Olivér Miklós Rácz: Using confidence indicators for the assessment of the cyclical position of the economy*

In an inflation targeting regime, the best possible knowledge of demand-side inflationary pressure is of priority importance for monetary policy. In applied macroeconomic models, this is traditionally represented by the actual position of the cyclical component of GDP (the output gap). This study aims at defining a new output gap indicator, which, as opposed to the traditionally employed methods, also relies on direct information concerning the actual utilisation of economic resources.

Exploiting such information substantially improves the real-time stability of the output gap estimate. The output gap indicator generated by my method (resource utilisation gap) has convincing predictive power and therefore gives a valid indication of the demand-side inflationary pressure in the real economy. Taking the above into account, the method described below will become a useful additional tool to support decision-making in monetary policy in Hungary.

MOTIVATION

The primary objective of the Magyar Nemzeti Bank is to achieve and maintain price stability. In Hungary, the rate of inflation is essentially determined by three factors, i.e. the prices of imported goods, inflation expectations and economic demand. Price stability is achieved by the MNB anchoring inflation expectations and influencing the exchange rate of the forint and internal demand in the Hungarian economy through interest rate policy decisions.

In terms of monetary policy decision-making, having as accurate information as possible on the inflationary pressure generated by economic demand is of key importance in order to be able to reduce such pressure. In applied macroeconomic models, the insufficiency or the overheating of the demand environment is expressed by the output gap. When, for example, the output gap is positive, the growth of the economy will exceed the growth rate of potential output and prices will thus be forced up by the overheated demand.

However, the output level achievable on the long run, i.e. the 'potential output' and the output gap are non-observable variables, normally identified through some method of statistical estimation. The new feature of the method described below is that it relies on information concerning the degree of utilisation of economic resources in addition to statistical characteristics.

Since the best possible identification of the inflationary pressures arising from the actual cyclical position is of key importance for making monetary policy decisions, an output gap estimate should obviously have low sensitivity to incoming data. In addition to the above, a cyclical indicator is considered to be valid if both its sign and magnitude give an accurate indication of the demand-side inflationary pressure. In other words, it should be able to predict inflation at least as exactly as a single-variable forecast which is unable to control for real economy impacts.

In contrast to traditional methods, the use of the method described here for the identification of the cyclical position shows high end-point stability, therefore providing a more robust insight into the actual position of the output gap, with a convincing ability to predict inflation.

METHODS AVAILABLE TO ASSESS THE CYCLIC POSITION

A number of methods are available for the assessment of the output gap. According to classic growth theory, the

* The views expressed in this article are those of the author(s) and do not necessarily reflect the offical view ot the Magyar Nemzeti Bank.

long-term output level can be determined on the basis of the amount of capital and labour potentially available for production, the potential level of productivity and the production function characterising the whole economy. According to that method, the output gap is the difference between the actually observed output and the potential output. The long-term trend of production factors and productivity is normally identified by univariate statistical filters, the most common of these being the Hodrick–Prescott (HP) filter (Hodrick and Prescott, 1997).

An advantage of such univariate methods lies in the fact that they can be easily generated. However, in terms of identifying the actual cyclical position of the economy, such filtering process has its limitations. The HP filter, similarly to most single-variable filtering methods, is based on the assumption that the observed data cover complete cycles. Looking back on a time series of sufficient length, they can thus separate cyclical and trend components with sufficient reliability, but they are rather vague at the end-points of the time series. That end-point variability may be particularly high in economic positions when the performance of the economy shows a permanent and substantial difference from the potential levels. Consequently, such methods provide a rather inaccurate guidance for the assessment of the actual cyclical position. For more information on the subject, see Orphanides and van Norden (2002).

In addition to the above, there are multivariate statistical filters relying on different theoretical relations. Tóth (2010), for example, employs a filtering method that relies on macroeconomic statistics indicating overheating in order to identify the cycle. Such statistics include the balance of the current account or the deviation of inflation from the target. These variables may provide some help in the assessment of the current cyclical position. Since, however, each variable is broken down to cycle and trend, the method cannot fully eliminate the construction problem arising in the case of univariate filters. In this case, there is no auxiliary variable that could give a reliable indication of the overheated state of the economy or its opposite.

OTHER SOURCES OF CYCLICAL INFORMATION

Therefore, in order to improve the end-point stability of the above methods, auxiliary indicators should be found which substantially improve the identification of the current position. Some indicators may include information relevant to the output gap. These are either indicators based on questionnaire surveys or typically labour market statistical indicators. With regard to the Hungarian economy, such surveys are conducted by the Economic Research Institute (GKI) on behalf of the European Commission. Among other things, the questions typically concern the current order-book levels of various sectors, the actual degree of utilisation of their production capacities or their differences from normal levels. Statistical indicators may include the unemployment rate, the amount of overtime hours in various industries or different indicators of labour market-tightness.[1] The Annex includes the summary of variables used for my estimate.

