRU concept, where the NAIRU should slowly adjust to the underlying microeconomic structural changes in the economy.

4. Empirical strategy for estimating Croatian NAIRU

The model presented in the previous section is estimated using quarterly data for Croatia. The availability of the data was the main reason why the analyzed period is relatively short. Specifically, the period starts with first quarter of 1999 and ends with first quarter of 2011. The dependent variable in the model, rate of inflation is based on the Croatian Bureau of Statistics (CBS) consumer price index. This index was published as of 1998, and although there are methodological similarities with the previously published indices (retail price index and cost of living index), the availability of other supply side variables precluded the extension of the sample period.

The unemployment rate used for the NAIRU estimates is registered unemployment rate, which is throughout the period higher than the ILO methodology comparable labour force survey unemployment rate. In order to calculate the registered unemployment rate, in addition to the number of registered unemployed persons (which is available from the Croatian Employment Service register on monthly frequency), a data on employed persons is required. The CBS publishes data on employed persons (in legal entities, crafts and free lances; individual farmers) since March 1998 on monthly bases. Unemployment rate was thus calculated as the ratio of unemployed to the unemployed and employed persons. Monthly data were then averaged to obtain quarterly frequency.

Ever since the 1970s, the role of inflation expectations has been important for the Phillips curve literature (Gordon, 2011). For this important variable, two approaches have been taken in this paper. The first one was to use the consumer expectation index as published by the Croatian National Bank (CNB). Even though this indicator is not strictly related to inflation, the assumption was that it would be able to capture the consumer's sentiments, which should also theoretically encompass the inflation expectations. Unfortunately, the attempts to include this indicator in the present estimates resulted either in no convergence or in extremely erratic movements and/or insignificant variables. Therefore, an alternative approach was finally taken for the below presented estimates. Lagged values of inflation were included in the estimation equation, specifically up to 4 lags which amounts to one-year inflation persistence effect. This approach assumes adaptive expectation formations. Since the sample refers to relatively stable inflation period, this assumption was deemed reliable enough.

In order to estimate the NAIRU for Croatia, a selection of shock variables was included in the initial specification, which are frequently also used for NAIRU estimates in other countries. All shock variables were expressed as deviations from their sample means (Fitzenberger, Franz, Bode, 2008). Following variables were considered[5]:

[5] In the literature, there is a wider selection of the shock variables. The choice of the variables used in this paper is based mostly on the data availability for Croatian economy.

– productivity (real GDP per employment growth), calculated from the original data published by the CBS (Schreiber and Wolters, 2007; Fitzenberger, Franz and Bode, 2008);

– real effective exchange rate (producer price deflated and consumer price deflated), aggregated to the quarterly frequency based on CNB published monthly data (Schreiber and Wolters, 2007; Gordon, 1997);

– tax wedge and tax wedge growth (average net wage to average gross wage ratio), calculated from the CBS monthly published data (Franz, 2005);

– terms of trade (exports to imports deflator ratio) calculated from the national accounts quarterly GDP estimates, as published by the CBS (Gordon, 1997 uses relative price of imports);

– oil prices changes (Brent crude oil 1-month Forward – fob (free on board) per barrel, historical close, average of observations through period), available through the European Central Bank Statistical Data Warehouse (Schreiber and Wolters, 2007; Batini and Greenslade, 2005).

In addition, since Croatia is a high unemployment country, with presumably high structural unemployment indicated by a large share of long-term unemployment, the additional variable was included to attempt to capture the hysteresis effect. Specifically, difference in unemployment rates between the two successive periods, and lagged difference in unemployment were considered (see also Pichelmann and Schuh, 1997). The initial assumption was that in cases of relatively high unemployment, only additional unemployment could be considered as significant enough to create inflationary pressures.

All the variables were pretested for the presence of unit root. First the ADF test was applied, and in those cases where ADF indicated a presence of unit root, the KPSS test was also applied to confirm that the series is I(1).

