A quarterly measure of Potential output in the new European Fiscal Framework

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Introduction

☐ In the new EU fiscal framework prominent role for the Cyclically-adjusted budget balance (net of cyclical conditions and one-off and other temporary measures)

☐ The estimation of the cyclical component requires two inputs:

☐ The cyclical position of the economy expressed in terms of output gap (OG), the distance between actual and potential output (PO)

☐ A measure of the link between the cycle and the components of the budget (summarised by elasticity parameters).

☐ The monitoring of fiscal developments needs a timely estimates of fiscal variables in structural terms.

☐ The agreed procedure currently used to compute PO and OG can be extended to produce more robust and timely estimation.
Motivation

We propose a new methodology that:

- Uses mixed frequency to combine timely statistical information available at the quarterly frequency and historical annual data by using a multivariate dynamic factor model in mixed frequency.

- Is multivariate and thus allows to estimate the contribution of each factor to the potential growth (the current method is, in many cases, univariate).

- Reduces measurement error in the estimated parameters.

- Controls for the effect of input projections as quarterly figures can be easily bounded to annual series (such as EU Commission forecast or EUROPOP demographic projections).

- Reduced the effect of data revisions.
Outline of the presentation

☐ The new fiscal framework after the Six Pack, the Two Pack and the IT reform

☐ The EC production function approach for the estimation of output gaps

☐ Variability of potential growth, output gaps and structural deficits

☐ Improving the Production function approach by the EC:
  ☐ mixed frequency models with annual and quarterly data.
  ☐ a multivariate approach for the Labour component.

☐ Sensitivity analysis:
  ☐ The effect of input forecasts.
  ☐ The impact of revisions in the data.
The new fiscal framework

- After the crisis the SGP was strengthened. At the core of the preventive arm is the country-specific medium-term objective (MTO) which is a structural budgetary position mostly close to balance that should achieved and maintained over the cycle in order to assure the sustainability of public finances.

- Six Pack has also introduced an expenditure rule and a debt rule which require somehow the use of figures that are cyclically-adjusted.

- The balanced budget rule has been introduced in the national legal requirement at Constitutional level (reform of art. 81 of Constitution).

- Law 243/2012 mentions that: i) public finances are in equilibrium when at MTO, ii) define how to monitor fiscal performance, iii) introduces a correction mechanism in case of deviation from fiscal target, iv) allows to deviate from the MTO in exceptional events; v) introduces a debt and an expenditure rule.
The Two pack

- The so called Two Pack introduces, among other things:
  - common provisions for monitoring and assessing draft budgetary plans and ensuring the correction of excessive deficit of the Member States in the euro area;
  - a common budgetary timeline and common budgetary rules;
  - independent bodies to monitor compliance with national fiscal rules and evaluate the soundness of national budgetary processes.

- Law 243/2012 has already established the Parliamentary Budget Office, which will take part in the budgetary process through their own forecasts or endorsement.
The Medium term budgetary objective (MTO)

- MTO is a country-specific indicator defined in cyclically adjusted terms, net of one-off and other temporary measures lower than 0.5% of GDP for high debt MS.

- MTOs derivation when including implicit liabilities must take into account of three components:

  - The debt-stabilising balance for a debt ratio equal to the (60% of GDP) reference value (dependent on long-term potential growth), implying room for budgetary manoeuvre for member States with relatively low debt;

  - A supplementary debt reduction for Member State with a debt ratio (60% of GDP) in excess of the reference value, implying rapid progress towards it;

  - A fraction of the adjustment needed to cover the present value of the future increase in age-related government expenditure.
Path to the MTO and expenditure rule

- According to the current legislation, Member States far away from the MTO should converge toward it by reducing the structural deficit by 0.5 pp per year.

- After the crisis, this mechanism has been reinforced though the introduction of an expenditure rule. If at MTO, expenditure cannot grow in real terms more than the medium term rate of potential output. If not at MTO, expenditures should grow less.

- The presumption is to use the unexpected extra revenues windfalls for deficit and debt reduction while keeping expenditure on a stable sustainable path over the cycle.

