Structural Budget Balance and Fiscal Policy: the Limits of the European Approach*

Stefano Fantacone†[1], Petya G. Garalova[2], and Carlo Milani[3]

[1,2,3]Centro Europa Ricerche, Via Bruxelles 59, Rome 0018, Italy

Abstract

Under the Fiscal Compact's rules, the structural balance has become a crucial variable in the EU budgetary framework. This should facilitate the operativeness of the automatic stabilizers and avoid pro-cyclical fiscal policies . However, in the past years peripheral member countries have witnessed a widespread budget restriction in front of a deep downturn of the economic cycle. We show that this occurred due to the distorted information provided by the model used by the European Commission to calculate the structural budget balance. Starting from the direct relationship between this latter and the NAWRU, we shed some light on the estimation methodology and its implication on member states' fiscal policy. We focus our attention on the poor economic significance of the NAWRU and its large volatility over time. Finally, by the means of panel data estimations, we find out that the NAWRU is correlated with the economic cycle, which implies pro-cyclical effects on structural balances. Peripheral European countries seem to be more affected by these pro-cyclical effects than core countries.

Keywords: Potential GDP; structural balance; non-accelerating wage rate of unemployment (NAWRU); fiscal rules; austerity

1 Introduction

The European Commission (2015) has recently adopted a new framework aimed at making the best use of flexibility within the existing rules of the Stability and Growth Pact (SGP). These new guidelines seem to loosen the so-called austerity that appeared in Europe in the second half of 2011. More specifically, some corrections are made on the fiscal targets, which after the introduction of the Fiscal Compact are based on the concept of general government structural balance, i.e. the nominal balance adjusted for cyclical components, as well as one-off factors. Theoretically, a target constructed taking into account the cyclical effects should allow the functioning of the automatic stabilizer of the public balance. This is because in a recession the

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†E-mail: s.fantacone@centroeuroparicerche.it, Tel.: +39-06-8081304; fax: +39-06-80687280

structural deficit is typically smaller than the nominal one, thus, *ceteris paribus*, also the fiscal corrections should be smaller. However, in the recent past this mechanism failed to work for two main reasons: i) notwithstanding the deep recession, all the Mediterranean countries had to apply restrictive fiscal policies in order to reduce their structural balance, as requested by the zero target fixed by the Medium-term Budgetary Objective (MTO); ii) the methods used by the European Commission to estimate the output gap and calculate the structural budget balance proved to be inadequate.

In this paper, developing the work done in Fantacone, Garalova, and Milani (2015), we highlight the methodological limits of the Commission's approach. In Section 2 we define the fiscal rule based on the structural balance. In Section 3 we show how the structural balance measured by the Commission is strictly related to the level of the Non-Accelerating Wage Rate of Unemployment (NAWRU). In Section 4 we discuss, on the basis of the prevalent economic literature, some of the biases generated by the Commission's estimation of the NAWRU. In Section 5 we discuss our empirical results on the subject. In Section 6 we conclude.

2 The Structural Balance as a Target for Fiscal Policy

The Fiscal Compact set the target of fiscal policy in term of structural balance. The latter derives from decomposition of the nominal general government balance into the structural and the cyclical component:

$$\bar{I}_n = I_s + I_c \tag{1}$$

where. $(\bar{I}_n)$ is the government nominal balance as a percentage of GDP, which values are observable and detected by the National Statistical Offices (the above marked variables are the ones that may be directly observed), while the structural (I_s) and cyclically adjusted (I_c) components are not observable.

In the methodology adopted by the European Commission, the cyclical component is defined by the semi-elasticity of the budget (μ) to the output-gap (OG):

$$I_c = \mu \times OG \tag{2}$$

where the output gap is defined as the deviation of the actual GDP from its potential value (Y^*), in percentage of the latter.

$$OG = (\bar{Y} - Y^*)/Y^* \tag{3}$$

For countries with high public debt, the MTO impose that the target value of I_s is set to zero:

$$I_s = I_s^* = 0 \tag{4}$$

Therefore the target for nominal balance becomes:

$$I_n^* = \mu \times OG \tag{5}$$

For a given value of the semi-elasticity coefficient μ, the equilibrium level of government balance is determined solely by the size of the output gap, and therefore only by the automatic

stabilizers. Any value that exceeds such level should be eliminated through restrictive fiscal policy.

The meaning of this rule is twofold. On the one hand, the rigorous approach is imposed, as in a steady-state equilibrium with zero output gap the fiscal balance should be zero. On the other hand, there is the recognition of the stabilization role of fiscal policy, that can move counter-cyclically registering deficits in the presence of negative output gaps and, symmetrically, surpluses in the presence of positive output gap.

Within this framework, the calculation of the output gap assumes a crucial value because is the output gap value that determinates the amount of the observed deficit attributed to the cyclical state of the economy. The shortcoming of this approach is that the fiscal rule is anchored to an unobservable variable, subject to measurement uncertainty.

