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A MODEL FOR ESTIMATION OF NAIRU EXTENDED BY DEMAND SHOCKS AND ITS APPLICATION TO BUSINESS CYCLE ANALYSIS IN THE LABOUR MARKET IN HUNGARY AND POLAND

Abstract:

Article seeks to extend the Standard Gordon's " Triangle " model with demand shocks. The demand shocks are represented by a newly derived Current discount indicator (CDI). The recession on the labour market in Hungary and Poland was influenced by the growth of future consumption preferences of consumers. Negative gaps of unemployment increased during the recession only in Hungary. Short period subsequent boom in Hungary is linked with excessive pessimism of consumers what reduced unemployment positive gap and shortened the period with positive gape. In Poland the negative vision of future development in the economy resulted in shortening the period of boom. Policymakers should create more positive expectations and prevent to transfer negative emotions on the labour market.

Keywords:

Unemployment gap, psychological factor, Kalman Filter, Phillips Curve, NAIRU

JEL Classification: E24, E32, E37

1. Introduction

According to **L. Stock and K. Vogler-Ludwig** (2010), macroeconomic theory and economic policy deal with the categories of economic growth, inflation and unemployment rate. To better understand relations among these phenomena, we resort to concepts of Phillips Curve (PC), Non-Accelerating Inflation Rate of Unemployment (NAIRU), Okun's Law and other Textbook instruments.

The nowadays concept of substitution between inflation and unemployment is a result of a long development, to which Phillips' predecessors have contributed (Law, Thornton, Attwood, Mill, Fischer, Tinbergen, Klein and Goldberger, Brown and Sultan; **T. M. Humphrey September/October 1985**), as well as his followers (**A. P. Samuelson and M. R. Solow 1960, S. E. Phelps 1967, M. Friedman 1968, F. Modigliani and L. Papademos 1975 and J. Tobin 1997**). The founder of the modern version of the PC is according to T.M. Humphrey **A.W. Phillips** (1958).

L. Boone (2000) considers NAIRU an "equilibrium" or "expected" value of the variables of concern which is to be estimated by means of corresponding methods. These methods yield different values, though, which are to be regarded as a certain interval of the possible NAIRU values, not as a precise value (**P. Richardson et al. 2000**).

Since the process of estimating NAIRU is accompanied by a whole range of uncertainties, many authors attach to it only little applicability in the process of practical policy-making (**Á. Estrada et al. 2000**). **P. Mc Adam and K. Mc Morrow** (1999) only see the usage of NAIRU in the field of theory. However, the mentioned authors point out a great importance of the NAIRU concept for labour-market flexibility comparisons among countries, for national labour-market malfunctions assessment and for structural-reform considering in particular countries in particular periods.

The main aim of this analysis is extension by demand shocks of "Gordon's Triangle" model of inflation estimation amended by S. Sekhon. The demand shocks are being defined in terms of consumer's subjective discount rate. To estimate the gap of unemployment was applied the Kalman Filter method with an amended smoothing coefficient which fits better unstable environment of the chosen countries from the Visegrad Group (V4). Next, we compare the business cycle effects on the labour market, acquired by means of a model without demands shocks, to the estimated values yielded by the model which incorporates these shocks. Analysing the effects of demand shocks to the business cycle five possible scenarios have been

postulated. A considerable attention is paid to the period of financial-economic-debt depression and the period following. Part of the analysis is a set of appeals and recommendations to the policy-makers.

In the second section, we set forth a model extended by demand shocks, we are dividing the methods of estimating NAIRU into three groups and we choose one of them which we adjust by better fitting coefficient of smoothing. In the third section, we use the theory of the subjective discount rate to define the demand shock. The fourth section focuses on the Counting of effects and the Definition of Scenarios of the Demand Shock implications for the Business Cycle on the Labour Market. The fifth section analyses the impact of the demand shock to the economic cycle from the perspective of the labour market in Hungary and Poland. The resume of demand-shock-labour-market analysis for the chosen V4 countries along with appeals and recommendations to the policy-makers are content of the sixth section.