- The reference medium-term rate of potential GDP growth is determined on the basis of the EC methodology on forward-looking mechanical projections and backward-looking estimates spanning 10y.
The debt rule

- If government debt ratio is above the reference value of 60% of GDP it should be reduced at a rate of 1/20 of the distance from that reference value as average of the previous 3 years

\[ b_t > bb_t = 60\% + 0.95/3 (b_{t-1} - 60\%) + 0.95^2/3 (b_{t-2} - 60\%) + 0.95^3/3 (b_{t-3} - 60\%) \]

- And the eventual breach of the benchmark cannot be attributed to the influence of the cycle

\[
\left( \frac{B_t}{Y_t} \right)^{3 \text{-years-adjusted}} = \frac{B_t + \sum_{j=0}^{2} C_{t-j}}{Y_{t-3} \prod_{h=0}^{2} (1 + y_{t-h}^p)(1 + p_{t-h})}
\]

- But also

\[ b_{t+2} > bb_{t+2} = 60\% + 0.95/3 (b_{t+1} - 60\%) + 0.95^2/3 (b_{t} - 60\%) + 0.95^3/3 (b_{t-1} - 60\%) \]
Compliance with the debt criterion

(1) $b_t < 60\%$ of GDP

STEP 1

YES  NO

No further step

(2) $b_t < b_{b_t}$

YES  NO

STEP 3

(3a) $b_{t+2} < b_{b_{t+2}}$

YES  NO

No further step

(3b) $b_t > b_{b_t}$ due to the effects of the cycle

YES

EDP

NO

CCL

No further step

NO

No further step
Compliance with the debt criterion

☐ For MS out of current Excessive deficit procedure, 3 years transition period to converge to the debt benchmark

☐ In this period Minimum Linear Structural Adjustement (MLSA)

\[ G_3^* = \min(b_3^* - bb_3^*; b_5^* - bb_5^*; b_3^{*,3-year-adjusted} - bb_3^*) > 0 \]
Estimation of Output gaps

The OG is the discrepancy between the level of current real GDP and its potential (in percentual of this one). To estimate potential output, a production function approach (commonly agreed at EU level) is adopted:

\[ Y_t = L_t^\alpha \cdot K_t^{1-\alpha} \cdot TFP_t \]

GDP is represented as a Cobb-Douglas-type production function with constant returns to scale on capital (K) and labour (L).

TFP is the total factor productivity, i.e. the contribution of technical progress to economic growth.

\( \alpha \) is the output elasticity with respect to labour. Given constant returns to scale and perfect competition, is coincident to the wage share.

Potential output is obtained by replacing in the production function, an estimate of K, L and TFP corresponding to their full or potential utilisation.
Estimation of Potential Output by the EC

\[ Y_t = L_t^\alpha \cdot K_t^{(1-\alpha)} \cdot TFP_t \quad \text{Output} \]

\[ \bar{Y}_t = \bar{L}_t^\alpha \cdot \bar{K}_t^{(1-\alpha)} \cdot \bar{TFP}_t \quad \text{Potential Output} \]

1. \[ \bar{L}_t = PARTS_t \cdot POPW_t \cdot HOURST_t \cdot (1 - NAWRU_t) \]

2. \[ \bar{K}_t = K_t = K_{t-1} \cdot (1 - dep_t) + INV_t \]

3. \[ \begin{align*}
SR_t &= \bar{TFP}_t + C_t \\
CUBS_t &= \mu + \beta \cdot C_t + \varepsilon_t
\end{align*} \quad SR_t = \frac{Y_t}{L_t^\alpha \cdot K_t^{(1-\alpha)} \cdot TFP_t} \]
Estimation of Output gaps – Potential Labour

- The estimate of potential labour (LP) is achieved by smoothing a set of exogenous variables over the historical sample and over a medium-term extension period (usually 6y = a short-term forecast horizon + 3 year of technical extrapolation so as to minimize the end-point-bias).

\[ LP_t = \text{PARTS}_t \times \text{POPW}_t \times \text{HOURST}_t \times (1 - \text{NAWRU}_t) \]

- PARTS is the trend component of the unadjusted participation rate obtained by Hodrick-Prescott (HP) filter.