3 The Role of NAWRU in the European Fiscal Rule

The approach for calculating the potential output is commonly agreed at EU level. More specifically the European Commission estimates the potential GDP through a Cobb-Douglas production function:

$$Y^* = L^{*\alpha} \cdot K^{1-\alpha} \cdot TFP^* \tag{6}$$

Where L and K are the input of labour and capital and TFP is the total factor productivity, calculated as the residue of the equation.

The contribution of the labour is specified as:

$$L^* = Part^* \cdot Pop \cdot Hours^* \cdot (1 - \text{NAWRU}) \tag{7}$$

where *Part** and *Hours** are the trend component of the participation rate and the hours worked, respectively, and *Pop* is the working age population.

Equations (1) - (7) define the model that links the NAWRU and the structural balance:

$$\text{NAWRU}_{t+1} \uparrow \Rightarrow L^*_{t+1} \downarrow \Rightarrow Y^*_{t+1} \downarrow \Rightarrow |OG|_{t+1} \downarrow \Rightarrow I_{s_{t+1}} \uparrow \text{con} \quad OG_t < 0 \tag{8}$$

An increase of the NAWRU at time $t+1$ implies the reduction of the labour input and therefore of the potential GDP. If at t time the economy is in recession - which implies a negative output gap ($OG < 0$) - the reduction of the potential at $t+1$ decreases the absolute value of the output gap ($|OG|$) causing a deterioration in the structural balance. Therefore, during negative phases of the economic cycle there is a direct relationship between NAWRU and I_s, for which the higher is the NAWRU, the higher is the level of structural balance. Hence, as suggested by the fiscal rule, further budgetary measures should be implemented in order to reduce the deficit. This approach has an important counter-intuitive policy implication: an increase in structural unemployment must be followed by a tightening in fiscal policy. In other words fiscal policy assumes a *pro-cyclical* bias.

4 The Methodology for Calculating the NAWRU followed by the European Commission

NAWRU is an unobservable variable. In the model of the Commission it is estimated by the equation of the Phillips curve, specified as follows:

$$\Delta^2 w_t = \phi^{pr}\Delta^2(pr_t) + \phi^{ws}\Delta^2(ws_t) + \phi^{tot}\Delta^2(tot_t) - \beta.(u_t - nairu_t) + v_t^w \quad (9)$$

where pr, ws, tot and uare, respectively, productivity, wage share, terms of trade and unemployment rate. The equation is estimated by applying a Kalman filter.

Estimating the NAWRU by the Phillips curve implies that - according to Friedman (1968) and Phelps (1968) - equilibrium unemployment is neutral with respect to inflation rate. Such an assumption is rather commonly used in econometric models. Since the NAWRU provides information on the inflationary pressures, it is a useful indicator for monetary policy, as proposed in the seminal work by Modigliani and Papademos (1975) and, in the later version of time-varying techniques, by Gordon (1997).

Much less obvious is the use of NAWRU within a fiscal rule framework, since an acceleration of inflation can loosen the constraint on the public budget. This occurs because of the presence of fiscal drag, the reduction of the real value of debt or the increase in nominal GDP, which drives an increase in fiscal revenues. It is not clear, therefore, why a rise in the NAWRU should automatically lead to a tightening of fiscal policy, as required by (8).

It should be also noticed that even in the models of monetary policy based on the natural rate of unemployment an increase of the latter does not involve an automatic rise in the interest rates. From this point of view, European automatic fiscal rule seems to cause a greater degree of restriction than that justified by literature. The choice to anchor an automatic rule of economic policy to NAWRU can be criticized from other points of view. Stiglitz (1997) shows that the measurement of this variable is strongly uncertain, especially in the presence of hysteresis in the labour market, stressing at the same time that its increase does not necessarily entail an increase in the inflation rate, while Blanchard and Katz (1997) show how the ability to represent the conditions of the labour market through the NAWRU is particularly unsatisfactory for the European countries. These cautions are not considered in the European model where, as we have seen, the NAWRU is the pivot on which is hinged the size of the country's automatic fiscal consolidation.

With regard to the estimation method, the use of a statistical Kalman filter implies that the NAWRU varies over time and follows the trend of the actual unemployment rate. This means that the equilibrium unemployment rate within the European approach is not a fixed target, as occurs in the United States and that higher values of unemployment are tolerated during recessions, and lower during expansion periods. This obviously weakens the stabilizing role apparently recognized to the public budget by equation (5). The problem of the sensitivity of the NAWRU to the economic cycle is indeed highlighted in literature. Estrella and Mishkin (2000) identify a long-term component of NAWRU, suggesting that only the latter, being less responsive to fluctuations in the cycle, should be used to measure the potential GDP. More recently, The European Commission (2013) itself and the European Central Bank (2014) have provided evidence on why underestimating the role of institutional factors in the European labour market will lead to incorporate cyclical factors in estimating the NAWRU, whose level

Figure 1: Euro area countries: European Commission's NAWRU estimates

would be overestimated, especially for peripheral countries, thus confirming the findings of Gianella, Koske, Rusticelli, and Chatal (2008).