In terms of the objective pursued, one useful feature of most of the variables referred to above is that they are not revised after the data has been provided. Further advantageous features include that they soon become available compared to the publication of the GDP data and at times they serve as *leading*[2] indicators of the output gap. Finally, another feature favouring the estimation procedure is that nearly all components of the set of variables can be considered stationary, i.e. rather than following a trend, they have a stable mean and standard deviation in time.

Similar indicators are available for most European countries. In her paper written for the central bank of Sweden, Nyman (2010) made ground-breaking observations on the utilisation of the cyclical information of this type of indicators. The present study is based on her method. Aastveit and Trovik (2008) set a similar objective for their study.

An important feature of Nyman's method lies in condensing the information carried by the variables in question into a single indicator, with the smallest possible loss of information. To that end, the principal component generated by a static principal component analysis is used as an auxiliary variable in a multi-variate filtering process in order to decompose GDP into cyclical and trend components. During filtering, the principal component is used for the identification of the cyclical component. The cyclical component so established is termed *resource utilisation indicator* by Nyman.

Since, on the whole, the family of indicators used in her study represent the current utilisation of production resources, the method based on their utilisation is comparable to the production function-based methods referred to above. However, an important difference between the two methods is that while the production function-based method

[1] Tightness indicators are defined as the ratio of the number of registered new jobs and the number of unemployed.

[2] In this case, the 'leading' trait means that the turning points observed in the output gap may be pointed out by some of these indicators in earlier quarters.

focuses on the estimation of potential output, the primary objective of Nyman's strategy is, due to the nature of the indicators used, to define the degree of the deviation of the actual output from the potential level.

IDENTIFYING THE RU INDICATOR AND THE OUTPUT GAP BASED ON CONFIDENCE INDICATORS

Following Nyman's method, the first step is to obtain the common information carried by multiple cyclical indicators. This is done by an analysis of the static principal component, on the assumption that the chronological diversity of the indicators has a common determining factor, known as the first static principal component.

Essentially, a weight vector is identified, which is used to weight all components of the set of variables in order to generate the principal component as a single time series. The weight vector of the first static principal component is determined in a way that the first principal component should cover the biggest part of the common variance of the data, resulting in minimum loss of information. According to Nyman, the first static principal component thus generated is referred to as the resource utilisation indicator (or RU indicator, Chart 1).

GDP is broken down to trend and cyclical components in order to estimate the output gap based on the utilisation of resources. The method is based on the HP filter described above, with the adjustment that the RU indicator is used as the auxiliary variable to identify the cycle. This method therefore does not require an assumption on the current cyclical position as it is marked by the end point of the RU indicator.

Chart 1
The resource utilisation indicator and its uncertainty band
(standard deviation)

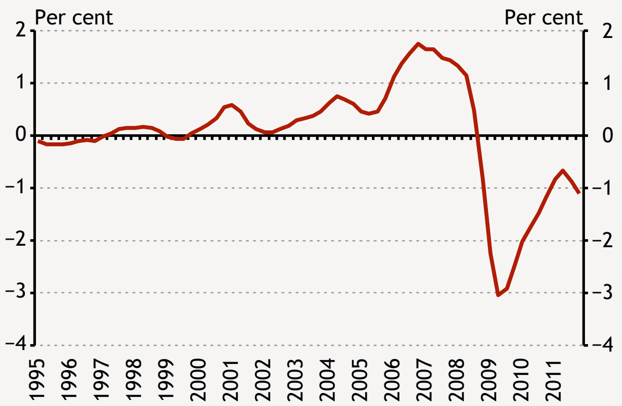
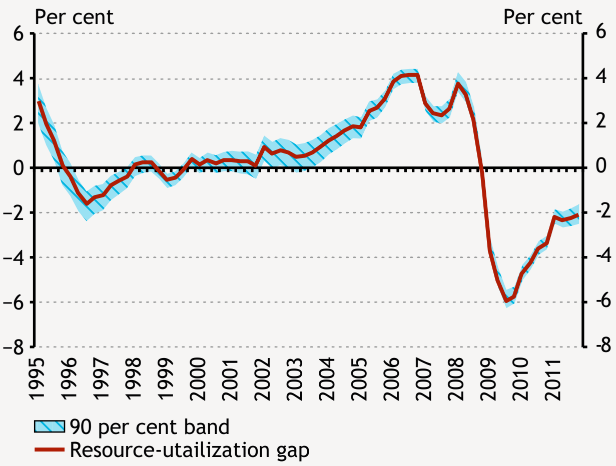


Chart 2
The resource utilisation gap and its uncertainty band
(percentage of trend)



Since output gap indicators are unobserved variables, the estimation methods they are generated with can be interpreted only in a specific uncertainty band. To describe the uncertainty, 1,000 random samples were generated from the existing set of variables and the RU gap was produced for each sample. The RU gap and its uncertainty band are depicted in Chart 2. The figure shows that the estimate varies across a relatively narrow band, thus significantly marking periods of substantial overheating or insufficient demand.

