Session Number: 8A
Session Title: Topics in National and Historical Accounting and Productivity Comparisons
Paper Number: 7
Session Organizer: Edward Wolff, New York University, New York, USA

Paper Prepared for the 28th General Conference of
The International Association for Research in Income and Wealth
Cork, Ireland, August 22 – 28, 2004

DOUBLE CONDITIONED POTENTIAL OUTPUT

EMILIAN DOBRESCU*

* Professor, Senior Researcher, Romanian Academy

Abstract

The central argument of this paper is that both – internal and external – equilibria should be taken into account in the estimation of potential output. If only the data on inflation, unemployment rate, and wages are used for its evaluation, no certainty exists that such a level will correspond to a stable foreign trade balance.

Our attempt is based on the following methodological assumptions:
- the potential output is concomitantly associated with a constant inflation and sustainable relative foreign trade balance (ratio of net export to gross domestic product);
- all supply shocks affect this level, potential output being, therefore, a variable indicator;
- consequently, the output gap reflects exclusively the demand pressure.

The proposed computational algorithm is based on the use of orthogonal regressions. It is exemplified on seasonally adjusted quarterly statistical series of variables charaterizing the Romanian transition economy; this application shows that the estimated output gap does contain significant regular and irregular cyclical components.

Key words: Potential Output, Output Gap, Orthogonal Regression, Cycle.

JEL: C 22, E 23, E 32.

I. Introduction

The current literature reveals some reasonable controversies around the concept of "potential output". On one hand, this is an "invisible" indicator, which may not be unequivocally estimated. Several computational algorithms were proposed, each of them generating different results, sometimes even contradictory ones. On the other hand, the question cannot be simply avoided or ignored. The analysts and especially the policy-makers need to know, with a reasonable approximation, what is a desirable level of the real GDP, in the proximity of which a given economy does not register major disequilibria and is developing in a predictable manner.

The volume of studies regarding this matter is already sizeable and it continues to rise. While the present paper does not aim at evaluating extensively this literature, I will emphasize some issues which are, in my opinion, particularly important for our approach below.

1. The first one concerns the observed indicators to which the potential output is related. Inflation is, by far, the most frequently considered variable, either in theoretical researches, or in empirical analyses (including the building of macro-models).

The "Phillips Curve"-"Okun's Law" combination was for a long time , the main accepted paradigm (Galli, G., D.Terlizzese, I. Visco, Elmeskov and Pichelmann; Fair 1994; Karbuz; Mankiw 1995; Kawasaki; de Bondt, van Els and Stokman; Frisch; Kichian; Akerlof, Dickens and Perry; Schorderet; Abel and Bernanke; Proietti, Mussoy and Westermanny; Gerlach and Yiu; Ögünç and Ece).

NAIRU investigations have considerably extended this line of research (Layard, Nickell and Jackman; Staiger, Stock and Watson 1996 and 2001; Allen, Hall and J.Nixon; Holden; Whelan; Stiglitz; Blanchard and Katz; Gordon 1997 and 1999; Duarte and Andrade; Black and Fitzroy; Chaney; Stockhammer; Herz and Röger; Bårdsen and Nymoen; Nymoen).

The NAWRU version has focused on the correspondence between the output gap and wages as a main component of the production costs as well as of inflation (Elmeskov; Elmeskov and MacFarlan; Ball; Holden; Duarte and Andrade; Johansen; Nymoen). The AWSU approach has explored the same connection using the share of wages in added value (Gordon 1996, Holden and Nymoen).

In conclusion, until now, the relationship between potential output and inflation has had priority. This is undoubtedly one of the most relevant expressions of the global economic environment. Nevertheless, it focuses primarily on the internal dimension of the issue.

The foreign trade balance is also a very important symptom of the state of an economy, reflecting the external side of equilibrium. This problem had not been completely disregarded in the literature, but it was discussed chiefly on the premises that the price index and the current trade balance are linked together by a stable clearing mechanism, which induces an univocal correlation between them (Layard, Nickell and Jackman; Holden). Obviously, domestic inflation and foreign trade balance interact on several levels through exchange rates, wages, import prices, other production costs, which are all factors of economic competitiveness. But this interdependence is mediated by the institutional framework, by the shifting behaviours of firms and households, by the changing macroeconomic policies, and by the unstable international environment. Consequently, we do not have enough reasons to believe that a constant (even low) inflation is typically associated ~~to~~ with a medium-to-long run sustainable net export. On the contrary, a lot of historical examples show that variable or steady price indices combine – during a representative period - with quite different configurations of the foreign trade balance (deficit, surplus, near zero). In this field, there are many influencing factors, whose analysis goes beyond the scope of the present research.

I have only considered and stressed these circumstances as fundamental facts. Therefore, we cannot ascertain unequivocally that a potential output derived from data on inflation, unemployment rate and wages, will correspond to a stable foreign trade balance (or, for that matter, to a zero net export). This paper attempts to include explicitly, not only the movement of domestic prices, but also the evolution of net export in the determination of potential output. In other words, both – internal and external – equilibria will be simultaneously involved in the estimation of the discussed indicator.

Consequently, the potential output is the output level associated with:

- constant inflation and
- constant relative foreign trade balance, represented by the ratio of net export to gross domestic product.

To outline both these two features we will further call this a **double conditioned potential output**.

2. The temporal stability of the potential output is another essential question. The theory and practical applications evolved towards a flexible interpretation. If initially only the long-run definition of potential output was considered, (according to the natural growth rate), subsequently, its medium and short-run levels definition have been investigated; (for example, as a weighted average of the long-run and previous statistical levels (Holden) or, lately, as the soft concept of *time-varying NAIRU* (Gordon 1999). Due to this evolution, the concept became more amenable to empirical research, but, at the same time, the distinction between the potential output and the actual GDP was blurred

2.1. In fact, the question to ask should be: "how does the potential output react to both demand and supply shocks?"

a) On the supply-side, according to the traditional expectations-augmented Phillips curve, inflation depends on its past level, on deviation of the output from its own natural rate (inflationary gap), and on supply shocks (Mankiw). This refers to the short-run supply shocks, because the long-run ones intrinsically affect the equilibrium of the economic growth. But, there are many changes with permanent effects that gradually penetrate into economy (Kichian). In other words, there is a big class of long-run shocks, which consist of step by step accumulated short-run shocks. The difficulty to unambiguously distinguish the short and long term supply-shocks is aggravated by the hysterezis phenomenon, which is often present in the labour market (Elmeskov and MacFarlan; Krugman; Bellmann; Blanchard and Pedru; Calmfors; Karamé; Betcherman; Gordon 2003). As a result, it seems realistic to accept that the potential output incorporates all supply shocks - positive or negative – irrespective of:

- their temporal influences (on short or long term),
- spatial sources (internal or from abroad), and
- nature of their impulses (technological developments, variation in quality of human capital, modification of market environment, changes in institutional framework, and so on).