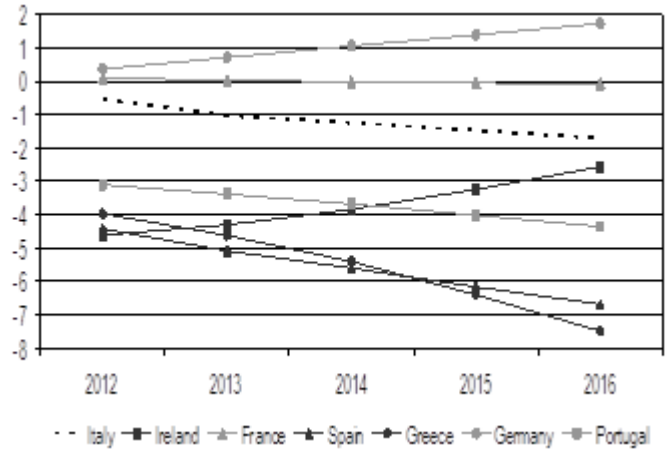
Overall, according to the literature there are a plenty of shortcomings in the setting of the European fiscal policy approach. As we show in the rest of the paper, specific weakness in the estimation method of the NAWRU further limit the economic significance of the approach.

5 Is the NAWRU estimated by the European Commission a reliable indicator?

5.1 The Econometric Inconsistency

As we have seen, the NAWRU is measured by the Commission through the estimation of a Phillips curve (equation (9)), but taking into account the values of R-squared of these estimates (The European Commission, 2010) shows a wide range of values that is between the maximum of Austria (0.65) and the lowest in Italy (0.02). The figure reported for the Eurozone as a whole is 0.13, in line with the findings for the United States (0.16). On average, this values are extremely low showing that for some countries (besides Italy, surely Portugal, but also Belgium and Germany, for which the R-squared is less than 0.3) the Phillips curve estimated by the Commission is not representative of relationship inflation-unemployment underlying the determination of the structural balance. The fact that R-squared is so low even for the United States highlights the doubts on the general validity of the methodological scheme proposed by the Commission. What is surprising is that these bad econometric results have not been set aside, but are currently used to determine the fiscal effort required to single countries. A choice that reduces the credibility of the European fiscal rule.

To understand better this aspect, we consider the data reported in Figure (1), which shows the level of NAWRU attributed to some countries by the Commission's estimates in 2014. According to these data, the stability of inflation would require unemployment rates close to 20% in Greece and Spain, more than 12% in Portugal and 10.7% in Italy. Clearly, these calculations are not informative to the policy maker, who in the Italian case would have, for example, to choose whether to reduce unemployment to below 10% or preserving price stability.



Notes: estimated on the base of the average unemployment rate in the period 1997-2007, which was equal to 6.7% in Germany, 5.3% in Ireland, 10.3% in Greece, 11.9% in Spain, 9.6% in France, 8.9% in Italy and 6.6% in Portugal.

Figure 2: Euro area countries: an alternative measure of output gap (difference with respect to the European Commission's estimates), **Source**: *Our elaborations on European Commission, Economic Forecast Data*

A trade-off that appears even grotesque considering that the deflationary environment in which the Eurozone has slipped would suggests the need to promote, not to avoid, a price increase. At this regard it should also be noted that the information extracted from the NAWRU and incorporated into the European fiscal rule are in conflict with the current policy of the ECB, which is promoting an increase in inflation expectations.

The use of these "bad estimates" influences the calculation of the output gap of many countries. Figure 2 shows how the size of the output gap would change if the structural unemployment rate is set equal to the average level observed in the decade before the financial crisis (1997-2007), when the stability of inflation was still preserved. The differences are very strong for all the peripheral countries: the output gap in 2014 would be wider by 5.5 points wider in Greece and Spain, by 3.7 points in Portugal and Ireland, by 1.2 points in Italy. The differences are even more pronounced in the years 2015-16.

