The Econometrics of the EU Fiscal Governance: is the European Commission methodology still adequate?

Fioramanti, Marco and Waldmann, Robert J.

15 September 2017

The Econometrics of the EU Fiscal Governance: is the European Commission methodology still adequate?

Marco Fioramanti[1] and Robert J. Waldmann[2]

Abstract: Following the 2005 regulations emending the Stability and Growth Pact with the introduction of country-specific objectives in structural terms, the EU fiscal governance is based on the concept of Potential Output, the highest level of production an economy can sustain without incurring inflationary pressure. Potential Output is an unobservable quantity and, for this reason, it must be estimated. There are many techniques to obtain an estimate of the potential of an economy, each of which with pros and cons. The methodology adopted by the European Commission and EU Member States, while consistent with most of the recent economic and econometric theory, is still not robust enough to give a unique and irrefutable measure on which to base EU's fiscal framework. In this paper, we challenge the EC's approach showing its failure to adequately capture the relation between inflation and cyclical unemployment, the Phillips curve, in estimating the trend unemployment.
Should fiscal policy continue to be based on this concept, further extension of the methodology must be implemented in order to obtain more robust estimates.

JEL classification: C10, E32, E60, H60.

Keywords: Potential output, Output gap, Structural balance, NAWRU, Phillips curve

[1] Marco Fioramanti, Macroeconomic Analysis Department - Parliamentar Budget Office,
email: Marco.Fioramanti@UPBilancio.it.
[2] Robert J. Waldmann, Department of Economics and Finance - University of Rome "Tor Vergata",
Robert.Waldmann@gmail.com

1. Potential Output, Output Gap and Fiscal Stance

Potential output (PO), the highest level of production an economy can produce with the full utilization of available resources without incurring inflationary pressures, is a key concept in the European Union (EU) economic governance. Its estimates is the starting point to assess the cyclical conditions of Member States (MS) of the EU and to derive structural deficits which are key to evaluate the compliance with the EU fiscal framework and in particular with respect to the Stability and Growth Pact (SGP). Once PO has been estimated the cyclical position of a country, the output gap, can be calculated as a difference between actual and potential output (in percentage of PO). The output gap, together with the semi-elasticity of the budget balance to the cycle[3] are first used to net-out headline budget balance (BB) from the cyclical components. Then, to obtain the Structural budget balance (SB) which is the reference measure of the fiscal stance of a MS, measures affecting MSs' budget only temporarily (one-offs) are also subtracted from the headline deficit. In formula:

$$SB = BB - \varepsilon \cdot OG - oneoffs \quad (1)$$

where ε is the semi-elasticity of the budget balance to the cycle and $OG = \frac{Actual\ GDP}{PO} - 1$. While all the elements in (1) but POs are measured or estimated from observable phenomena. PO is not observable and different techniques can be used to guess the potential of an economy. Unfortunately different techniques can - and most of the time do - produce very different estimates of PO and, as a consequence, different results for the fiscal position of a MS are obtained. Furthermore, even the same technique and representation of the unobserved process describing PO can produce quite different results depending on tiny differences in technical assumptions, as shown in Fioramanti and Waldmann (2016) and Fioramanti (2017).

This is what actually happens with the methodology in use by the European Commission and by all the MS[4] and this is the focus of this paper. In particular, section 2 reviews the European Commission methodology briefly explaining the legal and technical background for the calculation of potential output and the output gap. Section 3 is devoted to a deeper overview of the methodology used to calculate the non-accelerating wage rate of unemployment, NAWRU. The weakness of the European Commission methodology is reported in section 4, which contains the novel contribution. There, we show that the Phillips Curve has flattened over recent years, with a diminishing sensitivity of inflation to unemployment, and that what is really driving the pattern of the NAWRU in the EC estimates are

---

[3] For the definition and the estimation of the semi-elasticity of budget balance see Mourre *et al.* (2014) and Price *et al.* (2014).
[4] Given the relevance of the object, a dedicated working group, the Output Gap Working Group of the Economic Policy Committee, was set back in that days to develop a common analytical framework.

imposed constraints on the variance of the stochastic processes. In section 6 we conclude and discuss some possible ways forward.

2. The European Commission methodology for the estimation of output gap

2.1 Legal background

The Stability and Growth Pact was first introduced in 1997 with the Amsterdam Resolution of the European Council to strengthen the monitoring and coordination of national fiscal and economic policies with the goal of enforcing the deficit and debt limits established by the Maastricht Treaty. The public finance targets were initially set in terms of observable headline budget balance and debt (3% and 60% respectively). In 1998 and 1999 two council regulations[5] entered into force modifying the preventive and corrective arms of the pact to take into account the cyclical position of MSs. In 2005 two additional regulations[6] changed the main target variable of the surveillance process to a country-specific Medium Term Objective (MTO) expressed in structural terms.[7] In particular the country specific MTO takes into account: *i)* the debt-stabilizing balance for a debt ratio equal to 60% of GDP; *ii)* a supplementary debt-reduction effort in case the debt ratio exceeds 60% of GDP; *iii)* a fraction of the adjustment needed to cover the present value of the future increase in age-related government expenditure.[8] The SGP has been recently modified and reinforced by the Six-pack in 2011 and the Two-Pack (2014).[9] The Treaty on Stability, Coordination and Governance (TSCG) (2013) has further reinforced the commitment, for those countries who signed it, for sound public finances, leaving the structural balance as the main reference target.

The compliance with the SGP's deficit criterion is now based on two pillars: the MTO and the expenditure benchmark. To make a long story short, for those MSs who signed the TSCG the MTO corresponds to a SB not lower than -0.5% of GDP and, the expenditure benchmark, a growth rate of real primary expenditure not exceeding the 10-year average growth rate of potential GDP.[10]

As can be seen, the estimation of potential output is key in monitoring fiscal compliance with the SGP.

---

[5] COUNCIL REGULATIONS N. 1466/1997 and 1467/1997.
[6] COUNCIL REGULATIONS N. 1055/2005 and 1056/2005.
[7] For a short history of the Stability and Growth Pact visit this link.
[8] For additional details on the calculation of the MTO see the code of conduct on the "Specifications on the implementation of the Stability and Growth Pact and Guidelines on the format and content of Stability and Convergence Programmes".
[9] For an overview of the EU Fiscal Governance visit the European Commission website.
[10] These targets are further qualified depending on whether MSs are at the MTO or converging toward it and whether the business cycle is in normal or not. For further details see European Commission (2016a) and European Commission (2015).