In this interpretation, the potential output is clearly changing value, not only in the long-run, but in the medium and short term horizons as well. Therefore, it is related to Gordon's time-varying NAIRU.

b) Unlike supply shocks, the demand ones act preponderantly on short-run. There are, of course, shifts in preferences which could profoundly influence the structure of demand. Nevertheless, such modifications become observable only during extended periods, in any case longer than the possible duration of a given level of the potential output. This assumption would need a more detailed examination, but, for the time being, it will be adopted as such. Thus, we will consider that demand shocks affect only real output, the potential output remaining neutral to this type of changes. In other words, the difference between actual and potential outputs reflects exclusively a demand pressure. Such a statement could appear as an extreme simplification. However, it eliminates the uncertainties implied by the inclusion of supply-shocks~~,~~ among inflation determinants, separately from the output gap. In the author's opinion, the concept becomes thus more consistent with its original paradigm.

2.2. The dependence of potential output on supply-shocks not only in the medium-to-long run, but in the short-run as well, has a key methodological implication. No matter how it is built, the computational algorithm must explicitely include either parameters that are stable during the period considered representative for a given potential output, or include more flexible parameters.

Under these circumstances, another question becomes noteworthy. Is there any difference between potential and actual outputs, from their variability point of view? It seems plausible to state that the potential output is less volatile than the actual one, at least by the strength of the fact that the last one is conditioned not only by the supply shocks, but by the demand ones, too. Thus, the usual hypothesis stating that the potential output stays constant during two successive intervals (especially when these are relatively short) cannot be rejected. It will be also adopted in the scheme described below.

3. During the last decades the literature on the estimation methods of potential output has been very rich. Two approaches are dominant:

- the first one is global, in that potential output is determined as an aggregate indicator, on the basis of series of actual gross domestic product (as such or in combination with other variables);
- the second one is structural, emphasising the main factors determining potential output and using a wide variety of production functions.

3.1. The global estimation has evolved tremendously , from a simple specification, towards more and more sophisticated algorithms (Beveridge and Nelson; Nelson and C.Plosser; Watson; Stock and Watson; King and Rebelo; Harvey and Jaeger; Kuttner; Baxter and King; Cogley and Nason; Mankiw; Conway and Hunt; Gerlach and Smets; de Brouwer; Driver, Greenslade and Pierse; Duarte and Andrade; Gerlach and Yiu; Guarda; Domenech and Gomez; Logeay and Tober; Rennison). They also employed various methods, such as: linear time trends, unvariate and multivariate filters, unobserved components models.

The great advantage of these methods consists in the possibility of approximating the potential output directly from statistically defined indicators, to which it is related. Using only these methods, we can generally define the projections by extrapolating the identified characteristics of the past series. As a result, there are serious difficulties to integrate the globally estimated potential output into larger predictive macromodels.

3.2. As a solution to this drawback of global (empirical) models, the structural approach emerged as the obvious alternative. It is centred on the neo-classical production function models (Kawasaki; Ekstedt and Westberg; Zaman 2001 and 2002; Denis Mc Morrow and Rõger; Rõõm; Proietti, Mussoy and Westermanny). Without any doubt, such an approach is closer to micro-foundations and, moreover, may generate – under adequate investment and labour force relationships – more reliable forecast. However, it is not imune to other drawbacks:.

a) Irrespective of the difficulty in compiling a consistent time series representing capital itself, there is an even more problematic issue of estimating a rate of capacity utilization consistent with an unobservable indicator such as potential output. For this reason, most models containing production functions do not include such a rate.

b) Natural (normal) employment (or unemployment) also cannot be directly approximated using available data. This explains why the methodologies based on production functions define it on the basis of global (empirical) estimates (most of all NAIRU or NAWRU). Sometimes, the elasticity of output with respect to the labour input is determined imposing its equivalence with the share of wages in added value, which is a questinable solution.

3.3. A mixed approach is also possible. It integrates the core relationship, which derives from a global (empirical) estimation into a system, containing not only a production function, but domestic absorption, export and import, and other macroeconomic determinants.

3.4. Ther are also some notable attempts at comparing different procedures using equations of inflation that include – apart from the output gap - some supply shock variables:

- changes in the relative price of imports, in the relative price of food and energy, and in the real exchange rate (Gordon 1997);
- unit labor costs and import prices adjusted for tariffs (de Brouwer);
- real oil prices and real import prices (Driver, Greenslade and Pierse).

Rennison used also Monte Carlo techniques to evaluate alternative output gap estimators.

4. Concluding this introductory section, the central methodological assumptions of the present study are the following:

- the potential output is interpreted as double conditioned, which means the equilibrium level of potential GDP corespondes to both a constant inflation and a sustainable net export;
- all supply shocks affect this level, potential output being, therefore, variable;
- output gap reflects exclusively the demand pressure.

II. Computational algorithm

1. The global (empirical) estimation of potential output starts with the definition of the two above-mentioned conditions: the price index equation and the relative foreign trade balance equation.

The inflation is determined as follows:

$$P=P(-1)*(Y/Y_p)^{\beta} \qquad [1]$$

where P are prices, Y – actual output at constant prices, Y_p – potential output expressed in the same prices as actual one, all variables expressed in indices (of course, with the same temporal reference). According to the theory, the coefficient β is positive due to straightforward reasons detailed in Appendix I.
Using the logarithms (small letters), the relationship [1] becomes

$$\Delta p=\beta*(y-y_p) \qquad [1a]$$

The second condition may be represented as follows:

$$n_x=a+\gamma*(y-y_p) \qquad [1b]$$

in which n_x is the ratio of net export to GDP. Generally speaking, γ is negative: domestic demand pressure resulting in a positive output gap stimulates imports and, subsequently, induces a deterioration of the foreign trade balance. Nevertheless, if the economic growth is based on improving productive competitiveness and/or on a pro-export active policy, a positive correlation between Y (or $(y-y_p)$) and n_x is likely to exist, at least temporarily.

The constant term in [1b] can be interpreted as being the level of a relative foreign trade balance (possible under given international circumstances, including capital markets) around which the economy tends to stabilise in the given period.