5.2 The Excess of Volatility

The comparison of the current estimates of the NAWRU with the average of the decade preceding the crisis - thus with a reference to the long-run - leads to focus on the excess of volatility of the indicator proposed by the Commission. As we have seen, the NAWRU is estimated using a Kalman filter applied to the Phillips curve. This implies that the measure of potential GDP is subject to continuous revision over time, depending on the update of the historical series (this is a property common to all statistical filters, which are nothing if not a method of interpolation of the original series). The economic analysis makes extensive use of indicators of potential output variable in time and, since Gordon (1997)'s contribute, also NAWRU measures that show a certain degree of variability are commonly used. To be useful as part of a scheme of fiscal policy based on a fixed rule, however, these variability should remain within a restricted

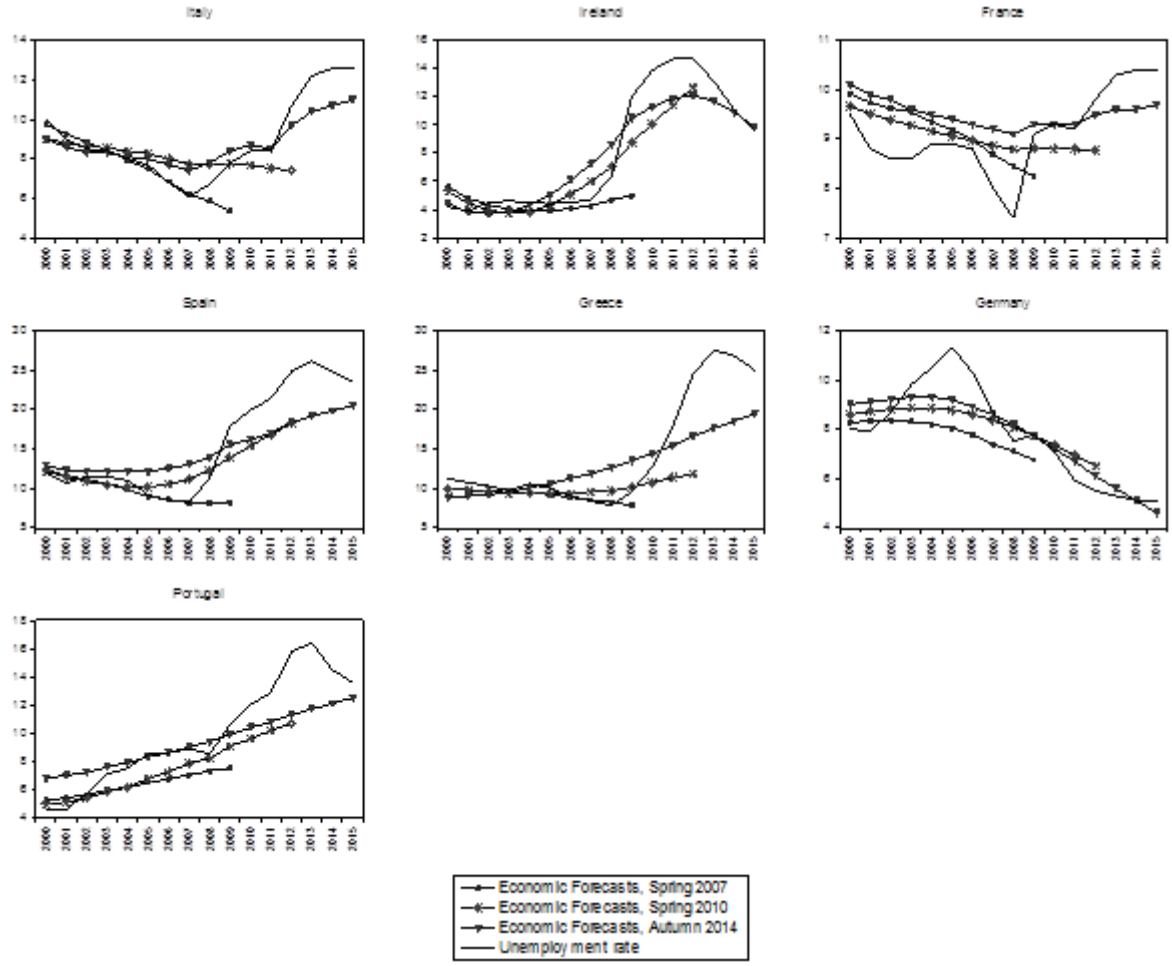


Figure 3: The revised NAWRU estimates during the European recession, **Source:** our elaborations on European Commission, Economic Forecast data.

fluctuation band. Otherwise, economic policy could be subject to abrupt changes, incurring in risks of overshooting, as in the case of wide shock, statistical filters lose their stabilizing function. This emerges clearly from Figure (3), where we show the large and sudden increase occurred to the NAWRU of peripheral countries in the aftermath of the European recession. This means that, according to the Commission's estimates, much of the actual increase of unemployment has structural nature and that would be impossible to compress it if not at the cost of causing an acceleration in prices. Such a the model establishes the impossibility for the peripheral countries to return to pre-crisis situation.

5.3 The Pro-cyclical Bias: Elements of Nonlinearity

The discussion carried out so far leads us to the heart of the problem, namely the fact that the European methods prove inadequate in ensuring a credible breakdown of structural and cyclical public debt. It is a failure that goes beyond that part of indeterminacy that is impossible to eliminate from the statistical methods of decomposition of the time series. The key element, culpably neglected, is that the measurements proposed by the European Commission contain an element of non-linearity, which reduces the ability to distinguish the cycle from the trend in

the presence of large and persistent shock.