2.2 Technical background

Several methodologies can be used to calculate potential output, from pure statistical filtering to structural time series models as shown for example in Cerra and Saxena (2010).[11] The European Commission and MSs adopt the production function approach.[12] Potential output is supposed to be a function of capital (*K*), labour (*L*) and total factor productivity (*TFP*). The production function is a Cobb-Douglas with constant return to scale with labour share a=0.65. In formula:

$$Y = TFP \cdot L^{\alpha} \cdot K^{1-\alpha}$$

The single factors of PO are calculated in the following way:

- Potential capital is assumed to be equal to actual capital and is obtained using the perpetual inventory method. For older MSs, the initial condition is $K_0 = K_{1960} = 3 \cdot GDP_{1960}$. The assumption that potential capital is equal to actual capital is justified by the fact that in every year investment is just a tiny fraction of capital and the actual value of this latter is already smooth;
- Smoothed TFP is obtained using a Bayesian bivariate Kalman filter. Starting from actual TFP obtained as a Solow residual, trend TFP is extracted using a trend-cycle decomposition in which the univariate structural model for TFP is augmented with an equation relating TFP and an indicator of capacity utilization as described in Planas *et al.* (2013);
- Labour is the (smoothed) total amount of hours worked, obtained as:

  $$L = (POPW \cdot PARTS \cdot (1 - NAWRU)) \cdot HOURS$$

  where *POPW* is the working age population in 15-74, *PARTS* is the smoothed participation rate, *HOURS* is the smoothed average of per-capita hours worked and *NAWRU* is the non-accelerating wage rate of unemployment. *PARTS* and *HOURS* are forward extended for six years first using a simple ARIMA model and then smoothed using the Hodrick-Prescott filter. *POPW* is taken as it is. *NAWRU* is computed estimating, via maximum-likelihood, a bivariate Kalman filter in a trend-cycle decomposition augmented with economic information coming from an accelerationist version of the Phillips curve.
- On top of the extensions above, a set of rules to allow the output gap to close in the three years after the last year considered in the calculation of the output gap is added to the procedure.

The main data source is AMECO, the Annual Macro-ECOnomic database of the European Commission's DG-ECFIN containing both historical and forecasted variables. PO calculation takes as given both historical data coming from Eurostat and forecasted values from DG-ECFIN forecast

[11] For an application to the specific case of Italy see Bassanetti *et al* (2010)
[12] See Havik *et al.* (2014).

publications. In what follows the generic term "numbers" is used to refer to the set containing both historical data and forecasted values. *POPW* is taken from the Eurostat Population Projection (Europop2015).[13]

3. EC methodology for the NAWRU

In this section, we limit our analysis to the estimation of the NAWRU, even though the calculation of trend TFP is not immune from criticism.[14] Furthermore, many of the critiques of the NAWRU apply also to trend TFP.

The baseline trend-cycle decomposition for unemployment via the Unobserved Component Model is assumed to be of the form:

$$u_t = T + C = u_t^* + (u - u^*)_t \quad (2)$$

where u_t^* represents the trend - *NAWRU* and $(u - u^*)_t$ the cycle - unemployment gap. Trend unemployment is assumed to follow a second-order random walk of the form:

$$u_t^* = u_{t-1}^* + \mu_{t-1} + a_{pt} \text{ where } \mu_t = \mu_{t-1} + a_{\mu t} \quad (3)$$

with a_{pt} and $a_{\mu t}$ being white noise disturbances with variances V_p and V_μ respectively (for Slovenia the NAWRU is assumed to be a first order random walk). The cyclical component is assumed to evolve according to an AR(2) process:

$$(u - u^*)_t = \varphi_1(u - u^*)_{t-1} + \varphi_2(u - u^*)_{t-2} + a_{ct} \quad (4)$$

and a_{ct} is, again, a white noise with variance V_c. Stationarity condition requires that $\varphi_1 > 1$ and $\varphi_2 < 0$.

This univariate model is augmented with an accelerationist version of the Phillips curve. In the case of Italy the Phillips curve is specified by equation (5)

$$\Delta\pi_t = \mu_\pi + \beta_0(u - u^*)_t + \beta_1(u - u^*)_{t-1} + \beta_2(u - u^*)_{t-2} + a_{\pi t} \quad (5)$$

where $\Delta\pi_t$ is the change in the wage inflation rate[15] and $a_{\pi t}$ is the usual white noise disturbance with variance V_π. μ_π is a constant that can be placed either in (5) or in (4) with no consequences on final estimates. For Austria, Belgium, Germany, Luxembourg, Malta, and Holland, only the current level of cyclical unemployment is included and the model is extended with additional exogenous variables. For

[13] Eurostat produces new population projection every 3 years.
[14] For an overview of the methodology, see Planas and Rossi (2015).
[15] More specifically, the underlying variable in the AMECO database is the nominal compensation per employee, total economy (HWCDW).

all other European Union countries a different equation, which is called a "New Keynesian Phillips Curve" was used. In this approach, the dependent variable is real unit labour costs. The equation includes lagged real unit labour costs, current cyclical unemployment and lagged cyclical unemployment.

We present the system (2)-(5) as a reference baseline model.

The state space representation of (2)-(5) is:

$$\text{State equation} \begin{bmatrix} u_t^* \\ (u-u^*)_t \\ (u-u^*)_{t-1} \\ (u-u^*)_{t-2} \\ \mu_t \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 \\ 0 & \varphi_1 & \varphi_2 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} u_{t-1}^* \\ (u-u^*)_{t-1} \\ (u-u^*)_{t-2} \\ (u-u^*)_{t-3} \\ \mu_{t-1} \end{bmatrix} + \begin{bmatrix} a_{pt} \\ a_{ct} \\ 0 \\ 0 \\ a_{\mu t} \end{bmatrix}$$

$$\text{Measurement equation} \begin{bmatrix} u_t \\ \Delta\pi_t \end{bmatrix} = \begin{bmatrix} 0 \\ \mu_\pi \end{bmatrix} + \begin{bmatrix} 1 & 1 & 0 & 0 & 0 \\ 0 & \beta_0 & \beta_1 & \beta_2 & 0 \end{bmatrix} \begin{bmatrix} u_t^* \\ (u-u^*)_t \\ (u-u^*)_{t-1} \\ (u-u^*)_{t-2} \\ \mu_t \end{bmatrix} + \begin{bmatrix} 0 \\ a_{\pi t} \end{bmatrix}$$