Obviously, $Y=Y_p$, $P=P(-1)$, $n_x=a$, and $\Delta p=0$ describe the steady state, corresponding to the mentioned characteristics of the double conditioned potential output.

Normally, these features could be formalised in other, more sophisticated, ways. I would prefer the simplest expressiom, and not only for computational reasons. In such a straightforward format, the weaknesses (or eventual advantages) of the approach proposed here may be easier to identify.

2. The stochastic expressions of the relationships [1a] and [1b] are:

$$\Delta p=\beta*(y-y_p)+\varepsilon_p \qquad [2a]$$
$$n_x=a+\gamma*(y-y_p)+\varepsilon_n \qquad [2b]$$

It is assumed that both, ε_p and ε_n, are “white noise”.

From [2a] and [2b], we can derive two estimations for the potential output. One of them observes price restriction (y_{pp}) and the other one corresponds to the foreign trade balance condition (y_{pn}).

$$y_{pp}=y-\Delta p/\beta+\varepsilon_p/\beta \qquad [3a]$$
$$y_{pn}=a/\gamma+y-n_x/\gamma+\varepsilon_n/\gamma \qquad [3b]$$

If the potential output simultaneously presumes constant inflation and stable relative foreign trade balance, then [3a] and [3b] have to be equal ($y_{pp}=y_{pn}=y_p$), which means:

$$a/\gamma+\Delta p/\beta-n_x/\gamma+\varepsilon=0 \qquad [4]$$

where $\varepsilon=(\varepsilon_n/\gamma-\varepsilon_p/\beta)$, again a “white noise”.

Two regression-pairs are thus possible:

$$\Delta p=a_1+b_1*n_x+\varepsilon_1 \qquad [4a1]$$

$$a_1=A\Delta p-b_1*An_x \qquad [4a2]$$

in which a_1=-$a*\beta/\gamma$, $b_1=\beta/\gamma$, $\varepsilon_1=-\varepsilon*\beta$, and corresponding averages $A\Delta p$ and An_x, or

$$n_x=a_2+b_2*\Delta p+\varepsilon_2 \qquad [4b1]$$
$$a_2=An_x-b_2*A\Delta p \qquad [4b2]$$

in which $a_2=a$, $b_2=\gamma/\beta$, and $\varepsilon_2=\varepsilon*\gamma$, and An_x and $A\Delta p$ with the same significance.

As can easily be shown, the separate regressions [4a1] and [4b1] are not reversible, except in the trivial case when the coefficient of correlation between Δp and n_x is equal to unity.

The problem becomes more complex when we cannot establish a reliable causal relationship between the given variables. In other words, when we do not know what coefficient, b_1 or b_2, should be used to estimate β and γ.

3. Such reversibility means that the relationships [4a1] and [4b1] have to be valid at the same time with [4a2] and [4b2].

Setting the error terms aside, we have:

$$\begin{aligned}
&\Delta p=a_1+b_1*n_x=a_1+b_1*(a_2+b_2*\Delta p)=a_1+b_1*a_2+b_1*b_2*\Delta p=\\
&=A\Delta p-b_1*An_x+b_1*(An_x-b_2*A\Delta p)+b_1*b_2*\Delta p=\\
&=A\Delta p-b_1*An_x+b_1*An_x-b_1*b_2*A\Delta p+b_1*b_2*\Delta p=\\
&=A\Delta p-b_1*b_2*A\Delta p+b_1*b_2*\Delta p=A\Delta p+b_1*b_2*(\Delta p-A\Delta p) \qquad [5]
\end{aligned}$$

Therefore,

$$\Delta p-A\Delta p=b_1*b_2*(\Delta p-A\Delta p) \qquad [5a]$$

and

$$b_1*b_2=1 \qquad [5b]$$

The orthogonal regression observes this condition [Malinvaud, Dissanaike and Wang, Saman]. In its classical form, the coefficients b_1 and b_2 are determined as follows:

$$b_1=\{(\sigma_p^2-\sigma_n^2)+[(\sigma_p^2-\sigma_n^2)^2+4*\sigma_{pn}^2]^\wedge(1/2)\}/(2*\sigma_{pn}) \qquad [6a]$$
$$b_2=\{(\sigma_n^2-\sigma_p^2)+[(\sigma_n^2-\sigma_p^2)^2+4*\sigma_{pn}^2]^\wedge(1/2)\}/(2*\sigma_{pn}) \qquad [6b]$$

where σ_p^2 is the variance of Δp, σ_n^2 – the variance of n_x, and σ_{pn} represents their covariance.

Substituting

$A=(\sigma_p^2-\sigma_n^2)$ and $B=[(\sigma_p^2-\sigma_n^2)^2+4*\sigma_{pn}^2]^\wedge(1/2)$ which is equivalent also to $[(\sigma_n^2-\sigma_p^2)^2+4*\sigma_{pn}^2]^\wedge(1/2)$, we have

$$\begin{aligned}
&b_1*b_2=[(A+B)/(2*\sigma_{pn})]*[(-A+B)/(2*\sigma_{pn})]=\\
&\quad=[(B+A)*(B-A)]/(2*\sigma_{pn})^2=(B^2-A^2)/(2*\sigma_{pn})^2 \qquad [7a]
\end{aligned}$$

which means

$$b_1*b_2=[(\sigma_p^2-\sigma_n^2)^2+4*\sigma_{pn}^2-(\sigma_p^2-\sigma_n^2)^2]/(2*\sigma_{pn})^2=(4*\sigma_{pn}^2)/(4*\sigma_{pn}^2)=1 \qquad [7b]$$

I do not consider here the problems associated to the classical form of orthogonal regressions and the possibilities to improve it [Dissanaike and Wang]. At this point, only its property to generate reversible econometric coefficients is of interest to us.