In order to check this hypothesis, we have estimated the following panel ($t = 1981, ..., 2013$ and $i =$ countries UE12 (excluded Lusemburg)):

$$\begin{aligned} EF_{i,t}^{nawru} = k + \sum \theta_i DEF_i + \beta_1 EF14b_{i,t}^{HPgap} + \beta_2 EF14b_{i,t}^{HPgap} DcoreDperiod_y + \\ \beta_3 EF14b_{i,t}^{HPgap}(1 - Dcore)Dperiod_y + \gamma_1 cuneo_{i,t} + \gamma_2 disocL_{i,t} + \\ \gamma_3 sindac_{i,t} + \gamma_4 pilpro_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{10}$$

EF = Economic Forecast European Commission from 2007 to 2014 (16 report)
EF14b = Economic Forecast European Commission autumn 2014
$y =$ 2002-2007; 2008-2010; 2011-2013

As dependent variable we consider the NAWRU estimates reported in the Economic Forecast Reports published between 2007 and 2014 (a total of 16 reports). Unlike the European Commission (2013) and Orlandi (2012), our empirical analysis implicitly introduces another dimension to the panel, linked to different revisions of the estimates of NAWRU in Economic Forecast half yearly presented by the Commission in the period between 2007 and 2014.

The coefficients of greater interest for our purposes are the betas, those related with the HPgap variable, which is a simple cyclic measure given from the output gap obtained by the European Commission, in the Autumn 2014 Economic Forecast (latest available), using the Hodrick-Prescott statistical filter.

Through the coefficient β_1 it is possible to verify if in the NAWRU estimated by Commission there are cyclical factors that invalidate its use for estimating the potential GDP. A negative value of this coefficient indicates that in phases when the cycle is negative (positive), highlighted by a $EF14^{HPgap}$ negative (positive), the Commission's NAWRU estimates tend to increase (decrease), resulting in a pro-(anti-)cyclic effect.

By estimating the coefficients β_2 and β_3 it is possible to evaluate the different effect of the cyclical component in the core countries (Austria, Belgium, Finland, France, Germany and the Netherlands), identified through the dummy *Dcore*, versus peripheral ones (Greece, Ireland, Italy, Portugal and Spain) in three historical periods, in turn identified through the dummy *Dperiod* : i) the pre-crisis period, which runs from 2002 to 2007; ii) the first phase of the crisis, from 2008 to 2010, involving mainly the financial sector; iii) the second phase of the crisis, from 2011 to 2013, where it was observed the contagion to the sovereign bonds of two of the major European economies, Italy and Spain.

The other variables have been put in the equation (10) to be able to control:

- the effect of taxation on labour income (wedge), a factor that may have a negative impact on the meeting between the demand and supply of labour ((The European Commission, 2014); (Orlandi, 2012); (Gianella, Koske, Rusticelli, and Chatal, 2008));
- the share of workers in a state of unemployment for over 1 year (unempL), that for the so-called hysteresis can cause a higher rate of long-term unemployment ((Ball, 2009); (Blanchard and Katz, 1997); (Stiglitz, 1997));
- the degree of unionization of workers (union), index of potential rigidities in the labour market that tend to overly protect union workers compared to new entrants ((Orlandi,

2012); (Gianella, Koske, Rusticelli, and Chatal, 2008); (Stiglitz, 1997); Blanchard and Summers (1986));

- GDP per capita (gdp), indicator of the relative wealth of the countries considered, which may result in a process of catching-up, and that takes also into account population dynamics (Stiglitz, 1997). This variable is also included to capture the effects of any bubbles that in the pre-crisis period may have led to an increase in the product, which was followed by an adjustment with the outbreak of the crisis (see, for example, (Estevao and Tsounta, 2011)).

Some control variables identified in literature as possible determinants of the structural unemployment rate, were not included in the equation (10) because related to EF14HPgap, or because of a lack of historical data for all the countries considered, as in the case of the incidence of unemployment benefits in relation to GDP and the level of the minimum wage. The equation (10) is estimated by the random-effect estimator[1].

In Table 4 are reported the results of the estimation of equation (10) excluding the interaction of the variable $EF14^{HPgap}$ with the dummy that identifies the pre or post-crisis (Dperiod) and in which the control variables were included one at a time.

The HPgap coefficient is always negative and significant. The NAWRU estimated by the Commission is therefore being affected by cyclical components, resulting in a pro-cyclical effect of the estimates of potential GDP. Looking at the analysis of Estrella and Mishkin (2000), it can be said that with the methodology proposed by The European Commission (2010) we tend to estimate a short term NAWRU instead of calculating, as would more properly carried out, a long term one. With reference to the control variables the impact of taxation, in line with The European Commission (2013), Orlandi (2012) and Gianella, Koske, Rusticelli, and Chatal (2008), is positive and significant in all specifications considered.