The state space model is estimated by maximum likelihood via the Kalman recursion using the diffuse Kalman filter for initialization.[16]

The likelihood function is rarely well shaped and many local maxima can be found. The usual way to proceed for the estimation is to start with an initial guess (starting values) of the parameters to be estimated based on previous studies and experience. When Phillips curves with variable natural rates of unemployment are estimated restrictions are usually imposed on the variances of disturbance terms. A solution adopted by most studies is to fix the signal-to-noise ratio (i.e. the ratio of the variance of the residuals of the transition and the measurement equation) in order to have a smooth NAWRU, as suggested by Gordon (1997) and applied for example by Richardson *et al.* (2000) to the OECD countries and Fabiani and Mestre (2004) to the euro area.

The EC follows a different, and more invasive, approach. Variances of disturbance terms are restricted to an interval with upper and lower bounds imposed by the econometrician to reach three main goals: *i)* minimize the revisions between the most recent estimate of the NAWRU time series and the previous estimate of the same time series based on older numbers; *ii)* obtain a good level of significance of β_0 in (5); *iii)* maximize the log likelihood. This procedure is an iterative procedure implemented "by hand".[17]

---

[16] See the reference in footnote 7.

[17] For a tentative of automatization of the procedure via a grid-search algorithm see Ministero dell'Economia e delle Finanze (2015) 18-22.

4. Is this methodology valid?

In this section, we challenge the current validity of the EC estimate of NAWRU using the latest vintage of numbers from EC's Spring 2017 Economic Forecast. Fioramanti (2017) highlights the instability of the estimation to small changes in the preliminary set-up of the model, like *i)* the number of forecasts used along with the historical data, *ii)* the imposed bounds on the variances of the disturbances to stochastic processes and *iii)* the software used for the computation. Fioramanti and Waldmann (2016) further stress the minor role of the Phillips curve, and in particular the significance of the coefficients on cyclical unemployment compared to the major role of the imposed bounds on the variances in determining the official estimate of NAWRU. In both the works cited above the analysis was mainly concentrated on Italy.

In this paper, we instead focus our attention on the 15 old Member States which belonged to the EU in 2000 and challenge the official estimates mainly based on three points: *i)* again the role of cyclical unemployment *vs* the bounds on the variances, *ii)* the usefulness of the European Commission estimate of cyclical unemployment in forecasting wage inflation compared to simple alternatives, and *iii)* the stability of the Phillips curve.

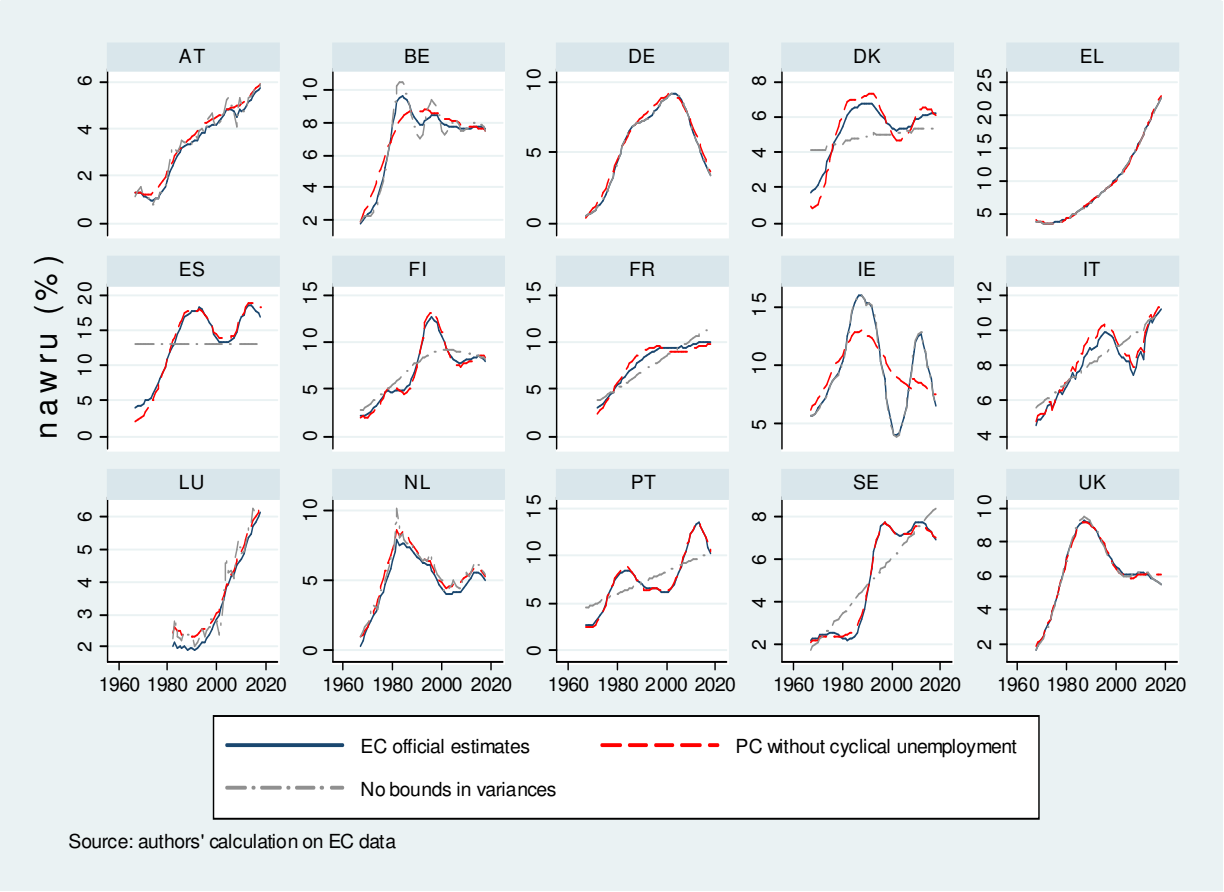
4.1 Cyclical Unemployment *vs* variance bounds: which matters more?