2. Standard Model and Method for Estimating NAIRU Extended by the Demand Shocks

P. McAdam a K. McMorrow (1999) consider the expectation-amended PC the most frequently used methods of estimating NAIRU. Computation of the equilibrium rate of unemployment or the steady-state rate of unemployment (i. e. constant inflation rate) is supposed to be estimation of NAIRU according to the mentioned concept. As a result, NAIRU finds itself at such a level, then, at which the relation between the unemployment gap and the unexpected inflation is stable. The most frequently applied estimating concept, according to the authors mentioned, is Gordon's "Triangle" model. This model is based on the unemployment level consistent with stable expectations (expectation-amended PC).

According to **J. R. Gordon** (August 1996), the inflation rate is explained by means inflation expectations and by the demand conditions expressed in terms of the unemployment gap and the supply shocks. For sake of making the estimation of the output gap (or, the unemployment gap) more precise, we extend this Triangle model (**J. S. Sekhon 1999**) by the effect of primary demand shocks. The input variables of this extended model are four indicators: unemployment, inflation, supply shocks and demand shocks. The model keeps on being based on the unemployment level consistent with stable expectations, i. e. it is based on the expectation-amended PC.
The shape of the newly formed Quadrate model of inflation is as follows:

$$\pi_t - \pi_t^e = \beta(u_t - \bar{u}_t) + \partial X_t + \varepsilon Y_t + \nu_t, \qquad (1)$$

where π_t is the estimate of the actual inflation rate, π_t^e is the expected inflation rate, u_t is the unemployment rate, $\bar{u}_t$ is the NAIRU, X_t are the regressors controlling supply shocks (such as petroleum, import prices and exchange rates), Y_t is the new variable representing the regressors controlling demand shocks (in case of this article it is CDI) and ν_t is error term.

Since NAIRU is not perceptible directly, it has to be estimated by means of econometric models, which can be categorized into three groups (**P. Richardson et al. 2000**): structural methods, purely statistical methods and the so called "reduced-form approach" methods. In this article is used model of the Kalman filter - approach from "reduced-form group" (the Overview of Parameters, P-Values and Chosen Characteristics of Models is in Appendices - Tab. 1 and Tab. 2) whit which we obtain the NAIRU variable in time (**B. Kadeřábková and E. Jašová 2012**). Smoothing factor of unobservable variables will be applied in the amount of 0.6, which is higher than widely used coefficient 0.2 (**J. Beneš and P. J. N'Diaye 2004**). We used it because of interception of the development in transition economies and in the cyclical turbulence.

3. Defining the Demand Shock

To define the demand shock, by which the standard model was extended, was used the relation between the households' current and future consumption. **J. Rotschedl and E. Jašová** (2014) infer the current discount indicator (CDI), which bases on the assumption of the households' relation between their current and future consumption, basically from: "If the amount of credits increases faster than the amount of deposits, the subjective discount rate value is greater than the interest rate (the CDI is positive). If the credit growth rate is equal to the deposit growth rate, then the subjective discount rate is equal to the interest rate (the CDI is zero). The last option left is the credit level growing slower to the deposits, which results in the subjective discount rate being lower than the interest rate (the CDI is negative)." The CDI can be formalized as follows:

$$\mathrm{CDI} = \left(\frac{\alpha_t}{\alpha_{t-1}} - 1\right) * 100\,, \quad [\mathrm{CDI}] = \%, \qquad (2)$$

where CDI is the current discount indicator, αt is the ratio of state variables: credit level to deposit level in the time "t", αt-1 is the ratio of state variables: credit level to deposit level in the time "t-1".

To compute the time series of CDI in this paper, data of ECB have been used (in EUR). Credits are equalized with the indicator “Loans, Total, Outstanding amounts at the end of the period, Households and non-profit institutions serving households“ and the households’ deposits are identified with “Deposit liabilities, Total, Outstanding amounts at the end of the period, Households and non-profit institutions serving households“.

Authors regard CDI as an aggregate indicator which is based not only on the well-known and frequently used subjective discount rate **(ρ)** but also on the elasticity of inter-period substitution of consumption **(θ)** and other soft factors. So, CDI stands for psychological factors on the consumers’ demand side (further on referred to as demand shocks).