4. We go back now to the initial parameters a, β and γ. Summing [3a] and [3b], and maintaining the assumption about their equality ($y_{pp}=y_{pn}=y_p$), we get the following formula for y_p:

$$2*y_p=2*y-\Delta p/\beta+a/\gamma-n_x/\gamma+(\varepsilon_p/\beta+\varepsilon_m/\gamma)=2*y-\Delta p/\beta+(a-n_x)/\gamma+(\varepsilon_p/\beta+\varepsilon_m/\gamma) \quad [8]$$

Including $\beta=b_1*\gamma$, potential output is approximated by

$$y_p=y+(a-\Delta p/b_1-n_x)/(2*\gamma)+\varepsilon \quad [8a]$$

The first order difference Δy_p will be determined:

$$\begin{aligned}\Delta y_p&=y_p-y_p(-1)=y+(a-\Delta p/b_1-n_x)/(2*\gamma)+\varepsilon-y(-1)-(a-\Delta p(-1)/b_1-n_x(-1))/(2*\gamma)-\varepsilon(-1)=\\&=y-y(-1)-[(\Delta p-\Delta p(-1))/b_1+n_x-n_x(-1)]/(2*\gamma)+(\varepsilon-\varepsilon(-1))=\\&=\Delta y-(\Delta^2p/b_1+\Delta n_x)/(2*\gamma)+\Delta\varepsilon \quad [9]\end{aligned}$$

where Δ^2 is the second order difference operator.

Theoretically, it would be difficult to reject the conjecture that potential output should be less volatile than the actual one. According to the usual methodologies,

$$\Delta y_p=\Delta y-(\Delta^2p/b_1+\Delta n_x)/(2*\gamma)=0 \quad [10]$$

the coefficient γ is derived from (10) as:

$$\gamma=(\Delta^2p*b_1+\Delta n_x)/(2*\Delta y) \quad [10a]$$

and β is given by:

$$\beta=b_1*\gamma \text{ or } \beta=\gamma/b_2 \quad [10b]$$

Therefore, both γ and β are variable, reflecting changeable factors which influence the level of potential output. Unlike these, the parameters a and b correspond to its relatively stable determinants.

The series of potential output can thus be approximated using the relationship [8a]:

$$y_p\approx y+[(a-\Delta p/b_1-n_x)/2]/\gamma \quad [8b]$$

The main characteristic of this determination is its organic connection not only with inflation, but with foreign trade balance, too.

III. An Empirical Application (Romanian Case)

Some of the standard procedures for the determination of potential output were already applied to the Romanian transition economy [Croitoru, Doltu, and Tarhoaca; Bucsa;

Ghizdeanu and Neagu; Stanica; Albu 2004 with refference to the natural unemployment rate]. The algorithm, described in the previous chapter, will be further exemplified.

1. We have used quarterly data for the gross domestic product (at current and constant prices), net export (at current prices), and the consumer price index (more relevant for the present application than the GDP deflator). All variables are seasonally adjusted. The primary and derived indicators are presented in Appendices II and III.

2. The orthogonal regression (Appendix IV) generates the relationships:

$$\Delta p=-0.59218-10.1032*n_x$$

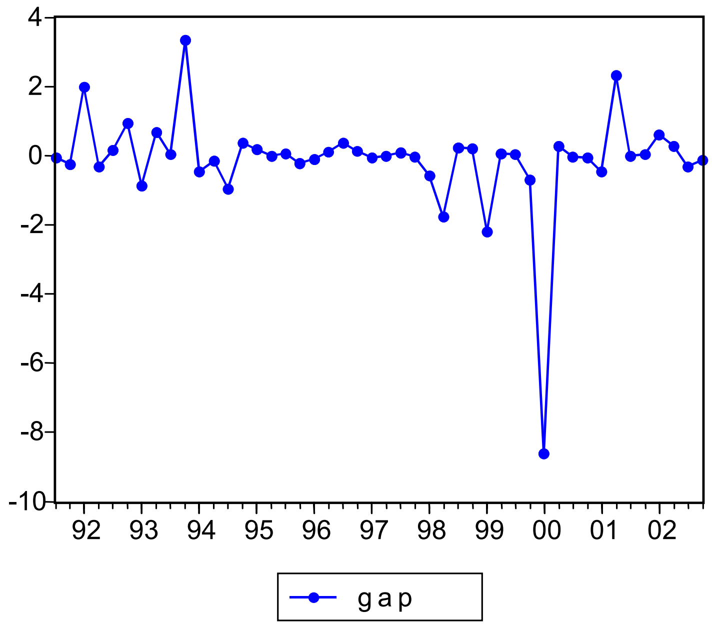
and

$$n_x=-0.05861-0.09898*\Delta p$$

perfectly reversible [-10.1032*(-0.09898)=1].

Using the equations (10a) and (8b), the indices of potential output (Y_p) have been determined and, on this basis, the corresponding output gap (Appendix V). The results are presented in the Graph gap below.

Graph gap

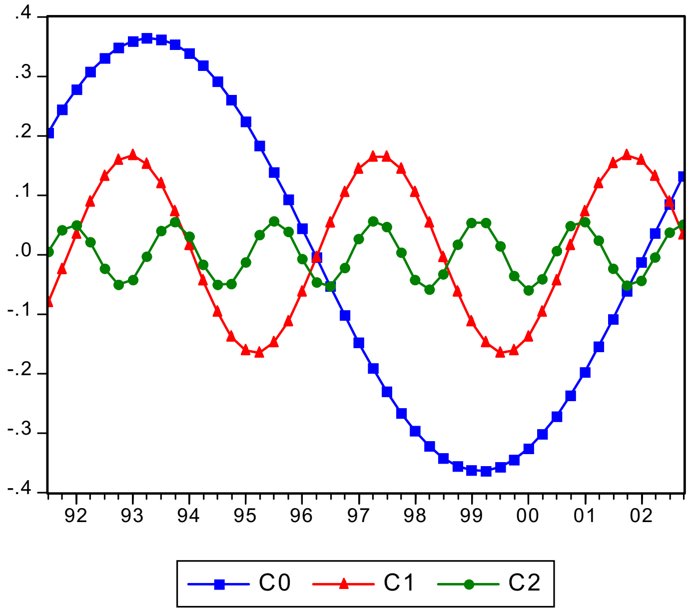


The sign of the gap clearly alternates, which is consistent with the rationale of ~~the~~ potential output.

3. In order to identify the possible determinants of these fluctuations, a cycle analysis has been performed. The gap series was divided into cyclical part (C0) and residuals (ResC0). The last series (ResC0) was then submitted to the same procedure, obtaining C1 and ResC1. This decomposition has been successively applied until the amplitude of the cycle became zero (C11 in our case). Appendix VI contains all computational details.