While all the variables were tested, the important result is that inflation series is I(1), while the unemployment rate was not conclusively I(1). Even if the statistical properties imply that unemployment rate is unit root, this might be questionable, since it is bounded variable. The best compromise between the statistical properties and the definition of the variable could be that unemployment rate has some unit root properties within the analyzed sample. The presence of unit root in both inflation and unemployment rate has important consequences for the empirical exercise and the interpretations of the existence of the long-run Phillips curve. That is why the adequate statistical procedure was carefully followed, even though we had some uncertainties regarding the unemployment rate actual behaviour. The relationship between inflation and unemployment rate variables was tested for the presence of cointegration. Since the Johansen test was not able to identify any cointegrating

relationship, it could be concluded that the there is no long-run Phillips curve in Croatia, but that there might be some short-term relationship and there is a rational for short-run NAIRU estimation (see, for example, Franz, 2005).

The final specification required determining the inclusion of relevant supply side shocks. The general to specific approach resulted in the estimation which included only oil prices changes as the significant variable. Thereby, the final specification that entered the Kalman filter observation equation was following:

$$d(CPI) = \sum_{i=1}^{4} \alpha_i d(CPI(-i)) + \beta(u - u^*) + \gamma oilp + \delta dummy + \varepsilon \qquad (3)$$

The state vector transition equation is described by equation (2). It has to be noticed that other possible specifications for the transition equations have been assumed as well, but did not reach convergence in such short sample. Same has been reported by Botrić (2005), where although different specification had been used for the Phillips curve, the random walk hypothesis for the NAIRU also remained the only one reaching convergence.

The dummy variable that was included in the specification relates to the crises effect. The timing of the effect is accordingly to Krznar (2011). The rational behind inclusion of this variable is the following. Since the estimates rely on a relatively short sample, and recent crises is assumed to have some effect on the underlying fundamentals of the economy, the potential shift in the fundamentals is captured by the dummy variable. Even though this is relatively simple method, it was deemed necessary. There are many possible reasons why there might be a shift in NAIRU, and in times of overall economic uncertainty, the precise answer to the causes of the shift are not easily recognisable. Thus, future extensions of NAIRU estimates in Croatia should probably encompass this issue in a more elaborate way, preferably within a comprehensive macroeconomic model. But, until the causes and consequences of the latest global economic crises are thoroughly revealed, this task is beyond the scope of NAIRU estimating exercises.

The state vector was initialized with the previous NAIRU estimates for Croatia (Botrić, 2005), where the average value was 11.9 for the 1994-2003 period. The signal to noise ratio[6] was preset to 0.16 (see Batini and Greenslade, 2006). No additional smoothing has been performed to the NAIRU estimates presented and discussed in the following section.

[6] As Boone (2000) reports, the standard values range between 0.1 and 0.5. The author has thereby varied the signal to noise ratio accordingly, but the final results were deemed the most appropriate in case of 0.16 ratio.

5. NAIRU estimates and discussion

The specification described in the previous section resulted with the converging estimates. The results of the Phillips curve estimation, i.e. equation (3), with the Kalman filter method are presented in Table 1.

Table 1: Kalman filter Phillips curve estimates, dependent variable d(cpi), 1999q1-2011q1

Variable	Estimated coefficient (standard error)
D(cpi(-1))	-0.03 (0.12)
D(cpi(-2))	0.05 (0.12)
D(cpi(-3))	0.12 (0.13)
D(cpi(-4))	-0.37*** (0.13)
Oil prices	0.01*** (0.00)
Unemployment rate – NAIRU	-0.00 (0.01)
Dummy	-0.08 (0.09)
Diagnostics	
N = 49	Iterations number: 1
Log likelihood: -3.54	