4. Counting of effects and the Definitions of Scenarios of the Demand Shock implications for the Business Cycle on the Labour Market

In order to calculate the effects of the demand shock on the business cycle in the labour market, we compared the values of unemployment gaps in the model without CDI with those in the model with CDI. At the same time the unemployment gap is obtained when we subtracted the estimated value of NAIRU from real unemployment rate.

Analysing the relation between the demand shock and the labour market has been postulated several scenarios which describe the link between the inter-period time perception by the consumer (which is presented by CDI here) and the unemployment rate’s development. The Number of Scenario with additional information is in Appendices (Tab. 3). We obtained two categories of unemployment: the structural unemployment (neglecting the frictional unemployment in this paper, we may identify the former with the NAIRU) and the cyclical unemployment.

The first scenario assumes the invariant character of CDI between two years which implies the consumer’s attitude to the present and the future being unchanged, the unemployment rate increasing between two years or staying at the level of the previous year, the NAIRU decreasing between two years and the cyclical unemployment prevailing in the economy.

According to **the second scenario**, CDI exhibits an inter-period increase which implies consumers’ rising preference for the current consumption relatively to the

future consumption, in other words, the consumers are more willing to indebt themselves (optimistic expectations of the future ability to pay off the debt) and the unemployment rate and NAIRU exhibit an inter-period decrease.

The third scenario assumes the inter-period decrease of CDI which means consumers' rising preference for the future consumption relatively to the current consumption, the consumers are less willing to borrow, they rather create additional reserves (pessimistic expectations for the future ability to pay off the debt or objective inability to increase the level of indebtedness). As far as the inter-period rise in the unemployment rate and in NAIRU is the case, we talk about the structural unemployment being prevailing.

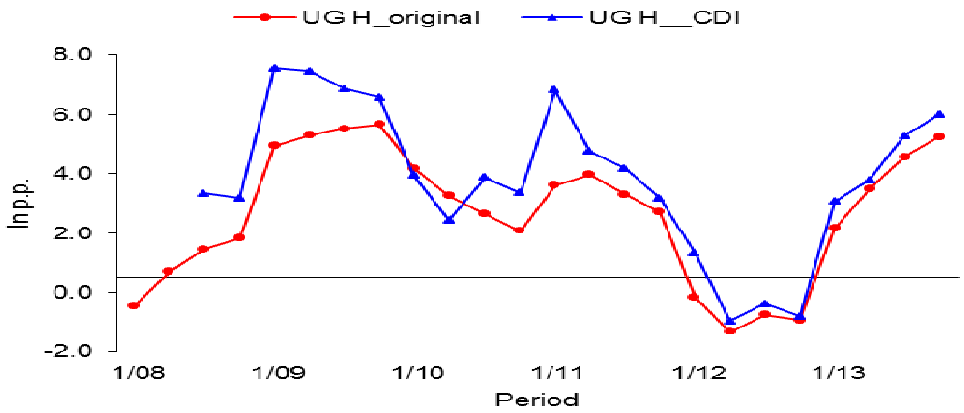
The fourth scenario presents the so called first extreme case, i. e. a case of inadequate optimism, accompanied by an inter-period rise in CDI. The consumers' preference for the current consumption increases, they take more credits (they believe in a better future), even though the unemployment rate rises between two years. The inter-period decrease in NAIRU indicates the cyclical unemployment being prevailing and the inter-period rise in NAIRU implies the structural unemployment being present in the economy.

The fifth scenario describes the so called second extreme case, i. e. a case of inadequate pessimism. CDI is decreasing between two years, the consumers grow to prefer saving inadequately (they don't believe in a better future) and the unemployment rate between two years decreases, paradoxically, and NAIRU exhibits the inter-period decrease, too.

5. Analysis of the impact of the demand shock to the economic cycle from the perspective of the labor market in Hungary and Poland

In this section we analyze the period of the structural changes in the economy and the labor market. Specifically, we select period financial-economic-debt recession and the immediately following period. An Overview of the Basic Indicators and Scenario for Particular Periods for the Hungary and Poland is in Appendices (Tab. 4).

Figure 1 - The Unemployment Gap Development According to the Standard Model and After Its Extension by the Demand Shock in Hungary



Source: Author's Own Computation Based on the OECD Data.