Starting from the EC official estimates of the NAWRU, Figure 5.1 shows for each old MS, three different estimates: *i)* the official EC estimate; *ii)* the NAWRUs estimated relaxing the constraints on the variances of the stochastic processes, but keeping the lag specification for cyclical unemployment unchanged with respect to the official estimate; *iii)* a final specification in which, maintaining the original constraints on variances bound, cyclical unemployment is removed at all lags, so the estimated natural rate of unemployment is not related to the acceleration of wage inflation at all. As can be seen from Figure 1 in most of the cases NAWRU calculated with no cyclical unemployment is closer to the official one than NAWRU calculated with no bounds in the variances. In particular, for 10 out of the 15 old MS (Austria, Denmark, Spain, Finland, France, Italy, Luxemburg, the Netherlands, Portugal, Sweden, and United Kingdom) the RMSE calculated between the official estimate and the models with no cyclical unemployment is smaller than the RMSE calculated between the official estimate and the models without variances bounds. This is a strong evidence that what is actually driving the calculation of the NAWRU is not the economic relation between (wage) inflation and unemployment, but the imposition of specific bounds on the variances in the estimation procedure.

Similarly, for the same 10 out of 15 countries, the correlation between cyclical unemployment calculated with no cyclical unemployment is greater than the correlation calculated without variance bounds. For 11 of 15 countries (the 10 listed above and Germany) this correlation is greater than 0.95.

This demonstrates that the PC plays a minor role in the estimation of cyclical unemployment for these countries.

Figure 4.1: NAWRU for different specifications



Source: authors' calculation on EC data

Table 4.1: RMSEs and correlations

Country	RMSE (official - no bounds)	RMSE (official - no betas)	Corr (official - no bounds)	Corr (official - no betas)
AT	0.2546	0.2529	0.6915	0.9597
BE	0.4449	0.6573	0.8692	0.8861
DE	0.0000	0.2890	1.0000	0.9718
DK	1.2316	0.5297	0.8701	0.9180
EL	0.0019	0.1285	1.0000	0.9993
ES	4.6126	0.7410	0.8197	0.9692
FI	1.4627	0.3457	0.8649	0.9791
FR	0.8982	0.4870	0.8951	0.8741
IE	0.0737	2.4816	0.9992	0.6102
IT	0.8660	0.3672	0.8930	0.9726
LU	0.3743	0.3014	0.8619	0.9638
NL	0.6071	0.5425	0.9565	0.9751
PT	1.7636	0.2057	0.7328	0.9805
SE	1.0397	0.1566	0.8018	0.9896
UK	0.1261	0.1531	0.9965	0.9927

Source: authors' calculations

4.2 Is the PC still alive and well?

In estimating the NAWRU the EC uses the accelerationist version of the Phillips curve in which the change in wage inflation is explained by cyclical unemployment (with possible lags) and, for some countries, additional variables like labour productivity, terms of trade and wage share. Fioramanti and Waldmann (2016) criticize this specification because, in recent years, the relation between inflation and unemployment has weakened and because inflationary expectations appear to have become anchored. To support the EC view instead, Hristov and Roeger (2017) produces a set of regressions that, according to their view, confirm the validity of the EC approach. Unfortunately, their approach suffers from a set of restriction or limitation, namely, the time span used is very limited, the relation between wage inflation and labour productivity suffers from endogeneity, and, crucially, the restriction that the coefficients on headline unemployment and NAWRU are equal and opposite is imposed and not tested. This means that the regressions test only whether the subtraction of the official NAWRU estimate totally eliminates the association between unemployment and wage inflation, and not whether the subtraction of the official NAWRU estimate is optimal.

To better evaluate the official NAWRU estimates we run a set of panel robust fixed effect regressions for different PC specifications for the old MS, where possible over the entire sample 1965-2018 using EC Spring 2017 Economic Forecast numbers.[18] Results are reported in Table 2.

The variables definition is the following: **dw** is wage inflation and the prefix **L.** is the lag operator, while **ddw** is the change in wage inflation (for the accelerationist version of the PC). **ur** is the actual unemployment rate and **nawru** is the official EC estimate of the non-accelerating wage rate of unemployment, while **ur_cyc** is the cyclical unemployment obtained from **ur-nawru**. **E_pce** is the EC forecast at time *t* (spring) of next year inflation. This variable is used as a proxy of inflation expectations. Finally, **lp** is labour productivity.

In the baseline regression (column 2) wage inflation is regressed on lagged wage inflation and cyclical unemployment. Both coefficients seem to be statistically significant and with the correct signs. On the other hand the Wald test of **L.dw**=1, to test the accelerationist versus the traditional PC, strongly reject the accelerationist PC (F(1, 14)=61,33, Prob=0.0000). That is, there is statistically significant evidence that inflation expectations are partially anchored. To test the optimality of the official estimate of cyclical unemployment column 3 reports the estimation of the PC in which cyclical unemployment is decomposed in its sub-components: actual unemployment and NAWRU. In this regression **nawru** is not statistically significant while **ur** is, meaning that actual unemployment is the sole statistically

[18] European Commission (2017).

significant relevant variable.[19] In column 4 the accelerationist version of the PC is tested and it confirms that this formulation is not valid (sign and significance of **L.dw**) and NAWRU is confirmed to be not statistically significant. We then tested the forward-looking formulation of the PC. In this specification, also called New Keynesian Phillips Curve, actual wage inflation is supposed to be not only driven by cyclical unemployment and lagged wage inflation, but also, given the forward looking behaviour of agents, by expected inflation, here proxied by EC forecast of next year inflation. In this regression the number of observations reduces to 270 because of the limited availability of inflation forecasts.[20] This model confirms the significance of actual unemployment and the irrelevance of NAWRU, shows the lack of statistical significance of expected inflation and at the same time rejects the restriction, imposed by Hristov and Roeger (2017), of **L.dw**+**E_pce**=1[21] and also rejects the null of accelerationist New Keynesian version of the PC.[22]