3.1. The series C0, C1, and C2 may be characterised as regular cycles.

Grapf C012



a) We have no reasons to consider C0 – with a period of 11-11.5 years – as a classical long business cycle. In my opinion, it derives from specific transitional determinants. Its first segment (1991-1996) is characterised by positive output gaps, reflecting, probably, the "resistance" of the Romanian economy to restructuring processes involved by implementation of functional market mechanisms. The incoherence of macroeconomic and institutional policies promoted during the period 1997-1999 has pushed the output gap towards significant negative levels. A certain recovery is then observed, but a new demand preassure wave becomes visible. The causes of such an evolution are complex and their examination exceeds the intended framework of the present work.

b) I think C1– with a period of 4-4.5 years – represents a typical electoral cycle. After 1989 the Romanian data covers full election cycles - 1992-1996 and 1996-2000 – and one incomplete (2000-2003); they are characterised mainly by the variation of the nominal income policy. If this variation is expressed through the global indexation coefficient (ratio of annual index of current nominal GDP to previous annual CPI), we can identify, at least for this period (Dobrescu), the following pattern: for two consecutive years the coefficient's value is above unity, after which, again for two consecutive years, it is below unity. From this point of view, we find that - apart from the elections year itself, one year before and one year after the elections - the second year after elections is the one that is least influenced by this major political event and, consequently, it can be conventionally named a "non-electoral" year. The arithmetic averages (ELC) of the global indexation coefficient were computed for the corresponding years of electoral cycles. Their values were compared to the evolution of the output gap in C1.

Table no. 1

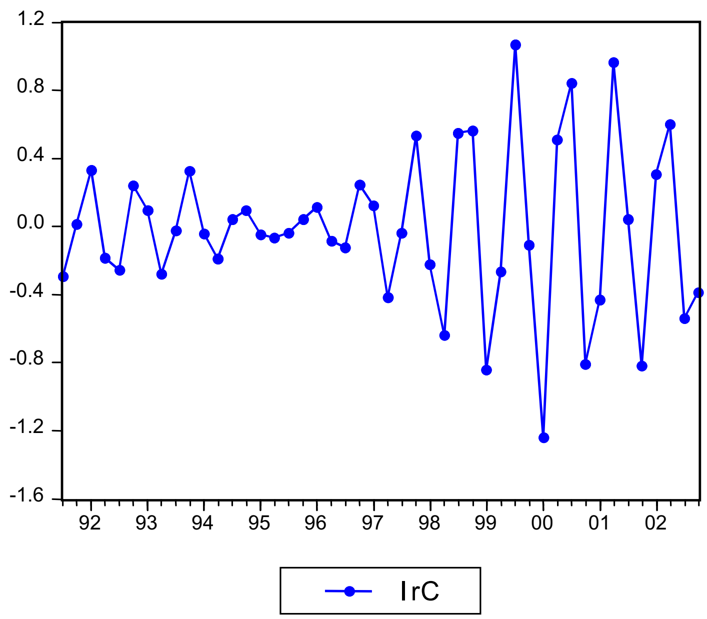
Position in electoral cycle	Years	ELC	Output gap in C1
Elections year	1992, 1996, and 2000	1.053196	Positive, increasing or passing from negative to positive
Post-electoral year	1993, 1997, and 2001	1.244457	Unambiguously positive
Non-electoral year	1994, 1998, and 2002	0.750399	Passing from positive to negative or positive but decreasing
Pre-election year	1995, 1999, and 2003	0.838702	Unambiguously negative

The output gap seems to be consistent with the demand preassure induced by nominal income policies.

c) As a regular cycle, C2 has a length of 1.8 years (approximately 7 quarters). Its amplitude is rather small. An attempt to explain such a cycle would be highly speculative at this point. This issue calls for additional research. The influence of this type of cycles is relatively weak.

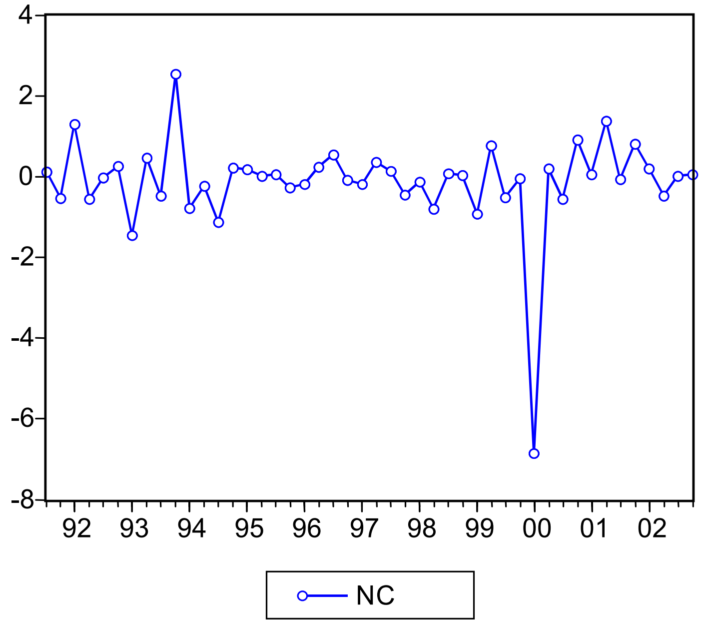
3.2. The cycles C3-C10 can be considered irregular (Appendix VII). Summing their effects, we have constructed an aggregate irregular (Graph IrC).

Graph IrC



3.3. We have also identified an important non-cyclical component is present, too (Graph NC).

Graph NC



4. The output gap and its main components have variable algebraic signs. We have, therefore, normalised the absolute values to compute the shares in the structure of the output gap (Appendix VIII). The computations have yielded the following shares: 0.22293 for C0, 0.117961 for C1, 0.038352 for C2, 0.273448 for IrC, and 0.34731 for NC.

Bucharest, April 2004

Appendix I

Inflationary Pressure of the Output Gap

Symbols:
Y – Output, constant prices
L – Employment, persons
K – Kapital, constant prices
MLP – Marginal labour productivity, constant prices
W – Wage on employed person, current prices
P – Level of current prices
GOS – Gross operating surplus
swy – Share of wages in value added (output)
ex - Expectations

Relationships:

[A1] $Y=A*L^{\alpha}*K^{1-\alpha}$

$0<\alpha<1$

[A2] $MLP=\partial Y/\partial L=\alpha*A*L^{\alpha-1}*K^{1-\alpha}$

[A3] $GOS=P^{ex}*Y-W^{ex}*L=P^{ex}*A*L^{\alpha}*K^{1-\alpha}-W^{ex}*L$

[A4] $\partial GOS/\partial L=\alpha*P^{ex}*A*L^{\alpha-1}*K^{1-\alpha}-W^{ex}$

[A5] $\partial^2 GOS/\partial L^2=(\alpha-1)*\alpha*P^{ex}*A*L^{\alpha-2}*K^{1-\alpha}$

From $0<\alpha<1$ yields $\partial^2 GOS/\partial L^2<0$; consequently, GOS admits a maximum.