- POPW is the working-age population, extrapolated out of the sample period using the Eurostat 2010 long range population projections.

- HOURST is the trend of average hours worked per employee and it is smoothed using an ARIMA process.

- NAWRU is the non-accelerating wage rate of unemployment.
Estimation of Output gaps – NAWRU specification

☐ NAWRU is derived by applying an unobserved component model estimated by a Kalman filter.

☐ The observed unemployment series is decomposed into a trend and a cyclical component.

☐ The trend component is modelled as a random walk with drift (the drift term itself follows a random walk). The cyclical component is obtained via a Phillips curve which regresses the change in wage inflation on cyclical unemployment as well as on other exogenous variables (labour productivity, terms of trade and wage share).

☐ In the out of sample extrapolation, the NAWRU is extended over the forecast period by a mechanical rule which allows stabilising it after a period of 3 years.
Estimation of Output gaps – Capital

- Potential capital stock, measured by the perpetual inventory method, corresponds to its actual value.

- The full utilisation of the existing stock is assumed.

- The capital is extrapolated in the out-of-sample period according to a given profile of productive investment (estimated through an AR(2) process) and assuming a constant depreciation rate.
Estimation of Output gaps – TFP specification

- Technical progress (TFP) is assumed to be propagated in a neutral way through qualitative improvements both in labour and capital inputs.

\[ TFP_t = (E_L^\alpha E_K^{1-\alpha})(U_L^\alpha U_K^{1-\alpha}) \]

- TFP sums up both the level of efficiency of labour and capital inputs and their degree of utilisation.
Estimation of Output gaps – TFP contribution to potential

- The long-run component of TFP is obtained through a bivariate Kalman Filter (KF) model which exploits the link between the TFP cycle and the degree of capacity utilisation in the economy.

- Capacity utilisation is measured using two indicators: the Capacity Utilization Indicator (CUI), which is available for manufacturing only, and the Business Survey Capacity Indicator (BS) collected for manufacturing, construction and services as part of the European Commission's Business and Consumer Survey Programme.

- TFP can be obtained by applying either a Maximum Likelihood or Bayesian (default model) estimation techniques to the bivariate model in state-space specification given by the Solow Residual (SR) and the series of Capacity utilisation.
Weaknesses of the EC methodology

- The OG Production Function approach uses annual observation and univariate extrapolation procedures.

- Annual frequency is not optimal to: i) efficiently use recent information; ii) capture cyclical swings.

- Extrapolation procedures: i) not a uniform approach; ii) often univariate models are used (especially for the estimation of the potential Labour); iii) and extrapolation procedure are used to produce out of sample forecasts (by splicing one series to another).

- Estimates are strongly affected by two sources of variability: input forecasts and revision in official data.
Potential growth revisions

Italian Potential growth

Source: EU Commission Forecasts – different vintages
Output gap revisions

Italian Output Gap

Source: EU Commission Forecasts – different vintages
If nominal deficit was always 3% of GDP, the revisions in output gap would provide a very mixed picture.

No possibility for a policy maker to assess the attainment of the MTO (balanced budget). How to reduce such variability?
Innovation 1: The mixed frequencies approach

- The mixed frequency approach allows to combine historical annual data available since 1960 with recent information released at the quarterly frequency.

- We use a multivariate model so that components (e.g.) of the potential Labour (such as Hours worked, participation rate ad unemployment) are estimated simultaneously which is a suitable feature especially for out of sample forecasts.

- The Kalman filter produces directly out of sample forecasts avoiding to make univariate extrapolations for each components.
The Mixed frequency model

The basic framework is a Stock and Watson dynamic factor model cast in mixed frequency. We refer to the Monthly Indicator of the economic activity in the Euro Area EuroMIND, developed by Eurostat and documented in Frale et al. (JRSS-A 2010). The idea is that each variable can be decomposed into a common factor and an idiosyncratic component, both following AR process.

\[
\begin{bmatrix}
    x_t \\
y_t
\end{bmatrix} = \phi_0 f_t + \phi_1 f_{t-1} + \gamma_t + S_t \beta, \quad t = 1, \ldots, n
\]

\[
\phi(L) \Delta f_t = \eta_t, \quad \eta_t \sim \text{NID}(0, \sigma_\eta^2)
\]

\[
D(L) \Delta \gamma_t = \delta + \xi_t, \quad \xi_t \sim \text{NID}(0, \Sigma_\xi)
\]