THE VALIDITY AND SENSITIVITY OF THE RESOURCE UTILISATION-BASED OUTPUT GAP

The validity of an output gap indicator, i.e. whether it shows the degree and orientation of demand-side inflationary pressure properly, can be assessed on the basis of its ability to predict inflation. The relationship between the economic cycle and inflation is represented by the so-called *Phillips-curve*, which may be stated as follows:

$$p_t = E(p_{t+1}) + (y_t^{actual} - y_t^{potential}) + \varepsilon_t$$

The left side of the expression has actual inflation, which depends on the expectation concerning inflation in the forthcoming period (the first term of the right-hand side), the current cyclical position of the economy (second member) and the shock not explained by the former two members (ε_t, e.g. oil price shocks).

I produced out-of-sample annual forecasts based on the Phillips curve. In the estimations, the real-time cycle of the RU gap and the HP filter appeared in the place of the

Table 1
Mean square errors of the forecasts

	(1)	(2)	(3)
AR(1)	0.0069	0.0083	0.0071
HP	0.0040	0.0050	0.0052
EK	0.0038	0.0031	0.0037

Left-hand-side variables: (1) quarterly variation of core inflation filtered for taxes, (2) quarterly variation of trend and core inflation filtered for taxes, (3) quarterly variation of the inflation of demand-sensitive items.

output gap. In the forecasts, three potential inflation indicators were employed as left-hand-side variables, including core inflation filtered for taxes, its trend-filtered variant and the inflation of the products sensitive to demand shocks.

The performance of the forecasts is compared in Table 1 on the basis of their root mean squared error. In addition to the two Phillips curve forecasts, the predictive errors of the univariate AR(1) model of the left-hand-side variable in question are also shown as a point of reference. The latter is the equivalent of the *empty model* arrived at by eliminating the second right-hand-side member from the above equation. On the basis of the above, for each of the three inflation variables, the predictive error of the models containing the RU gap was smaller than that of the univariate models. It was also at least equal with or, in two cases, smaller than that of the real-time HP cycle model.

Another important expectation from an indicator of this sort is that its indications of the cyclical position should vary as little as possible when new data are received. To that end, the RU gap and the HP gap are generated on samples starting with Q1 2006 and expanded in each[3] quarter. The end-point stability of indicators can be illustrated by comparing the end points of the indicators estimated on varying samples (real-time estimate) and full-sample estimates. With the arrival of new data, from 2006, above-the-average utilisation of economic resources was indicated by the indicator even in real time. Similarly, overheating was indicated by the RU gap indicator (Chart 3).

The end-point variability of the RU indicator is considered stable, since real-time and full-sample estimates show small differences from 2006 on. On the other hand, the real-time and full-sample estimates of the HP gap show significant differences, particularly between 2006 and 2008. Consequently, of the methods available, the performance of the RU gap indicator indicating the real-time cyclical position best suits the requirements of monetary policy decision-making (Chart 4).

Chart 3
Real-time performance of the RU indicator
(percentage of trend)

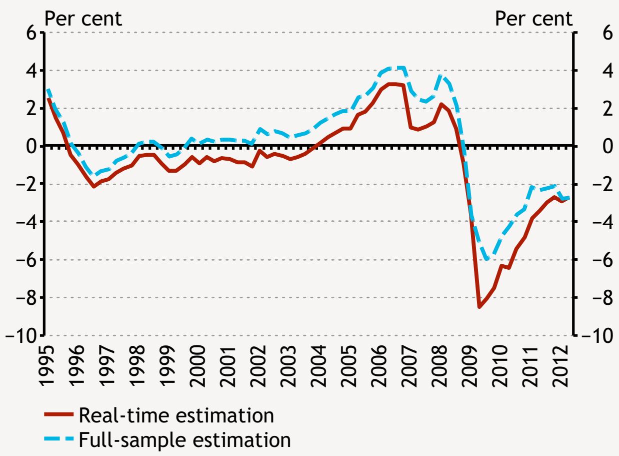
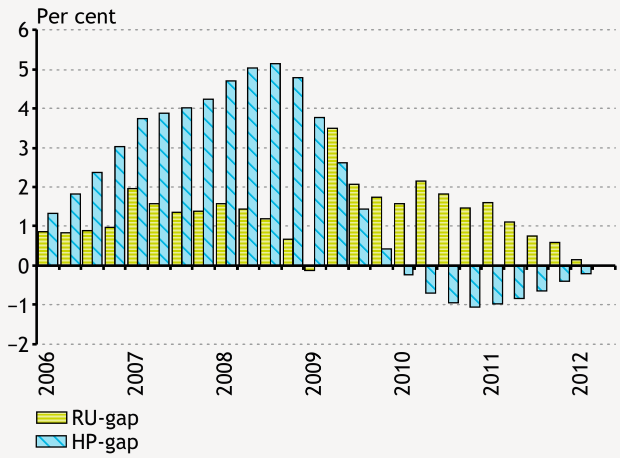