[A6] MaxGOS results from $\partial GOS/\partial L=0$

$\alpha*P^{ex}*A*L^{\alpha-1}*K^{1-\alpha}-W^{ex}=0$

$\alpha*A*L^{\alpha-1}*K^{1-\alpha}=W^{ex}/P^{ex}$

Therefore, the condition for profit maximisation is

$W^{ex}/P^{ex}=MLP$

[A7] At equilibrium (indicated by subscript p)

[A7.1] Share of wages in value added (output)

$swy_p=W^{ex}*L/(P^{ex}*Y)=L*(MLP/Y)=$

$=L*\alpha*A*L^{\alpha-1}*K^{1-\alpha}/(A*L^{\alpha}*K^{1-\alpha})=$

$=\alpha*A*L^{\alpha}*K^{1-\alpha}/(A*L^{\alpha}*K^{1-\alpha})=\alpha$

[A7.2] Employment

$\alpha*A*K^{1-\alpha}*P^{ex}/W^{ex}=L_p^{(1-\alpha)}$

$L_p=[\alpha*A*K^{1-\alpha}*P^{ex}/W^{ex}]^{1/(1-\alpha)}$

[A7.3] Output

$Y_p=A*L_p^{\alpha}*K^{1-\alpha}=A*[\alpha*A*K^{1-\alpha}*P^{ex}/W^{ex}]^{\alpha/(1-\alpha)}*K^{1-\alpha}=$

$=A*[\alpha*A*K^{1-\alpha}]^{\alpha/(1-\alpha)}*K^{1-\alpha}*[P^{ex}/W^{ex}]^{\alpha/(1-\alpha)}=B*[P^{ex}/W^{ex}]^{\eta}$

where $B=A*[\alpha*A*K^{1-\alpha}]^{\alpha/(1-\alpha)}*K^{1-\alpha}$ and $\eta=\alpha/(1-\alpha)$; both B and η are given.

Consequently, $Y>Y_p$ (with increasing wages) will accelerate inflation. The opposite is true for $Y<Y_p$. The coefficient β must, therefore, be positive.

References

Abel, A.B. and B.S. Bernanke (2001): “Macroeconomics”, Fourth Edition, Addison Wesley.

Akerlof, G.A., W.T. Dickens, and G.L. Perry (2000): “Near-Rational Wage and Price Setting and the Long-Run Phillips Curve”, Brookings Papers on Economic Activity, 1.

Albu L.L. (1997): “Strain and Inflation-Unemployment Relationship in Transitional Economies: A Theoretical and Empirical Investigation”, CEES Working Papers, December, University of Leicester, Centre for European Economic Studies, Leicester.

Albu L.L. (2004): “Dinamica ratei naturale a şomajului în perioada tranziției”, Oeconomica, IRLI, 1, pp.123-139.

Allen, C. and S. Hall (1997): “Macroeconomic Modelling in a Changing World”, John Wiley and Sons; C. Allen and J. Nixon: “Two Concepts of the NAIRU”.

Ball, L. (1996): “Disinflation and the NAIRU”, NBER Working Paper 5520.

Bårdsen, G. and R. Nymoen (2003): “Testing Steady-State Implications for the NAIRU”, Working Paper Series No. 16/2002, Department of Economics, N-7491 Trondheim, Norway, [www.svt.ntnu.no/iso/wp/wp.htm].

Baxter, M. and R.G. King (1995): “Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series”, NBER, Working Paper 5022.

Bellmann, L. (1996): “Wage Differentiation and Long-Term Unemployment- An International Comparison”, IAB Labour Market Research Topics 19.

Betcherman, G. (2000): “Structural Unemployment: How Important Are Labour Market Policies and Institutions?”, Canadian Public Policy – Analyse de Politiques, Vol. XXVI Supplement/Numero Special 1.

Beveridge, S. and C.R. Nelson (1981): “A New Approach to Decomposition of Economic Time Series into Permanent and Transitory Components with Particular Attention to Measurement of the Business Cycle”, Journal of Monetary Economics, 7(2), pp. 151-174.

Black, A.J. and F.R. Fitzroy (2000): “Earnings Curves and Wage Curves”, Working Paper 00-7 Department of Accountancy & Finance, University of Aberdeen, Scotland.

Blanchard, O. and P. Pedru (1998): “What Hides Behind an Unemployment Rate: Comparing Portuguese and US Unemployment”, Working Paper 6636, NBER.

Blanchard, O.J. and L. Katz (1999): “Wage Dynamics: Reconciling Theory and Evidence”, NBER Working Paper Series 6924, National Bureau of Economic Research, or The American Economic Review, 89, May, pp. 69-74.

Blanchflower D. and A. Oswald (1995): “An Introduction to the Wage Curve", Journal of Economic Perspectives, 9:3, pp. 153-167.

Bondt de, G.J., P.J.A. van Els and A.C.J. Stokman (1997): “EUROMON, A Macreoeconometric Multi-Country Model for the EU”, De Nederlandsche Bank NV [http://www.unibw-hamburg.de/WWEB/math/uebe/zuhause.engl.html].

Bryan, M. F. and Cecchetti, S. G. (1994), “Measuring Core Inflation”, in N. G. Mankiw, ed., Monetary Policy. University of Chicago Press.

Bucsa, D. (2002): “Output Gap Estimation Using Unobserved Component Models”, Dissertation Paper, Supervisor - PhD. Professor M. Alter, The Academy of Economic Studies Bucharest, Doctoral School of Finance and Banking.

Calmfors, L. (1998): “Monetary Union and Precautionary Labour-Market Reform”, Seminar Paoer No.659, Institute for International Economic Studies, Stockholm University.

Clark, P.K. (1987): “The Cyclical Component of U. S. Economic Activity”, Quarterly Journal of Economics, 102(4), pp. 797-814.

Claus, I. (2000): “Estimating Potential Output: A Structural VAR Approach”, Reserve Bank of New Zealand Discussion Paper 00/3.

Clements, M.P. and D.F. Hendry (1998): “Forecasting Economic Time Series”, Cambridge University Press.

Cochrane, J.H. (1994): “Permanent and Transitory Components of GNP and Stock Prices”, Quarterly Journal of Economics, 109(1), pp. 421-465.