\(\phi(L)\) is an autoregressive polynomials of order \(p\) with stationary roots. The matrix polynomial \(D(L)\) is diagonal and \(\Sigma_\xi = \text{diag}(\sigma_1^2, \ldots, \sigma_N^2)\). The disturbances \(\eta_t\) and \(\xi_t\) are mutually uncorrelated at all leads and lags. \(S\) is a matrix containing intervention variables, such as outliers, calendar effects...
Innovation2: A multivariate approach in mixed frequency for Potential Labour

Recall that potential labour is calculated by

\[ \overline{L}_t = PARTS_t \times POPW_t \times HOURST_t \times (1 - NAWRU_t) \]

Unchanged NAWRU (but we come back on it)

We construct a multivariate model by using annual Employment, Unemployment rate, Working Age Population (POPW) and Hours Worked (HOURST)

The model is augmented using quarterly Participation rates (PARTS) and hours worked (HOURST), so that annual data are disaggregated and updated by using quarterly values.
Results for the Labour Market model
Quarterly information allows to better capture the business cycle.
Potential output and output gap

Potential Output

Potential Output growth rate

Output gap
The new procedure easily allows to constraint forecasts to match annual values. Sensitivity analysis shows that the most binding constraint is given by the projection of active population.
The new method produces more stable results in the historical sample and together with real time figures based on more updated forecasts (for example GDP 2012Q1 which contributes to reduce potential growth in 2012)
Sensitivity analysis 3: The advantage of using quarterly values

The quarterly method produces a series that is closer to the value of OG estimated by using full information on GDP for 2012.
Concluding remarks

We propose some innovations to improve the current methodology used by the EC: i) TFP at quarterly frequency and mixed frequency indicators and ii) multivariate model for Capital and Labour factors.

Our evidence suggests that this approach has at least 3 advantages:

1. It allows to easily constraint the forecast to different annual data so as to get different scenarios.
2. It reduces the revision problem

Shortcoming – computationally slightly more demanding.
Further extensions

- Estimating quarterly NAIRU by using coherent forecast of wages and unemployment rate so as to avoid the mechanical rule for NAIRU extrapolation.

- Extending the model for the Labour market including also wages

- Computing quarterly structural fiscal balance to monitor the development of the fiscal policy
References

- European Economy. Economic Papers 420. July 2010. The production function methodology for calculating potential growth rates and output gaps

- Program GAP: Planas C., Rossi A, Technical Description and User-manual-JRC Scientific and Thecnical Reports

- Cacciotti M, Frale C. Teobaldo S., A New Methodology for a Quarterly Measure of the Output Gap LUISS LAB WP no. 103 2013


Estimation of NAWRU by EC

- The estimation is based on a Phillips curve that explains the short run response of nominal wages to labour productivity, labour demand shocks and the unemployment gap.

- It is a bivariate model on output and inflation + exogenous variables estimated by the Kalman filter (ML or Bayesian)

\[
y_t = c_t + \mu_t + \sum_i \alpha_{1i} z_{1i}
\]

\[
\Delta \pi_t = \mu \pi + \varphi_1 \Delta \pi_{t-1} + \varphi_2 \Delta \pi_{t-2} + \gamma (1 - L)^d y_{t-1} + \sum_j \beta_j c_{t-j} + \sum_k \theta_k \varepsilon_{t-k} + \sum_i \alpha_{2i} z_{2i}
\]

- Restrictions on parameters and various trend specifications are allowed
Quarterly estimation for NAIRU

- We add Wages to the Labour market mixed frequency model so as to get a comprehensive quarterly estimation for all variables of Labour Supply.

- Forecast out of sample also Wage Growth

- Report the unemployment rate and wages in the model for NAIRU and get a quarterly estimate and forecast for NAIRU over the periodo (t+3 – t-5) that is until 2016.

- This allows to use coherent series for the labour market and to avoid using the mechanical rule for the extrapolation of NAIRU.