Positive and significant is also the effect of long-term unemployment, thus highlighting the presence of a hysteresis effect in the structural unemployment rate, while neither the degree of unionization or GDP per capita are influencing the level of NAWRU estimated by the Commission.

In Table 5 are reported the results of regression in the different considered periods (pre-crisis, first and second post-crisis). We find that the evidence of Table 4 are also confirmed in the broader estimate.

Supporting the evidence of non-linear effects, the cyclical component is stronger in the last period of the financial crisis (2011-13), and mainly among peripheral countries. β_2 and β_3 coefficients in Table 5, model III, are both negative, but only the latter is significant and with a higher magnitude. Moreover, the Wald test shows that the two coefficients are statistically different. A one point reduction in HP output gap (negative cycle) implies an increase in the peripheral countries' NAWRU of 0.374 points (at 5% of significance level). For core countries the effect is smaller and not significant.

In the pre-crisis period (2002-07), we find that the cyclical effect on NAWRU is for both core and peripheral countries negative and significant. The Wald test does not show any difference among β_2 and β_3 (Table 5, model I).

[1]In the regression outputs are reported the Breusch-Pagan test and the Mundlak test. From these tests what emerges is that the random-effect estimator is not distorted and is preferable to the fixed-effect estimator. As a test of strength we have in each case used the fixed-effect estimator. The main results are robust to this test and are available on request.

The estimates for the first post-crisis period (2008-10) show that the cyclical component is smoothly negative for core countries (one point of reduction in HPgap implies an increase in nawru of 0.1 points), while for peripheral countries the European Commission's NAWRU estimates does not depend by the output gap (Table 5, model II).

6 Conclusions

In the midst of the great recession generated by the sovereign debt crisis, the Eurozone has moved to fiscal targets defined in terms of structural balance. However, this step has not been accompanied by an adequate reflection on the methodology by which estimates the many unobservable variables that are at the basis of the measurement of the structural balance. The solution that has been chosen is entrusting the methodology already adopted by the Output Gap Working Group - the group inside the European Union with the mandate to ensure technically robust and transparent potential output -, but this means that the new fiscal rule incorporates a model originally designed only to provide broad information to the economic debate, without any claim to rise at a normative role. The analysis carried out in this paper have highlighted the many limits of the method proposed by the Commission, which are not econometrically significant, it is too unreliable over time and strongly influenced by the state of the economic cycle. Our empirical findings show that the NAWRU estimated by the Commission appears to be distorted in the stages of economic downturn, leading to pro-cyclical fiscal policies. Particularly affected by this distortion appear to be the peripheral countries of the euro area, which at the height of the financial crisis have undergone a revision of the estimates of the NAWRU far more severe than that of the core countries.

This point is particularly critical, since the use of the structural balance is motivated by the desire to isolate the changes induced on the public finances by fluctuations in the economic cycle, as to focus the surveillance mechanism on the discretionary choices of governments.

In fact, the persistence of a strong pro-cyclical component in the calculation of the structural balance has resulted in an extension of the fiscal tightening that has slipped the Eurozone into deflation. The new guidelines on the Stability and Growth Pact implicitly recognize the inadequacy of the model adopted in the recession years and can facilitate, from now on, the stabilization role of budget policy. But more than four years have been lost, imposing to some Eurozone countries deep product losses and high social costs.

: Table 1. Summary statistics and definitions of variables (period: 1981-2013)

Variable	Description	Source	Mean	St.dv	Min	Max	Obs.
Dcore	Dummy equal to 1 for Austria, Belgium, Finland, France, Germany and the Netherlands; 0 otherwise	Our calculations	-	-	-	-	-
DEFj	Dummy equal to 1 for the j-th European Commission's Economic Forecast published every 6 months in the period 2007-14; 0 otherwise	Our calculations	-	-	-	-	-
Dperiod	Dummy equal to 1 for the y-th period of the financial crisis (pre-crisis=2002-07; first post-crisis period=2008-10; second post-crisis period=2011-13); 0 otherwise	Our calculations	-	-	-	-	-
gdp	Nominal GDP pro capita (in thousands euro)	Oecd	21,500	13,300	0,878	82,500	7002
HPgap	European Commission's output gap estimate based on Hodrick-Prescott filter reported in the winter 2014 Economic Forecast Report	European Commission	-0,207	2,720	-10,300	11,200	7740
nawru	European Commission's NAWRU estimate reported in the Economic Forecast Reports published in the period 2007-14	European Commission	7,880	3,740	1,680	28,000	6211
unemplL	Unemployed for more than 1 year over total unemployed	Oecd	44,800	13,500	1,500	76,200	5670
union	Trade union employees over total employees (in %)	Oecd	35,300	17,300	7,500	80,700	7002
wedge	Fiscal taxation on labour income (in %)	Oecd	42,700	8,190	22,200	57,100	3024