Cogley, T. and J. Nason (1995): “Effects of the Hodrick-Prescott Filter on Trend and Difference Stationary Time Series”, Journal of Economic Dynamics and Control ,19, pp. 253-78.

Cogdon, P. (2001): “Bayesian Statistical Modelling”, Wiley Series in Probability and Statistics, John Wiley and Sons Ltd.

Conway, P. and B. Hunt (1997): “Estimating Potential Output: A Semi-Structural Approach”, Reserve Bank of New Zealand, Discussion Paper No. G97/9.

Croitoru, L., C. Doltu and C. Tarhoaca (2001): “Gap-ul produsului intern brut şi inflaţia: cazul României”, Qeconomica, IRLI, 2, pp.5-10.

de Brouwer, G. (1998): “Estimating Output Gaps”, Research Discussion Paper 9809, Economic Research Department, Reserve Bank of Australia.

Denis C., K. Mc Morrow and W. Rõger (2002): “Production Function Approach to Calculating Potential Growth and Output Gaps – Estimates for the EU Member States and the US”, European Economy, European Commission, Directorate-Generale for Economic and Financial Affairs, Economic Paper Nr. 176, September.

Dissanaike G. and S. Wang (2003): “A Critical Examination of Orthogonal Regression and An Application to Tests of Firm Size Interchangeability” [http://les1.man.ac.uk/sapcourses/Semstuff/Ort-wang.PDF].

Dobrescu E. (2000): “Macromodels of the Romanian Transition Economy”, Third Edition, EXPERT Publishing House, Bucharest.

Dolado, J. and J. Jimeno (1995): “Why is Spanish Unemployment so High?”, CEPR Discussion Paper, No 1184.

Domenech, R. and V. Gomez (2003): “Estimating Potential Output, Core Inflation and the NAIRU as Latent Variables”, University of Valencia.

Dornbusch, R. and S. Fischer (1994): “Macroeconomics”, Sixth Edition, McGraw-Hill.

Driver, R.L., J. Greenslade, and R. Pierse (2000): “Goldilocks And New Paradigm Economics: The Role of Expectations in Fairytales”, Bank of England.

Duarte, M.A.S. et J.S. Andrade (2000): “Le Taux de Chômage Naturel comme un Indicateur de Politique Economique? Une application à l’économie portugaise”, Faculdade de Economia, Universidade de Coimbra.

Ekstedt, H. and L. Westberg (1988): “Interaction Between Economic Growth and Financial Flows: Presentation of a Model Analysing the Impact of Short-Term Financial Disturbances on Economic Growth”, H. Motamen, Ed., Economic Modelling in the OECD Countries, London, New York 1988, pp. 219-244 [http://www.unibw-hamburg.de/WWEB/math/uebe/zuhause.engl.html].

Elmeskov, J. (1993): “High and Persistent Unemployment: Assessment of the Problem and its Causes”, OECD Working Paper 132.

Elmeskov, J. and M. MacFarlan (1993): “Unemployment Persistence“, OECD Economic Studies, No. 21, Paris, pp. 59-87.

Elmeskov, J. and K. Pichelmann (1993): ”Unemployment and Labour Force Participation-trends and Cycles”, General Distribution OCDE/GD (93)95, Economics Department, Working Papers No.130.

Estrella, A. and F. Mishkin (1998): “The Role of the NAIRU in Monetary Policy: Implications of Uncertainty and Model Selection”, Paper for NBER Conference on Monetary Policy Rules, Florida, January 15–17.

Evans, G.E. (1989): “Output and Unemployment Dynamics in the United States: 1950-1985”, Journal of Applied Econometrics, 4, pp. 213-237.

Fair, R.C. (1994): “Testing Macroeconometric Models”, Cambridge, Mass., London [http://www.unibw-hamburg.de/WWEB/math/uebe/zuhause.engl.html].

Fisher, I. (1926): “A Statistical Relation Between Unemployment and Price Changes”, International Labour Review, Vol. 13(6), pp. 785–792, reproduced in Journal of Political Economy, 1973, Vol 81(2), March/April, Part I, pp. 496–502.

Frisch, H. (1997): “Teorii ale inflatiei”, Sedona, Timisoara.

Friedman, M. (1968): “The Role of Monetary Policy”, American Economic Review, 58, March, pp.1-17.

Galli, G., D.Terlizzese, I. Visco, “Un modello trimestriale per la pre-visione e la politica economica”, in Le proprieta di breve e di lungo periodo del modello della banca d’Italia, Politica Economica, No.1, 1989, p. 37 [http://www.unibw-hamburg.de/WWEB/math/uebe/zuhause.engl.html].

Garratt, A. and R.G. Pierse (1996): “Common Stochastic Trends, Cycles and Sectoral Fluctuations: A Study of Output in the UK”, [http://www.econ.surrey.ac.uk/WorkingPapers/econ696.pdf].

Gerlach, S. and F. Smets (1999): “Output Gaps and Monetary Policy in the EMU Area”, European Economic Review, 43, pp. 801-812.

Gerlach, S. and M. Yiu (2002): “Unobservable-Component Estimates of Output Gaps in Five Asian Economies”, Hong Kong Institute for Monetary Research.

Ghizdeanu, I. and M. Neagu (2003): “Estimarea produsului intern brut potential”, Academia Romana, Seminarul de Modelare Macroeconomica, Caiet de Studii No.1, pp.25-32.

Giorno, C., P. Richardson, D. Roseveare and P. van den Noord (1995a): “Potential Output, Output Gaps and Structural Budget Balances”, OECD Economic Studies, No 24, pp. 167–209.

Gordon, R.J. (1996): “Macroeconomic Policy ~ The Presence of Structural Maladjustment”, Working Paper 5739, NBER.

Gordon, R. J. (1997), “The Time-Varying NAIRU and its Implications for Economic Policy”. Journal of Economics Perspectives, 11(1), pp.11-32.

Gordon, R.J. (1999): “Foundations of the Goldilocks Economy: Supply Shocks and the Time-Varying NAIRU”, Northwestern University and NBER.

Gordon, R.J. (2003): “Hi-Tech Innovation and Productivity Growth: Does Supply Create Its Own Demand?”, Working Paper 9437, NBER.

Greene, W.H. (1997): “Econometric Analysis”, New York University.

Guarda, P. (2002): “Potential Output and the Output Gap in Luxembourg: Some Alternative Methods”, Cahier d ’Etudes - Working Paper, No. 4, Banque Centrale du Luxembourg.

Harvey, A.C. (1990): “The Econometric Analysis of Time Series”, Second Edition, The MIT Press.