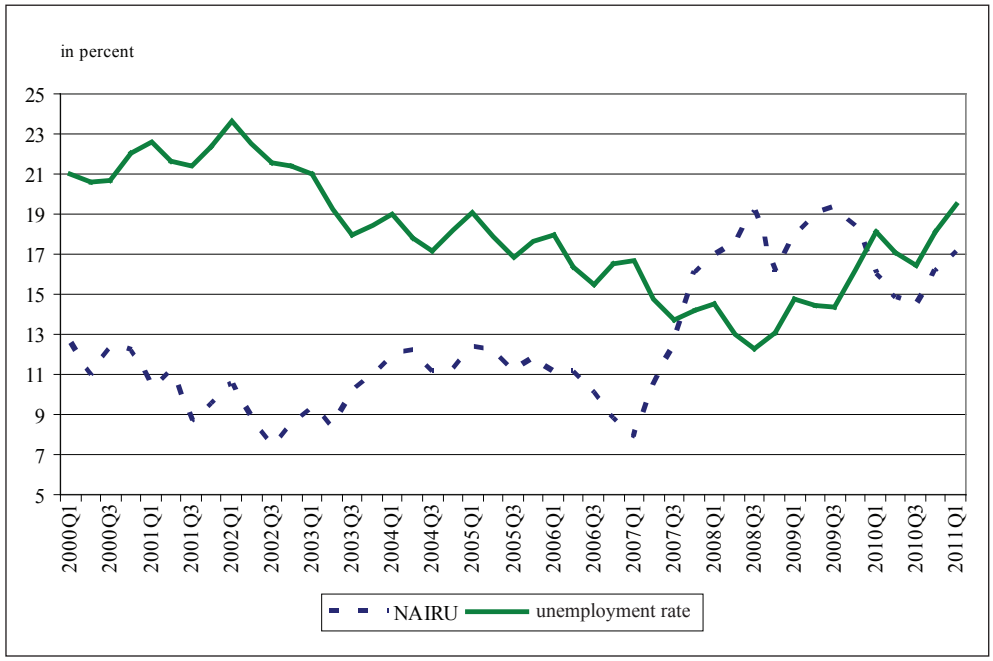
Notes: Standard errors in parenthesis. *** denotes significance at 1 percent, ** significance at 5 percent and * significance at 1 percent

Source: Author's estimates

Since the focus of the paper is not on the Phillips curve hypothesis, we will only briefly comment that the estimated coefficients are of the expected sign. Unemployment gap is insignificant, while the deviations of the oil prices from the sample mean are significant. Judging from these, it might seem that the cost-push factors are more important in Croatian inflation generation process than the demand-pull factors. Since some of the introduced dependent variable lags were also significant, it can be concluded that a certain degree of inflation persistence is also present.

Relatively more interesting than the coefficients themselves are the NAIRU values, which are obtained through Kalman filter estimates based on equation (2). These are presented in the following graph.

Figure 1: NAIRU and unemployment rate in Croatia, 2000q1-2011q1



Source: Author's estimates

The first thing to notice is that Kalman filter estimates of the NAIRU for Croatia do not follow the dynamics of the unemployment rate. Since alternative NAIRU estimates in the literature (those using one-side filters, like HP filter) usually strongly follow the underlying series path, it might be concluded that there is additional information that can be obtain from utilizing Kalman filter methodology. The dynamics also reveals that the movements of the estimated NAIRU are relatively smooth, which implies that the signal-to-noise ratio was relatively good specified.

Furthermore, the interesting thing is that the approaching of the latest global financial crises has been picked-up by the NAIRU indicator, even if it has been estimated on a relatively short sample of data. Average estimate of the NAIRU for the whole sample is 12.6, which is not far from the estimate obtained by Botrić (2005) using relatively different dataset and Phillips curve specification. Since the registered unemployment rate has been relatively high throughout the sample period, and certainly higher than the estimated NAIRU, it could be concluded that there were no significant inflation

pressures in Croatia[7]. Although the Croatian literature focuses more on inflation generation process, the evidence from the data the authors used in their analysis reveals that Croatia has enjoyed a period of low inflation, similar to many other economies (Nadoveza and Šimurina, 2010, Malešević Perović, 2009, Vizek and Broz, 2009, Nestić, 2008).

The period in which the estimated NAIRU-unemployment gap suggested existing inflationary pressures in Croatia follows closely the documented inflationary pressures in the CBS published data on consumer price index. Actually, the inflation rate started to speed up at the end of 2007 and increased even further at the beginning of 2008. In the second half of 2008, a gradual decrease in the inflation rate was recorded. Thus, the relevance of the estimated NAIRU for inflationary pressures detecting has also been confirmed.

Turning focus on the start of the crises period, it can be noted that actually NAIRU indicator started rising well before the official signs of the crises spreading to Croatia were declared, and even before the economy turning points reported by Krznar (2011). Indeed, estimated NAIRU was higher than unemployment rate as soon as 4th quarter 2007. When one keeps in mind that NAIRU falls into the category of indicators that point to the structural misbalances in the economy, than the sharp rise in such an indicator could have been taken as a warning.