: Table 2. Variables by country and period: average values

Variable	Country*										
	at	be	de	el	es	fi	fr	ie	it	nl	pt
labtax	48,1	55,9	51,3	41,0	39,2	44,1	50,0	24,8	46,8	38,3	37,5
2002-07	48,0	55,7	52,3	41,0	38,9	44,5	50,1	23,6	46,2	38,3	37,3
2008-10	48,4	55,8	50,4	41,0	38,7	42,9	49,8	24,3	46,9	38,4	36,9
2011-13	48,8	56,0	49,5	42,6	40,4	42,7	49,7	26,1	47,7	37,9	38,9
unempL	25,2	57,7	47,6	50,2	42,6	23,0	40,1	50,4	59,0	41,9	45,9
2002-07	25,1	49,4	52,6	52,6	27,6	24,2	39,3	32,1	52,3	35,2	43,2
2008-10	23,6	46,9	48,5	44,4	26,1	19,5	37,6	35,1	46,2	28,9	47,9
2011-13	25,0	46,3	46,0	58,8	45,2	21,8	40,8	60,5	53,9	34,4	51,1
navru	3,8	8,2	7,4	9,2	14,5	8,0	9,0	10,2	8,6	4,8	7,4
2002-07	4,3	7,8	8,8	9,4	10,6	7,7	9,1	4,4	8,0	3,3	7,0
2008-10	4,4	7,8	7,9	10,5	13,2	7,0	8,9	8,2	7,6	3,6	9,3
2011-13	4,5	8,0	6,9	12,7	17,6	7,0	9,2	11,7	8,0	4,3	11,1
Hpgap	-0,2	-0,2	-0,2	-0,5	-0,4	0,1	-0,1	-0,3	-0,2	-0,3	-0,2
2002-07	0,3	0,4	-0,2	4,3	2,2	1,8	0,9	4,3	1,2	-0,1	0,5
2008-10	-0,1	0,2	-0,8	7,4	2,6	0,5	-0,5	-1,3	0,0	1,5	1,4
2011-13	0,1	-0,2	0,5	-7,6	-2,5	-0,5	-0,1	-4,6	-0,9	-0,8	-2,1
gdp	24,1	22,3	22,8	10,5	13,6	23,1	22,4	22,7	18,0	24,7	9,8
2002-07	30,5	29,3	28,1	17,8	21,0	31,2	28,7	39,8	25,2	33,2	15,0
2008-10	34,9	33,0	30,9	21,1	23,8	35,1	31,6	38,3	26,7	38,0	16,9
2011-13	37,5	34,6	33,3	18,1	23,1	36,8	32,7	37,7	26,7	38,4	16,3
union	40,1	52,5	27,1	30,4	15,3	73,0	9,9	42,0	37,8	23,6	28,6
2002-07	33,2	54,5	21,8	24,9	15,5	71,6	7,8	34,5	33,6	20,4	21,0
2008-10	28,7	54,4	18,9	23,2	17,6	69,5	7,7	32,6	34,5	18,8	20,0
2011-13	27,6	55,0	17,9	21,9	17,4	68,5	7,7	31,1	36,3	17,8	20,0

Notes: at=Austria, be=Belgium, de=Germany, el=Greece, es=Spain, fi=Finland, fr=France, ie=Ireland, it=Italy, nl=Netherlands, pt=Portugal. Source: our estimates.

: Table 3. Correlation matrix

	labtax	unempL	union	gdp	Hpgap
labtax	1,000				
unempL	0,180	1,000			
union	0,161	-0,191	1,000		
gdp	-0,050	-0,364	0,271	1,000	
HPgap	-0,100	-0,186	0,025	-0,003	1,000

: Table 4. Regression results with cyclical effect

	Model			
	I	II	III	IV
HPgap	-0,233***	-0,131***	-0,117***	-0,143***
	[0,073]	[0,029]	[0,030]	[0,040]
labtax	0,528***	0,359***	0,376***	0,380***
	[0,121]	[0,115]	[0,100]	[0,114]
unempL	-	0,114***	0,101***	0,107***
		[0,023]	[0,022]	[0,024]
union	-	-	-0,094	-0,006
			[0,100]	[0,137]
gdp	-	-	-	0,098
				[0,088]
k	-15,855***	-13,156***	-10,553*	-16,383**
	[5,469]	[4,445]	[5,561]	[7,874]
Economic Forecast Report Dummy (DEF)	included	included	included	included
R-squared within	0,339	0,442	0,411	0,426
R-squared overall	0,012	0,049	0,060	0,014
Breusch and Pagan test (p-value)	0,000	0,000	0,000	0,000
Mundlak test (p-value)	0,007	0,002	0,000	0,000
Number of countries	11	11	11	11
Obs	2.420	2.372	2.294	2.268

Notes: In the table are reported the estimation results of eq. (1) without the interaction between HPgap and Dperiod. Period: 1981-2013. Sample: UE12 countries (with the exclusion of Luxembourg). Estimator: random-effect. Dependent variable: nawru. ***, **, * statistical significance of the parameters at 1, 5, and 10%. Cluster-robust standard errors appear in parentheses. We use Stata11 for all calculations. Source: our estimates.