Herz, B. and W. Röger (2002): “Traditional versus New-Keynesian Phillips Curves: Evidence from Output Effects” Bayreuth University European Commission, June.

Holden, S. (1997): “The Unemployment Problem - A Norwegian Perspective”, OCDE/GD 28, Economics Department, Working Papers No. 172.

Holden, S. and R. Nymoen (2002): “Measuring Structural Unemployment: NAWRU Estimates in the Nordic Countries”, The Scandinavian Journal of Economics, 104 (1), pp. 87–104.

Johansen, K. (2002) “Regional Wage Curves - Empirical Evidence from Norway”, Department of Economics, Norwegian University of Science and Technology Dragvoll, N-7491 Trondheim, Norway.

Karamé, F. (1999): “Unemployment Persistence: the Hysteresis Assumption Revisited. A Nonlinear Unobserved Components Approach”, EUREQua - Université Paris I; first version T2M99 Conference in Montreal.

Karbuz, S. (1994): “A Small Scale Macroeconometric Model for the Turkish Economy, Macroeconomic Decision Support for Turkey”, Ph.D. Dissertation, Technische University Wien, [http://www.unibw-hamburg.de/WWEB/math/uebe/zuhause.engl.html].

Kawasaki, K. (1997): “Macroeconomic Performance of the Scandinavian Model”, Economic Research Institute, Economic Planning Agency, Discussion Paper No.72, Tokyo, March [http://www.unibw-hamburg.de/WWEB/math/uebe/zuhause.engl.html].

Kichian, M. (1999): “Measuring Potential Output within a State-Space Framework”, Bank of Canada Working Paper 99-9.

King, G.K. and S. Rebelo (1993): “Low Frequency Filtering and Real Business Cycles”, Journal of Economic Dynamics and Control, 17(1-2), pp. 207-33.

Krugman, P. (1994): “Past and Prospective Causes of High Unemployment”, Federal Reserve Bank of Kansas City’s 1994 symposium on “Reducing Unemployment: Current Issues and Policy Options,” Jackson Hole, Wyoming, August, Federal Reserve Bank of Kansas City - Economic Review · Fourth Quarter.

Kuttner, K.N. (1994): “Estimating Potential Output as a Latent Variable”, Journal of Business and Economic Statistics, Vol. 12, No.3, July, pp. 361–68.

Layard R., S. Nickell and R. Jackman (1991): “Unemployment: Macroeconomic Performance and the Labour Market”, Oxford University Press, First published 1991, Paperback reprinted 1992, 1993.

Lindbeck, A. (1996): “The West European Employment Problem”, (Faff.doc) For Weltwirtschaftliches Archiv, A. L.13/8; The Bernard-Harms-Prize Lecture, held in Kiel, Germany on June 29, 1996.

Logeay, C. and S. Tober (2003): “Time-varying Nairu and real interest rates in the Euro Area”, Deutsches Institut für Wirtschaftsforschung (DIW Berlin), Discussion Papers 351.

Maddala, G.S. and I.M. Kim (2000): “Unit Roots, Cointegration and Structural Change”, Cambridge University Press.

Malinvaud E. (1964): “Methodes statistiques de l’econometrie”, DUNOD, Paris.

Mankiw, N.G. ed. (1995): “Monetary Policy”, The University of Chicago Press.

Nymoen, R. (2003): “Macroeconometric Modelling of Inflation Dynamics and Unemployment Equilibrium”, University of Oslo, Department of Economics.

Ögünç, F . and Ece, D. (2002): “Measurement of Potential Output for Turkey: Unobserved Components Model”, Central Bank of the Republic of Turkey.

Peracchi, F. (2001): “Econometrics”, John Wiley and Sons Ltd.

Pindyck, R.S. and D.L. Rubinfeld (1998): “Econometric Models and Economic Forecasts”, McGraw-Hill International Editions.

Proietti, T., A. Mussoy and T. Westermanny (2002): “Estimating Potential Output and the Output Gap for the euro area: a Model-Based Production Function Approach”, University of Udine and European University Institute, Department of Economics.

Quah, D., and S. Vahey (1995): “Measuring Core Inflation”, Economic Journal, 105(432), pp. 1130-1144.
Rennison, R. (2003): “Comparing Alternative Output-Gap Estimators: A Monte Carlo Approach”, Bank of Canada Working Paper 2003-8.
Rõõm, M. (2001): “Potential Output Estimates for Central and East European Countries Using Production Function Method”, Eesti Pank, Tallinn.
Saman C. (2003): “The Total Least Squares: Computational and Statistical Aspects and Algorithms”, Romanian Journal of Economic Forecasting, No.3, 2003, pp.107-117.
Schorderet, Y. (2001): “Revisiting Okun’s Law: An Hysteretic Perspective”, University of California, San Diego, Department of Economics, Discussion Paper 2001-13.
Staiger, D., J.H. Stock and M.W. Watson (1996): “How Precise Are Estimates of the Natural Rate of Unemployment”, NBER, Working Paper 5477.
Staiger D., J. Stock and M.W. Watson (2001): “Prices, Wages and the US NAIRU in the 1990s”, NBER Working Paper 8320.
Stănică, C. (2004): „Metode statistice de estimare a PIB-ului potențial. Cazul României”, Romanian Academy-Institute for Economic Forecasting, Manuscript.
Stiglitz, J. (1997): “Reflections on the Natural Rate Hypothesis”, The Journal of Economic Perspectives, 11, issue 1, pp. 3-10.
Stock, J.H. and M.W. Watson (1988): “Variable Trends in Economic Time Series”, Journal of Economic Perspectives, 2(3), pp. 147-74.
Stockhammer, E. (2002): “Explaining European Unemployment: Testing the NAIRU Story and a Keynesian Approach”, Department of Economics, University of Economics and Business Administration, Wien.
Verbeek, M. (2000): “A Guide to Modern Econometrics”, John Wiley and Sons Ltd.
Whelan, K. (1997): “Wage Curve vs. Phillips Curve: Are There Macroeconomic Implications?”, Division of Research and Statistics, Federal Reserve Board.
Zaman, C. (2001): “Two Possible Alternatives for Building the PREG Macro Scenarios”, TACIS, Planet E&Y, Poverty Reduction and Economic Growth Project.
Zaman, C. (2002): “The Output Gap and the Potential GDP of the Yugoslav Economy”, Policy and Legal Advice Centre-An EU-funded project managed by European Agency for Reconstruction.