Table 4.2: regression results

Model	Base	Alt. base	Accelerationist	Forward	Base+lp	Base+L.lp	IV Base+lp (§)
Dependent variable	dw	dw	ddw	dw	dw	dw	dw
L.dw	0.8633***	0.7916***	-0.2084***	0.2590*	0.7910***	0.7881***	0.7901***
	(49.4659)	(27.3702)	(-7.2049)	(2.9236)	(31.3688)	(29.9036)	(37.0194)
ur_cyc	-0.3389*						
	(-2.8095)						
ur		-0.2501*	-0.2501*	-0.2021**	-0.2861*	-0.2560*	-0.3364
		(-2.4221)	(-2.4221)	(-3.8963)	(-2.3058)	(-2.3078)	(-1.7787)
nawru		-0.0085	-0.0085	-0.2061	0.0837	0.0345	0.2126
		(-0.0613)	(-0.0613)	(-2.0094)	(0.4945)	(0.2140)	(0.6953)
E_pce				0.3067			
				(1.9240)			
lp					0.1595*		0.3822
					(2.3721)		(1.3257)
L.lp						0.1123	
						(1.5943)	
_cons	0.9634***	3.0785***	3.0785***	4.5467***	2.4180***	2.6316***	1.4951
	(6.0874)	(6.2236)	(6.2236)	(5.3633)	(4.2109)	(4.3745)	(1.1368)
N	810	810	810	270	810	810	810
ll	-1927.9712	-1906.2348	-1906.2348	-437.1169	-1898.6504	-1902.3452	
F	1635.2684	1593.8694	24.8685	194.7033	1755.5202	1671.9918	
r2_o	0.8061	0.7939	0.0759	0.3504	0.8052	0.8011	0.8059
chi2							89.7057

* p<0.05, ** p<0.01, *** p<00.001

(§) **lp** instrumented with **L.dw**, **ur**, **ur_cyc** and **L.lp** t-statistics in parentheses

[19] We get similar results with panel regressions for all 28 EU countries using data from the 2016s release provided data from Bulgaria in 1990s are not used. Bulgaria had extremely high wage inflation in the 1990s and those outliers dominate the regressions. Rather shockingly, we also get similar results using a randomly generated variable from a uniform distribution instead of the NAWRU. Results are available from the authors upon request.

[20] Date are from an updated version of the database from Fioramanti *et al* (2016).

[21] F(1, 14)=14.25, Prob=0.0021.

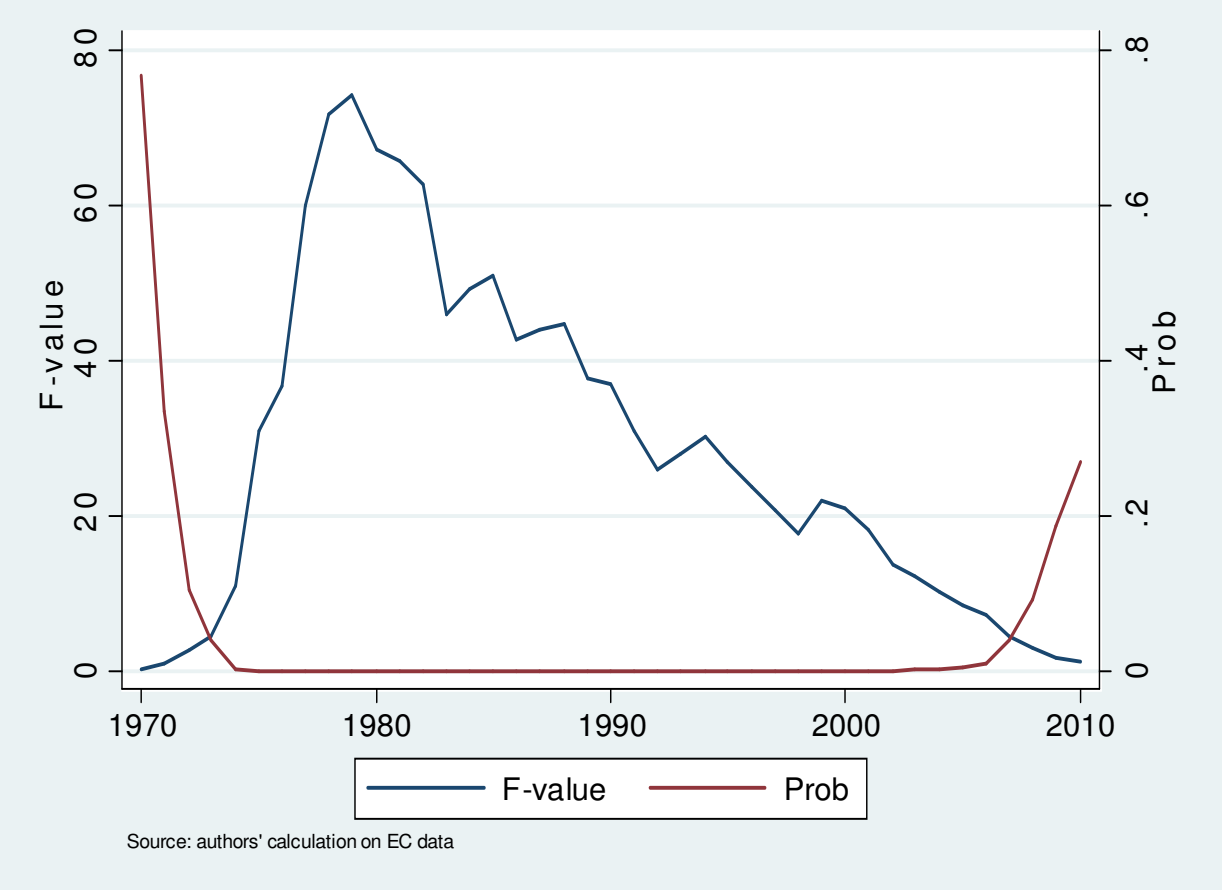
[22] The test is H0: L.dw+E_pce=1 with F(1, 14)=14.25 and Prob=0.0021.

A final step is to check whether labour productivity has some role in the PC as shown by Hristov and Roeger (2017). Apparently productivity is statistically significant in our preliminary regression (column 6), but here we have a potential endogeneity problem. The Durbin-Wu-Hausman test for endogeneity rejects the hypothesis of **lp** being exogenous.[23] We could, then, either proceed using lagged productivity (column 7) or, better, use instrumental variable (column 8).[24] In this latter case, the only significant variable of the regression is lagged wage inflation.