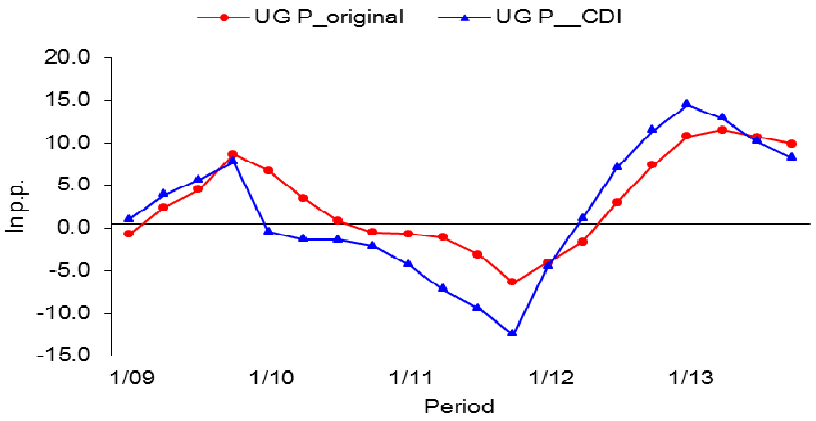
In Hungary (Figure 1), the effect of the depression on the unemployment gap was being reflected from the 2nd quarter of 2008 on and it was present until the 4th quarter of 2011. The unemployment rate in this time span increased by 0,9 p. p. on average and GDP was decreasing by 0,9 per cent annually. CDI decreased in this time span by 4,6 p. p. annually and the consumption of households decreased by 2,7 per cent annually. In this time span, the scenario no. 3 was the case (i. e. the consumers' preference for the future consumption rises and they are not willing to increase their indebtedness, the unemployment rate went up). The pessimism of the consumers became evident in the labour market in a form of increase in the negative unemployment gaps in the model extended by the demand shocks by 1,4 p. p. Except for that, the length of the depression got risen by 1 quarter, as compare with the original model.

There were positive gaps clearly visible in the labour market throughout 2012 and a moderate expansion appeared. The unemployment rate was decreasing by 0,1 p. p. annually on average, CDI decreased by 11,6 p. p. and the households' consumption decreased by 1,6 per cent annually. In case of a positive proof of the NAIRU estimation, scenario no. 5 was revealed, i. e. the so called second extreme case - a case of inadequate pessimism (the consumers grow to prefer saving excessively, the unemployment rate decreases annually). The negative view of the future was reflected by positive gaps having increased by 0,5 p. p. after inserting the demand shocks into the model. Another symptom of a decreased intensity of the

expansion was also the shortening of the length of this stage by 1 quarter, as compare with the original model.

In 2013, depression came back to the labour market. The unemployment rate decreased annually by 0,5 p. p. CDI rose by 11,2 p. p. and the households' consumption went up by 0,5 per cent. Scenario no. 2 characterizes this time span (the consumers prefer the current consumption more, relatively to the future, and they are more willing to get indebted, the unemployment rate decrease annually). More optimistic view of the future trends in the labour market has not been reflected in the size of the unemployment gaps after the extension of the model by the demand shocks, yet. As a matter of fact, the gap in the original model has increased by 0,6 p. p.

Figure 2 - The Unemployment Gap Development According to the Standard Model and After Its Extension by the Demand Shock in Poland



Source: Author's Own Computation Based on the OECD Data.

In **Poland** (Figure 2), in the time span from the 2nd quarter 2009 to the 3rd quarter 2010, there was a recession prevailing in the labour market. The unemployment rate in this time span rose by 1,3 p. p. on average. CDI exhibited an annual decrease by 8,1 p. p., the households' consumption increased by 2,4 per cent annually which would, in case of real disposable income's annual increase by less than 3,5 per cent, imply inconsistency in both indicators' development. Scenario no. 3 was indicated (consumers' preference for the future consumption rises, relatively to the current consumption, and their willingness to increase their indebtedness stagnates, the unemployment rate goes up). The pessimistic view of the future did not become evident in the labour market because negative unemployment gaps in the model extended by demand shocks have decreased by 2,1 p. p. as compared to the

original model. Except for that, the length of the recession got shortened by 3 quarters.

