

# Potential output measurement methods and issues

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# Outline

- The complexity behind the potential output concept
- Which method to use?
- Coherency of the results
- Most frequently used methods
- Some results for Romania

# The complexity behind the potential output concept

Potential GDP reflects the maximum output capacity of an economy consistent with stable inflation and “full employment” in the NAIRU sense.

The capacity of an economy to produce

Maximum sustainable level of employment

- capital
- labor
- TFP

Influenced by:

- demographics and labor market trends
- variations in investment and technological innovations

But also by:

legal and economic framework (tax system, labor and financial market regulations)

The level of output corresponding to...

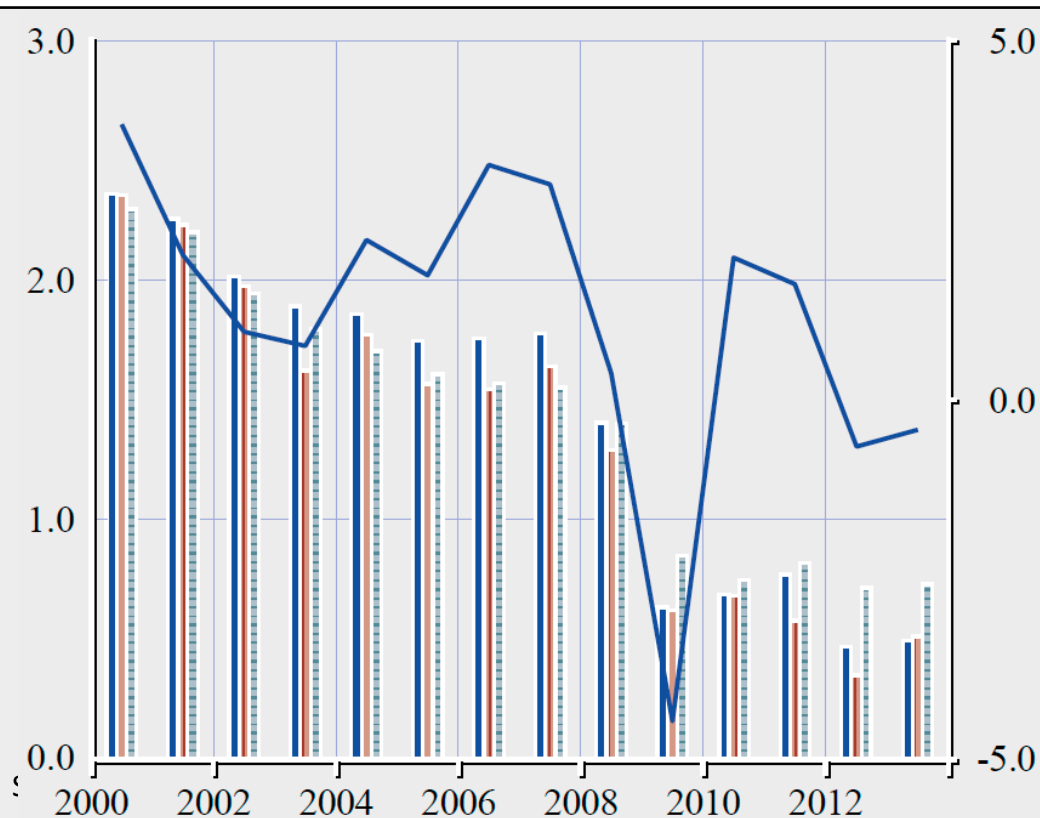
demand and supply in the aggregate economy are balanced...

and inflation tends to gravitate to its long-run expected value

# Potential output – an unobserved variable

## Euro area potential output estimates and real GDP growth

### Measurements difficulties



Higher differences between estimations in periods characterized by uncertainty

Source: ECB (2014)

- European Commission
- IMF
- OECD
- real GDP (right-hand scale)

# Which method to use?

Matching the methodology with the objectives of the institutions

For example Central Banks (e.g. FED) aim at:

- (1) Price stability;
- (2) Maintain full employment.

Relevant questions:

Are the methods based only on the GDP series like the HP filter doing a good job?

Should the methods explicitly reflect the relation between the potential output, inflation and unemployment?

# Which methods to use?

Are the methods appropriate given the specificities of the analyzed economy?

- For example statistical detrending captures a strong growth acceleration as an overheating regardless of the underlying cause (supply driven or demand driven).
- Are these methods appropriate for economies which experience rapid growth driven by supply-side factors?