4.3 Could the PC failure be explained by structural breaks?

In Blanchard *et al* (2015) the authors find that, in a sample of 20 countries the PC has flattened in more recent years and, at the same time, inflation expectations appear to have become more anchored.[25] To check if this is also true in our analysis, we preliminary tested for possible structural breaks. Unfortunately, we were unable to identify a small number of breaks. Apart from the tails of the sample, the hypothesis of the absence of a break is rejected for all years between 1970-2010 as Figure 2 shows.

Figure 4.2: Recursive Chow test for structural break (Fixed Effects)



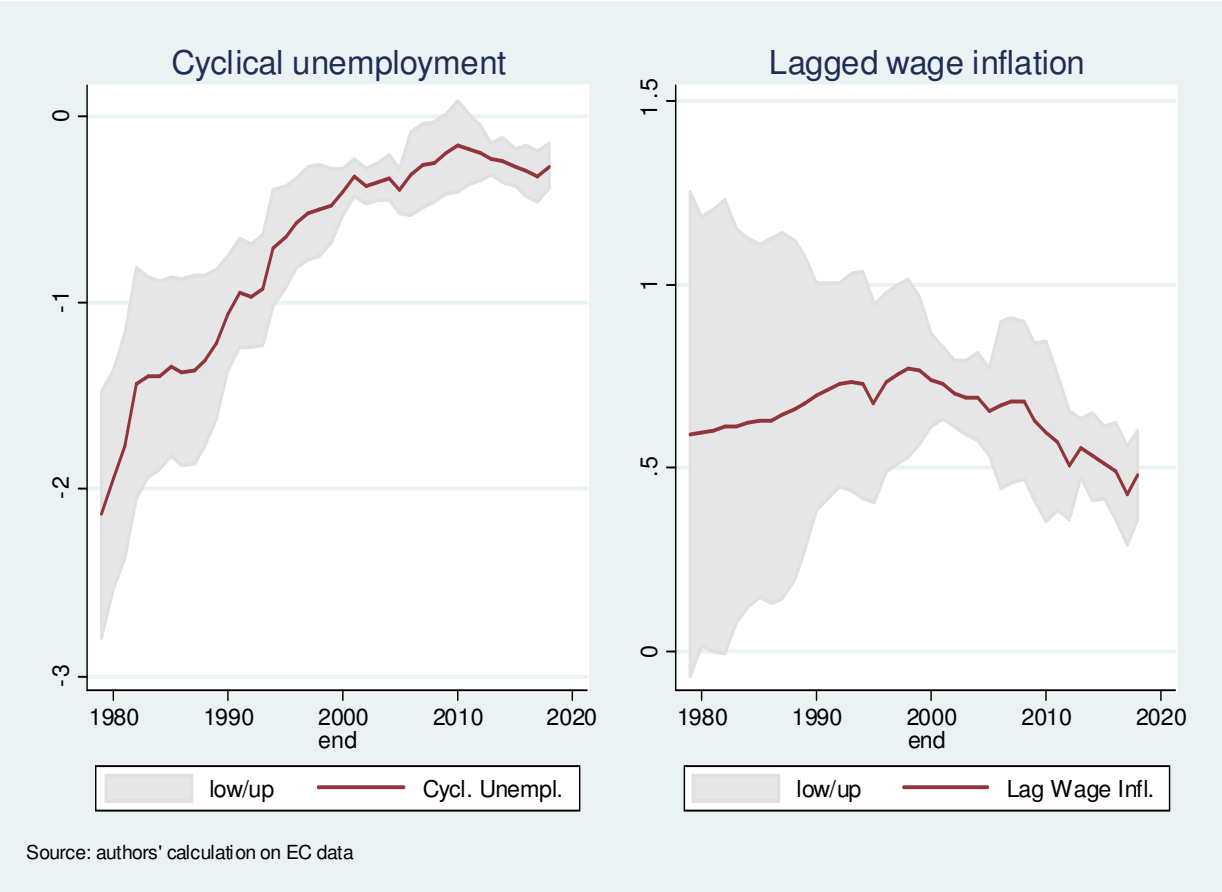
Source: authors' calculation on EC data

[23] F(1, 14)=5.63 Prob=0.0326
[24] Here **lp** is instrumented with **L.dw**, **ur**, **nawru** and **L.lp**
[25] They obtain their results using an unobservable component model estimated with maximum likelihood via kalman filter.

Note: the figure shows the results of recursive Chow tests from 1970 to 2010.

We then proceed running a rolling regression with a moving window of 20 years[26] of the baseline regression with wage inflation regressed on lagged wage inflation and cyclical unemployment. Figure 3 reports the results for the entire panel, while in the appendix the graphs are produced for single countries (Figure A.1 and Figure A.2). The coefficient of cyclical unemployment (left panel of Figure 3) shows an almost constant reduction (in module) from the '80s to 2010 where it slightly inverted the trend but remained well below 0.5 (in module). The coefficient on lagged wage inflation (right panel) registered a slight increase up to the end of the '90s and then declines. It is important to notice that since 2000 it has always been statistically significantly different from 1.[27] This latter evidence further supports the rejection of the accelerationist PC and confirms the anchoring of inflation expectations.

Figure 4.3: panel-level rolling coefficients



Source: authors' calculation on EC data

[26] We tested different windows sizes. With windows between 20 and 30 years the results are almost the same. Narrower windows produce less smooth curves, while wider windows produce limited variation in the results.
[27] The horizontal line corresponding to 1 does not lie in the grey area representing 95% confidence interval.

5. Policy implications and conclusions

The global financial crises started in 2007 has dramatically changed the economic structure of many countries and produced changes in the relations among observables phenomena. The recent years of very low inflation in presence of declining unemployment has raised many doubts on the current validity of the inflation-unemployment relation predicated by the Phillips curve. Many possible explanations have been proposed to explain the flattening of the Phillips curve.[28] This structural change also poses many questions to Central bankers on how to conduct monetary policy in such an environment.[29]

In this paper we have shown that the relation among unobservable phenomena and observable macroeconomic variables has changed and this fact poses serious doubt on the ability of the European Commission Production Function approach to describe certain structural aspects of the economy of the euro area's MSs. In particular, we have stressed how the relation between wage inflation and unemployment has changed during the recent period of high unemployment and low inflation, possibly as a consequence of anchored expectation and, possible, the (re)appearance of hysteresis. The relation between the non-accelerating wage rate of unemployment and unemployment seems to be returned being better described by the traditional version of the Phillips Curve rather than the accelerationist version; this latter still in use by the EC in the estimation of the NAWRU. Blanchard *et al* (2015) have very well documented these structural changes and their conclusion is reinforced by our results.