The labour market switched to the stage of boom in the time span between the 4th quarter 2010 and the 2nd quarter 2012. The unemployment rate was still rising annually by 0,3 p. p. and GDP grew up by 3,8 per cent. CDI fell down by 0,5 p. p. and the consumption of households went up by 2,5 per cent annually. However, down to the detected annual growth of the disposable income (by 0,5 per cent), there is no necessary decrease in the value of evidence of the conclusions regarding the development of the demand shock. In case of the variant with CDI, we detected scenario no. 3 (the consumers increase the preference for the future consumption, relatively to the current consumption, and the unemployment rate increases). The pessimistic view of the future has not become evident in the labour market because, after the insertion of the demand shock into the model, the positive unemployment gap increased even further by 3,1 p. p. On the other hand, the time span of boom got shortened by 1 quarter.

The labour market found itself in recession in the final period again (the time span between the 3rd quarter 2012 and the 4th quarter 2013). The unemployment rate grew up by 0,5 p. p. annually and CDI registered the annual decrease by 2,6 p. p. and the households' consumption rose by 0,6 per cent which would reduce the value of evidence of the conclusion about this time span if it were not for the annual increase of the real disposable income by 0,1 per cent. In this time range, scenario no. 3 was detected (the consumers increase their preference for the future consumption and the unemployment rate increases). This negative behaviour increased the negative unemployment gaps by 1,8 p. p. in comparison to the original model. Apart from that, the period of recession got longer by 1 quarter. Both moments are fully compatible with the conclusions about the effect of the pessimistic expectations of the consumers on the labour market.

6. The Summary of the Theoretical and Empirical Conclusions, Appeals and Recommendations to the Policy-Makers

1) This paper extended by demand shocks Gordon's Triangle model for estimating inflation as amended by S. Sekhon. The demand shocks are inserted into the model in terms of the current discount indicator (CDI) which captures the attitude of households to their future and current consumption. This extended model keeps on

being based on the unemployment rate consistent with stable expectations, i. e. it is based on the expectation-amended PC.

2) The effect of the demand shock on the business cycle has been detected by means of a comparison of the values of unemployment gaps in the model without CDI with those in the model with CDI. The variable estimation of NAIRU has been done by application of Kalman Filter. This method reflects the development in small open economies, i. e. in the environment of permanent economic and societal changes. Along this line, a more intensive smoothing of the estimated NAIRU is applied (0,6) which captured the changes in the trend development of transitive economies and economies during periods of instability.

3) Analysing the relation between the demand shock and the labour market 5 possible scenarios are put forward which assess the relations between the perception of the presence and the future by the consumers (presented by CDI) and the development of the aggregate rate of unemployment.

4) The Hungarian and Polish recessions are both attributed to the increase in the consumers' preference for the future consumption accompanied by the annual growth of the unemployment rate (i. e. scenario no. 3). However, a pessimistic view of the future on the side of consumers became evident in a form of an adequate increase in the negative unemployment gaps and in a form of prolonging the recession period only in Hungary. The successive period of expansion in Hungary is being explained by an inadequate pessimism of consumers (i. e. scenario no. 5) which increases the preferences for saving relatively to consuming even when the unemployment rate decreases annually. This pessimism about the future was reflected in the labour market by a significant reduction in the positive unemployment gap after the insertion of the demand shock and by shortening of the time span with a positive gap. The Polish consumer increases the preference for the future consumption relatively to the current consumption along with the annual growth of the unemployment rate (i. e. scenario no. 3). The pessimistic view of the future has not become evident in a form of the estimated value of the unemployment gap, the length of the period of boom has been affected, as a result.

5) Economic policy should primarily focus on supporting the transfer of positive expectations in the labour market and on neutralizing the negative emotions.

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8. Appendix

Tab. 1: The Overview of Parameters, P-Values and Chosen Characteristics of Models for Estimating NAIRU without the Current Discount Indicator (CDI)

Name of A Method	Model's Parameter			Chosen Characteristics of A Model	
	Name	Value	P-Value	R-squared	Durbin-Watson Stat.
Hungary					
	Constant	1,41	0,30		
	Unemployment Rate (t-11)	-0,27	0,09		
	Consumption Deflator (t-1)	0,29	0,01		
	Characteristics of a Model			0,50	2,08
Poland					
	Constant	0.14	0.9		
	Unemployment Rate (t)	-0,24	0,00		
	Oil Price (t)	0,02	0,01		
	Characteristics of a Model			0.81	1.53

Source: Author's Own Computation Based on the OECD Data.