# Coherency of the results

Coherency checks:

(1) Wage pressures: relation between the labor productivity growth and wage growth

Relation: positive output gap – wage pressures

(2) Current account balance: current account balance to GDP ratio

Relation: positive output gap – deterioration of the current account balance

(3) Inflation: core inflation measurements

Relation: positive output gap – core inflation

# Most frequently used methods

- *The HP filter*

$$\sum_{t=1}^T (y_t - y^*_t)^2 + \lambda \sum_{t=2}^{T-1} ((y^*_{t+1} - y^*_t) - (y^*_t - y^*_{t-1}))^2$$

Minimizes a combination of: a) the square deviation of the GDP ( $y$ ) from the trend ( $y^*$ ) and b) the variance in the growth rate of the trend.

- 1) End-sample biases;
- 2) The appropriate value for the lambda parameter;
- 3) Doesn't capture the structural characteristics of the economy



# Most frequently used methods

- *Production function approach*

$$y^*_t = A^*_t L^{*\alpha}_t K^{*1-\alpha}_t$$

$y^*$  potential output,  $A^*$  potential total factor productivity,  $L^*$  potential labor input,  $K^*$  potential capital input.

*Labor input:*

$$L_t = P_{(15-64)t} PR_t (1 - UR_t)$$

$P(15-64)$  the working age population (15-64), the participation rate (PR), and unemployment (UR)

Potential labor input is represented by: a) the trend of the actual employment; and can b) including an estimation of  $NAIRU - UR^*$

# Most frequently used methods

## *Capital input*

$$K_t = K_{t-1}(1 - \delta) + GFCF_t$$

Where K capital stock,  $\delta$  capital depreciation rate and GFCF gross fixed capital formation

## *Total factor productivity*

$$A_t = \frac{Y_t}{L_t^\alpha K_t^\beta}$$

A total factor productivity, Y real GDP, L the labor input, K the capital input

# Most frequently used methods

- *Kalman filters with different flavors*

## Univariate Kalman filter

$$Y_t = T_t + C_t + e_{1,t}$$

$$T_t = T_{t-1} + S_t + e_{2,t}$$

$$S_t = S_{t-1} + e_{3,t}$$

$$\begin{pmatrix} C_t \\ C_t * \end{pmatrix} = w \begin{pmatrix} \cos \lambda_c & \sin \lambda_c \\ -\sin \lambda_c & \cos \lambda_c \end{pmatrix} x \begin{pmatrix} C_{t-1} \\ C_{t-1} * \end{pmatrix} + \begin{pmatrix} e_{4,t} \\ e_{4,t} * \end{pmatrix}$$

Y - GDP series, T trend and C cyclical components,  $\lambda_c$  is the frequency of the cycle

# Most frequently used methods

## Multivariate Kalman filter\*

\*The model in the paper is based on Galatescu et al 2007

$$\pi_t = c(1) * \pi_{t-1} + [1 - c(1)] * \pi_t^e + c(2) * y\_gap_t + e_{1,t}, \quad Var(e_{1,t}) = 0.2$$

Where  $\pi_t$  represents median CPI,  $\pi_t^e$  is a measurement of expected inflation,  $y\_gap_t$  represents the output gap and  $e_1$  is the stochastic error term.

$$y\_gap_t = c(3) * y\_gap_{t-1} + c(4) * y\_gap_{t-2} + e_{2,t}, \quad Var(e_{2,t}) = 0.1$$

$$\Delta y\_trend_t = \Delta y\_trend_{t-1} + e_{3,t}, \quad Var(e_{3,t}) = 0.1$$

Where  $y\_trend_t$  represents potential output,  $e_2$  and  $e_3$  are stochastic error terms

$$y_t = y\_trend_t + y\_gap_{t-1} + e_{4,t}, \quad Var(e_{4,t}) = 0.1$$

Where  $e_4$  represents the stochastic error term, the rest of the notations remaining unchanged.