In empirical economics, uncertainty is something that can be reduced and progress in statistics and econometrics serve this purpose; but uncertainty will never be completely eliminated. The use of the Production Function approach in a very critical aspect of the European governance, such as the fiscal surveillance, while representing progress, does not guarantee the absolute correctness of the measure. This reducible-but-ineliminable degree of uncertainty is magnified once what is being measured is "unobservable". An additional layer of quandary overlaps in periods of rapid changes when the *relations* among different phenomena could, and usually do, change.

In recognizing the ineradicable uncertainty the European Commission has adopted a *Plausibility Tool*,[30] a way to cross check their own estimates of the Output Gap. While this is an improvement, it is of limited use insofar it can only be used by the EC itself while cannot be applied by Member States to show the plausibility of their estimates.

---

[28] See for example the recent Project Syndicate from Nouriel Roubini (2017) and a Financial Times article https://goo.gl/fGAH9F.
[29] See Brainard (2017).
[30] See Hristov *et al (2017)*

Is there, hence, a way to move out of the impasse? Our view is that, given the nature of the concepts, the only way to deal with related uncertainty is to have a range of estimates inside which every point estimate can be reasonable with some degree of confidence.[31] This region can be the result of pooling different models or techniques, the confidence interval of point estimate of a single model or even the region coming out from the EC' plausibility tool itself, but it has to be used not only to evaluate EC estimates, but also those coming from the EU MSs.

[31] In addition to the already mentioned contributions, our view is that also Proietti *et al* (2004), Rusticelli (2015) and Rusticelli *et al* (2015) capture very relevant aspects of the phenomenon under scrutiny.

References

Bassanetti A., Caivano M. and Locarno A. (2010) "Modelling Italian potential output and the output gap", Banca d'Italia - Working Paper N. 771.

Blanchard O., Cerruti E. and Summers L. (2015) "Inflation and Activity – Two Explorations and their Monetary Policy Implications", IMF Working Paper 15/230.

Brainard L. (2017) "Understanding the Disconnect between Employment and Inflation with a Low Neutral Rate", speech at the Economic Club of New York, 5th September.

Cerra V. and Saxena S.C. (2000) "Alternative Methods of Estimating Potential Output and the Output Gap: An Application to Sweden", IMF – Working Paper N. 59.

European Commission (2015) "Making the Best Use of the Flexibility within the Existing Rules of the Stability and Growth pact", COM(2015) 12 final.

European Commission (2016a) "Vade Mecum on the Stability and Growth Pact", European Economy – Institutional Paper N. 021, March.

European commission (2017) "Spring 2017 Economic Forecast: Navigating through Choppy Waters", European Economy – Institutional Paper N. 20, February.

Fabiani S. and Mestre R. (2004) "A System Approach for Measuring the Euro Area NAIRU", Empirical Economics N. 29, pg. 311-341.

Fioramanti M. (2017) "Potential Output, Output Gap and Fiscal Stance: is the EC estimation of the NAWRU too sensitive to be reliable?", in Ginebri S. *Italian Fiscal Policy Review 2015*, Ed. RomaTr*E-Press*.

Fioramanti M., González-Cabanillas L., Roelstraete B. and Ferrandis-Vallterra S.A. (2016) "European Commission's Forecasts Accuracy Revisited: Statistical Properties and Possible Causes of Forecast Errors", European Economy - Discussion Paper N.027.

Fioramanti M. and Waldmann R.J. (2016) "The Stability and Growth Pact: Econometrics and its consequences for human beings", Vox column appeared on-line on VoxEU.org, 19 November 2017.

Gordon R. (1997) "The time-varying NAIRU and its implications for economic policy". Journal of Economic Perspectives N. 11(1), pg. 11-32.

Havik K., Mc Morrow K., Orlandi F., Planas C., Raciborski R., Roeger W., Rossi A., Thum-Thysen A., Vandermeulen V. (2014) "The Production Function Methodology for Calculating Potential Growth Rates & Output Gaps", European Economy, Economic Paper N. 535.

Hristov A. and Roeger W (2017) "On the Econometrics with a Human Face and Business Cycle: A Reply to Fioramanti and Waldmann's Criticism on the EU's NAWRU Methodology", European Economy - Economic Brief N. 022.

Ministero dell'Economia e delle Finanze (2015) *Economic and Financial Document 2015*, Section I: Italy's Stability Programme.

Mourre G., Astarita C. and Princen S. (2014) "Adjusting the budget balance for the business cycle: the EU methodology", European Economy - Economic Papers N. 536.

Roubini, N. (2017) "The Mystery of the Missing Inflation", Project Syndicate, 13th September.

Planas C., Roeger W. and Rossi, A. (2013), "The information content of capacity utilization for detrending total factor productivity", Journal of Economic Dynamic and Control, 37, 577-590.

Planas C. and Rossi A. (2015) "Program GAP: Technical Description and User Manual", JRC Scientific and Technical report, May, version 4.4.

Price R.W., Dang T.T. and Guillemette Y. (2014) "New Tax and Expenditure Elasticity Estimates for EU Budget Surveillance", OECD Economics Department Working Papers N. 1174.

Proietti T., Musso A. and Westermann T. (2004) "Estimating Potential Output and the Output gap in the Euro Area: a Model-Based Production Function Approach", Empirical Economics N. 33, pg. 85-113.