Tab. 2: The Overview of Parameters, P-Values and Chosen Characteristics of Models for Estimating NAIRU after the Insertion of the Current Discount Indicator (CDI)

Method's Name	Model's Parameter			Chosen Characteristics of A Model	
	Name	Value	P-Value	R-squared	Durbin-Watson Stat.
Hungary					
	Constant	0.37	0.65		
	Unemployment Rate(t-8)	-0,31	0,10		
	Consumption Deflator (t-1)	0,23	0,10		
	Import Prices (t)	0,50	0,00		
	Current Discount Indicator CDI (t-8)	0,07	0,10		
	Characteristics of A Model			0.86	2,00
Poland					
	Constant	0,54	0.55		
	Unemployment Rate (t-7)	-0,25	0.62		
	Current Discount Indicator CDI (t-5)	0.03	0.26		
	Characteristics of a Model			0.98	2.03

Source: Author's Own Computation Based on the OECD Data.

Tab. 3: Number of Periods with Verification and a Proven Influence of the Demand Shock (number of analysed periods)

Member Country V4	Scenario No.	Number of Period with Verification		Number of Periods with a Proven Influence of the Demand Shock	
		NAIRU Analysis	Business Cycle Analysis	NAIRU Analysis	Business Cycle Analysis
Hungary					
	1	0	0	0	0
	2	1	1	1	0
	3	1	1	1	1
	4	1	0	1	0
	5	0	0	0	0
Poland					
	1	0	1	0	1
	2	0	0	0	0
	3	2	3	1	1
	4	1	0	0	0
	5	0	0	0	0

Source: Author's Own Computation Based on the OECD Data.

Tab. 4: An Overview of the Basic Indicators and Scenario Nos. for Particular Periods for the Chosen V4 Countries

Member Country V4	Number of Periods Detected	Indikátory								Scenario No.
		NAIRU/GAP original in per cents	NAIRU/GAP with CDI in per cents	NAIRU/GAP with CDR in per cents	CDI in per cents	CDR in per cents	Unemployment Rate in per cents	Households' Consumption in per cents	Real Disposable Income in per cents	
Hungary										
Part NAIRU										
	1/2007-2/2010	7.7	4.7	6.5	11.1	19.4	8.9	-2.4	-2.9	3
	3/2010-1/2011	8.5	6.6	6.5	9.1	15.3	11.3	-1.5	-0.5	4
	2/2011-4/2012	9.8	9.2	9.2	-7.9	-0.6	10.8	-0.5	-1.4	-
	1/2013-4/2013	6.5	5.9	5.9	2.5	-2.7	10.4	0.5	-	2
Part GAP										
	2/2008-4/2011	3.4	4.8	4.7	5.9	13.5	10.2	-2.7	-1.3	3
	2012	-0.8	-0.2	-0.1	-12.2	-4.2	10.9	-1.6	-4.6	-
	2013	3.9	4.5	4.5	-1	3.5	10.4	0.5	-	2
Poland										
Part NAIRU										
	2010	7	10.9	11.3	1.1	5	9.6	3.1	2.2	3
	1/2011-2/2011	10.3	15.1	15.6	2.4	6.7	9.4	3.2	0.4	-
	3/2011-2/2013	10.7	11.1	11.4	-2.8	2.1	10	1.1	0.1	3
	3/2013-4/2013	0.2	1.3	1.6	-3	-0.4	10.5	1.2	0.3	4
Part GAP										
	2/2009-3/2010	4.5	2.4	2.5	3.4	7.5	8.9	3.4	7.5	3
	4/2010-2/2012	-2.5	-5.6	-6	0.8	5.4	9.7	0.8	5.4	3 a 1
	3/2012-4/2013	8.9	10.7	10.5	-5.4	-1.8	10.4	-5.4	-1.8	3

Source: Author's Own Computation Based on the OECD Data.