At the beginning of 2010, the registered unemployment rate eventually caught-up the estimated NAIRU, as the crises effect spilled-over through the Croatian economy and contributed to the open unemployment. It can be noticed that the average estimated NAIRU for the "crisis period", for which we will consider period since 2008q3, amounted to 17.1, which is significantly higher than the previous periods. For the last few observations, it seems that the inflation pressures have eased somewhat. However, the NAIRU remains in the vicinity of the registered unemployment rate and seems to be following its dynamics closely. Therefore, it remains still to be seen whether the structural issues have been fully resolved or another round of pressures will hit Croatian economy.

Even though we have analyzed a relatively short period, we were able to pick some crucial segments of the macroeconomic changes with our estimated NAIRU for Croatia. It has to be noticed, however, that Madsen (2005) cautions away from the simple utilization of the "NAIRU rule" in conducting economic policy. He argues that there are still many inconsistencies in its definition and methods of estimation to be able to simply follow the ratio between the unemployment rate and NAIRU as the main policy guideline. This line of argument is certainly not without importance; in particular in Croatian case where there are no prior regular estimates to rely on. Therefore, extensive

[7] Botrić (2005) did identify one episode in June 2000, but using monthly data and retail price index. Since present paper uses quarterly data, this episode has been probably averaged out of the sample.

policy recommendations will not be drawn here based on the presented results. We will, however, emphasize that obtaining additional information on the state of the economy with more structural indicators should be beneficial to policy makers.

6. Conclusions

The main contribution to the existing literature is empirical one, since the paper provides first ever published estimates of the Croatian time-varying NAIRU. The average NAIRU estimated for the period 2000q1-2011q1 using the Kalman filter methodology amounted to 12.6 percent. The estimated NAIRU dynamics reveals its potential for economic policy utilization, by clearly identifying the inflationary pressure periods in Croatian economy. Furthermore, it might even point to the increasing structural imbalances prior to other, "official", indicators of economic downturn that hit Croatia in the aftermath of the global economic crises. Based on the presented estimates for the relatively short period that includes the recent crises, it seems that estimated NAIRU is able to point to the structural changes that Croatian economy recently experienced. Thus, we conclude that the initial hypothesis is confirmed and that regular evaluation of this indicator could be potentially beneficial to the policy makers in Croatia.

When interpreting the results, caution is required. Special notice should be given to the fact that due to the lack of data the period of the analysis is relatively short. Even key statistical indicators are constantly under methodological revisions, in particular in transition countries such as Croatia. Furthermore, although we are analyzing more advanced period of transition in Croatia, some underlying economic processes might still experience more dramatic changes than in established market economies. Thus, economic turmoil in combination with the statistical uncertainty raises additional concern regarding the stability of the estimated econometric relationships.

The potential benefits for policy indicated in the present paper should serve as an incentive for future research on the topic. Few possible extensions of the current research could be considered. First, different specification of the Phillips curve (including wage Phillips curve), more elaborate structure of the model (including Okun law in the specification) and considering segmentation of the labour market (the issue of the long-term unemployment). Second, a comprehensive study of the effects of the global economic crises on the underlying microeconomic structure of the Croatian economy properly accounted for in the modelling exercise. The inclusion of these effects depends on the availability of the methodology consistent data sources for longer time periods.

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Procjene hrvatskog NAIRU-a

Valerija Botrić[1]

Sažetak

Osnovni cilj ovog rada je procijeniti NAIRU za hrvatsko gospodarstvo, te razmotriti implikacije procijenjenog pokazatelja. U radu su prikazane procjene NAIRU-a u razdoblju od prvog tromjesečja 2000. godine do prvog tromjesečja 2011., koje su dobivene metodom Kalmanovog filtera. Rezultati pokazuju da je prosječna vrijednost NAIRU-a u analiziranom razdoblju 12.6 posto, što je ispod prosječne registrirane stope nezaposlenosti. Analiza kretanja procijenjenog NAIRU-a ukazuje na mogućnost da se pomoću tog pokazatelja identificira prisutnost strukturnih neravnoteža unutar gospodarstva. Konkretno, identificirano je razdoblje približavanja krize, kao i prisutnost inflacijskih pritisaka, čime je potvrđena potencijalna korisnost ovog pokazatelja za nositelje ekonomske politike i u Hrvatskoj.

Ključne riječi: *NAIRU, Kalmanov filter, Hrvatska*

JEL klasifikacija: *C22, E24, E31*

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