: Table 5. Regression results with cyclical effect in the pre- and post-crisis periods

$Dperiod_y$	Model		
	I (2002-07)	II (2008-10)	III (2011-13)
HPgap	-0,093**	-0,204***	-0,095***
	[0,045]	[0,047]	[0,036]
HPgap×Dcore×Dperiody	-0,132**	0,081**	-0,177
	[0,060]	[0,038]	[0,203]
HPgap×(1-Dcore)×Dperiody	-0,128**	0,244***	-0,279*
	[0,051]	[0,045]	[0,144]
labtax	0,423***	0,403***	0,315***
	[0,122]	[0,113]	[0,119]
unempL	0,109***	0,107***	0,098***
	[0,023]	[0,019]	[0,021]
union	-0,005	-0,001	0,018
	[0,169]	[0,149]	[0,154]
gdp	0,117	0,088	0,090
	[0,103]	[0,090]	[0,094]
k	-18,772**	-17,205**	-13,767*
	[9,327]	[8,669]	[8,350]
Economic Forecast Report Dummy (DEF)	included	included	included
$\beta_{Dcore} = \beta_{(1-Dcore)}$ (p-value)	0,928	0,001	0,706
derivate of nawru with respect to Dcore	-0,226***	-0,123***	-0,272
derivate of nawru with respect to (1-Dcore)	-0,221***	0,040	-0,374**
R-squared within	0,436	0,454	0,437
R-squared overall	0,009	0,018	0,017
Breusch and Pagan test (p-value)	0,000	0,000	0,000
Mundlak test (p-value)	0,000	0,000	0,000
Number of countries	11	11	11
Obs	2.268	2.268	2.268

Notes: In the table are reported the estimation results of eq. (1). Period: 1981-2013. Sample: UE12 countries (with the exclusion of Luxembourg). Estimator: random-effect. Dependent variable: nawru. ***, **, * statistical significance of the parameters at 1, 5, and 10%. Cluster-robust standard errors appear in parentheses. We use Stata11 for all calculations. Source: our estimates.

References

Ball, L. M. (2009): "Hysteresis in Unemployment: Old and New Evidence," Working Paper 14818, National Bureau of Economic Research.

Blanchard, O., and L. F. Katz (1997): "What We Know and Do Not Know about the Natural Rate of Unemployment," *Journal of Economic Perspectives*, 11(1), 51–72.

Blanchard, O. J., and L. H. Summers (1986): "Hysteresis and the European Unemployment Problem," Working Paper 1950, National Bureau of Economic Research.

Estevao, M. M., and E. Tsounta (2011): "Has the Great Recession Raised U.S. Structural Unemployment?," IMF Working Papers 11/105, International Monetary Fund.

Estrella, A., and F. S. Mishkin (2000): "Rethinking the Role of NAIRU in Monetary Policy: Implications of Model Formulation and Uncertainty," Working Paper 6518, National Bureau of Economic Research.

Fantacone, S., P. Garalova, and C. Milani (2015): "Deficit strutturali e politiche di bilancio: i limiti del modello europeo," *Rivista di Politica Economica*, 1(1).

Friedman, M. (1968): "The Role of Monetary Policy," *American Economic Review*, LVIII(1).

Gianella, C., I. Koske, E. Rusticelli, and O. Chatal (2008): "What Drives the NAIRU? Evidence from a Panel of OECD Countries," OECD Economics Department Working Papers 649, OECD Publishing.

Gordon, R. J. (1997): "The Time-Varying NAIRU and Its Implications for Economic Policy," *Journal of Economic Perspectives*, 11(1), 11–32.

Modigliani, F., and L. Papademos (1975): "Targets for Monetary Policy in the Coming Year," *Brookings Papers on Economic Activity*, 6(1), 141–166.

Orlandi, F. (2012): "Structural unemployment and its determinants in the EU countries," European Economy - Economic Papers 455, Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.

Phelps, E. S. (1968): "Money-Wage Dynamics and Labor-Market Equilibrium," *Journal of Political Economy*, 76(4), 678–711.

Stiglitz, J. (1997): "Reflections on the Natural Rate Hypothesis," *Journal of Economic Perspectives*, 11(1), 3–10.

The European Commission (2010): "The Production Function Methodology for Calculating Potential Growth Rates & Output Gaps," European Economy - Economic Papers 535, Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.

——— (2013): *Labour market developments in Europe, 2013*. The European Commission.

——— (2014): *European Economic Forecast*. The European Commission.

——— (2015): *Making the best use of the flexibility within the existing rules of the Stability and Growth Pact*. The European Commission.