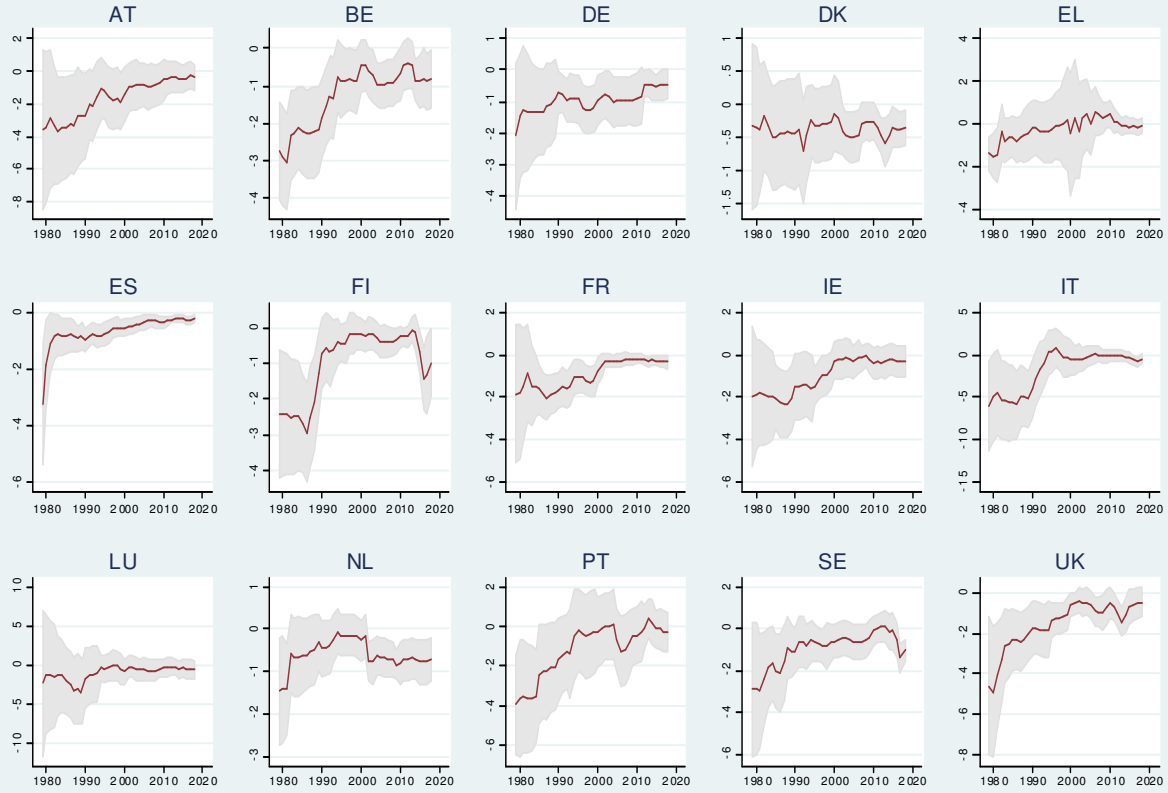
Richardson P., Boone L., C. Giorno C., Meacci M., Rae D., and Turner D. (2000), "The Concept, Policy Use and Measurement of Structural Unemployment: Estimating a Time Varying NAIRU Across 21 OECD Countries," OECD Economics Department Working Papers N. 250.

Rusticelli E. (2015) "Rescuing the Phillips curve: Making use of long-term unemployment in the measurement of the NAIRU", OECD Economic Journal, Vol. 2014, N. 6/1.

Rusticelli E., Turner D. and Cavalieri M.C. (2015) "Incorporating Anchored Inflation Expectations in the Phillips Curve and in the Derivation of OECD Measures of Equilibrium Unemployment", OECD Economic Department Working Papers N. 1231.

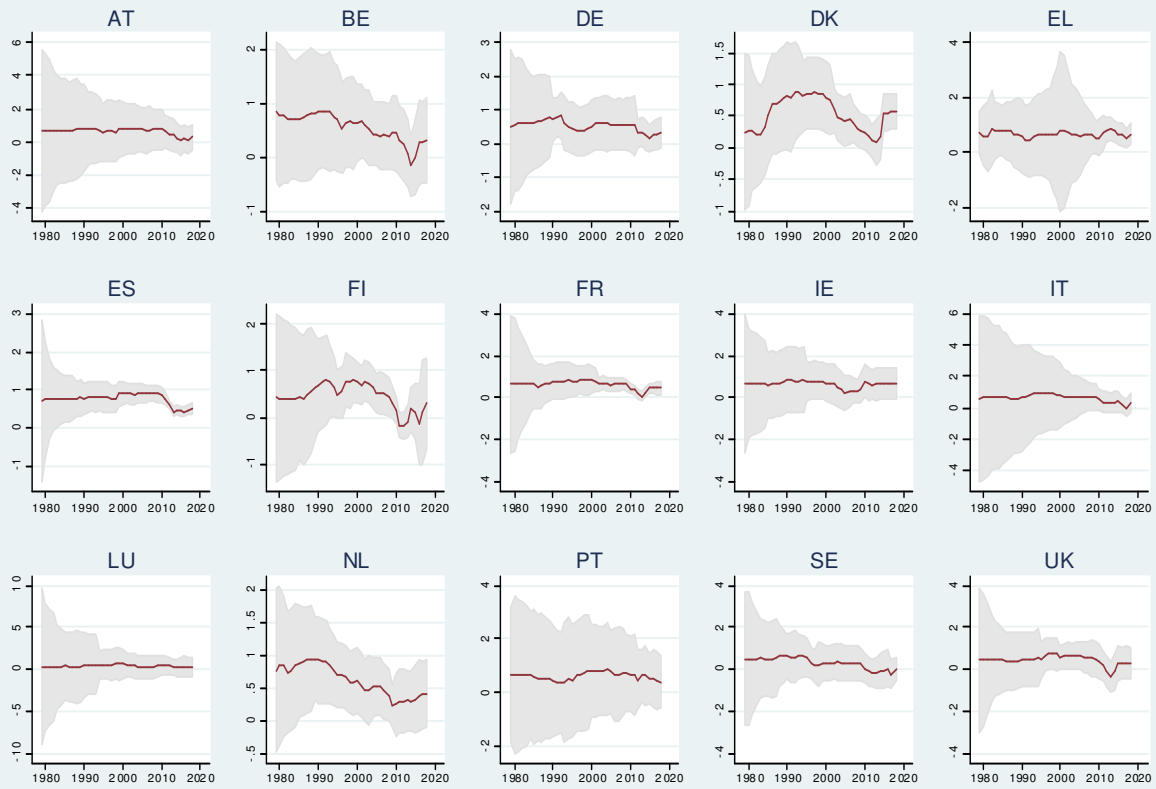
Appendix

Figure A. 1: coefficient on cyclical unemployment - rolling regression



Source: authors' calculation on EC data

Figure A. 2: coefficient on lagged wage inflation - rolling regression



Source: authors' calculation on EC data