# Some results for Romania

(1) HP filter

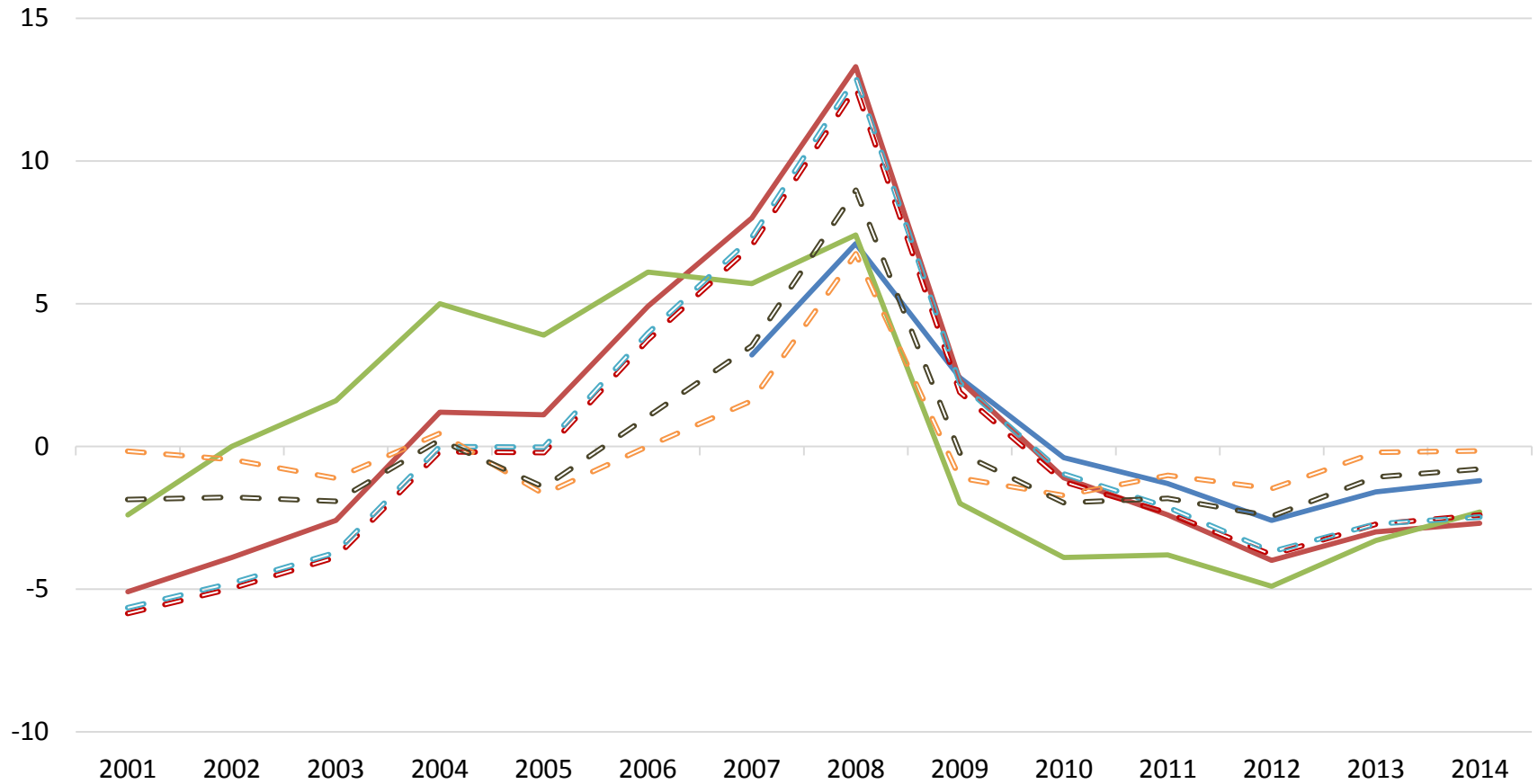
(2) Production function approach

(3) Univariate Kalman filter

(4) Multivariate Kalman filter

Kalman filter models were sensitive to the choice of the starting value.

# Some results for Romania



— IMF — EC-HP — EC-PF - - PF - - HP - - MK - - UK

# Some results for Romania

	Output gap - PF	Output gap - HP	Output gap - MK	Real unit labor cost (yoy change)	Real labor productivity growth (yoy)	Current account balance to GDP ratio	Core (Median)
2009	1.9	2.2	-1.1	-6.0	-4.2	-4.5	2.9
2010	-1.2	-1.0	-1.7	-7.7	-0.5	-4.6	1.8
2011	-2.3	-2.1	-1.0	-10.6	1.4	-4.6	1.8
2012	-3.8	-3.7	-1.5	0.3	-0.3	-4.5	1.4
2013	-2.7	-2.7	-0.2	-1.4	4	-0.8	1.2
2014	-2.4	-2.5	-0.2	0.5	...	-0.4	2.9

Source: Eurostat, AMECO, IMF, own computations

The results are coherent with recent developments of relevant macroeconomic indicators. The closing of the output gap correlates with:

- a) Decreasing wage pressures;
- b) Improving current account balance;
- c) Decreasing inflationary pressures.

Thank you!