Chart 4
Difference of the real-time and full-sample estimates of the RU gap and the HP filter over the sample period
(percentage-points)



[3] The method is used in order to imitate the real-time arrival of GDP data.

CONCLUSIONS

This study contains the description of the estimate of an output gap indicator based on the utilisation of resources, which improves the assessment of the current cyclical position of the Hungarian economy by exploiting the information of a broad set of variables. Through the method described in the study, an output gap indicator was generated whose predictive ability rivals that of the predictive models used as a point of reference and is therefore able to provide a valid indication of the inflationary pressure from real economy demand. Moreover, it is capable of the above despite the fact that the indicator is based on a set of variables independent from inflation data. On the other hand, compared to traditional filtering methods, it gives a significantly more robust insight into the current cyclical position of the economy. The resource utilisation gap will therefore become a useful additional tool to support the making of monetary policy decisions.

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ANNEX

List of variables

Name / content of variable	Sector	Source
Factor primarily restricting production: none	services	GKI: ESI survey
Factor primarily restricting production: demand	services	GKI: ESI survey
Factor primarily restricting production: labour	services	GKI: ESI survey
Factor primarily restricting production: equipment	services	GKI: ESI survey
Factor primarily restricting production: other	services	GKI: ESI survey
Current level of stocks compared to normal level	commerce	GKI: ESI survey
Current level of orders compared to normal level	industry	GKI: ESI survey
Current level of export orders compared to normal level	industry	GKI: ESI survey
Current level of stocks compared to normal level	industry	GKI: ESI survey
Factor primarily restricting production: demand	construction industry	GKI: ESI survey
Factor primarily restricting production: labour	construction industry	GKI: ESI survey
Factor primarily restricting production: material	construction industry	GKI: ESI survey
Factor primarily restricting production: other	construction industry	GKI: ESI survey
Current intention of households to purchase	–	GKI: ESI survey
Current intention of households to save	–	GKI: ESI survey
Current financial position of households	–	GKI: ESI survey
Capacity utilisation	industry	GKI: ESI survey
Factor primarily restricting production: none	industry	GKI: ESI survey
Factor primarily restricting production: demand	industry	GKI: ESI survey
Factor primarily restricting production: labour	industry	GKI: ESI survey
Factor primarily restricting production: equipment	industry	GKI: ESI survey
Factor primarily restricting production: other	industry	GKI: ESI survey

List of variables (cont'd)		
Name / content of variable	**Sector**	**Source**
Number of over-hours per month	services	HCSO: institutional statistics
Number of over-hours per month	competitive sector	HCSO: institutional statistics
Number of over-hours per month	processing industry	HCSO: institutional statistics
Employment rate	whole economy	HCSO: labour survey
Unemployment rate	whole economy	HCSO: labour survey
Number of vacancies	services	HCSO: vacancies statistics
Number of vacancies	commerce	HCSO: vacancies statistics
Number of vacancies	transportation	HCSO: vacancies statistics
Number of vacancies	hospitality	HCSO: vacancies statistics
Number of vacancies	financial services	HCSO: vacancies statistics
Number of vacancies	real estate services	HCSO: vacancies statistics
Number of vacancies	competitive sector	HCSO: vacancies statistics
Number of vacancies	processing industry	HCSO: vacancies statistics
Number of vacancies	construction industry	HCSO: vacancies statistics
Tightness indicator	competitive sector	HCSO: vacancies statistics
Unemployment and outflow	whole economy	National Employment Service
Tightness indicator (including non-subsidised vacancies)	whole economy	National Employment Service
Tightness indicator (including all vacancies)	whole economy	National Employment Service
Number of non-subsidised vacancies	whole economy	National Employment Service