

**On the long run negative effects of public deficit on unemployment
and the need for a fiscal constitution:
An empirical research on OECD Countries (1980-2009)**

- November 2011, preliminary and incomplete version -

Abstract

In his paper on the need of new constitutional fiscal rules William Niskanen maintains that the lack of fiscal rules limiting borrowing and taxes may easily lead to fiscal choices that while useful to get electoral consensus in the short run have an adverse effect in the long run. Here we test Niskanen's proposition by investigating on a panel of 22 OECD countries (1980-2009) the relationship between No Accelerating Inflation Rate of Unemployment, NAIRU, as dependent variable and Underlying government net lending, as a percentage of potential GDP (UNLG/pot GDP) and the total receipts (general government) as a percentage of GDP controlling the results with additional variables which may be credited to impact on NAIRU also in the short run. We found that UNLG/pot.GDP and the increase in fiscal burden are both relevant in increasing the NAIRU in the long run. Thus one can say that, in the long run, high deficits not only do not reduce unemployment but aggravate it, and high tax burdens needed to finance the service of the debt and other public expenditures, under an invariant UNLG/pot.GDP, further increase the NAIRU. In the short term no adverse effect of these variables is significant. Therefore Niskanen's proposition seems to be validated for the OECD countries. Results are robust to the presence of cross section correlation.

Keywords: NAIRU, fiscal policies indicators, cointegration analysis

JEL Codes: C23, E24, E62, H62

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1. Introduction

In his paper on new constitutional rules to limit federal borrowing and taxes, William Niskanen maintains that the expansion of the public expenditure by deficit spending or taxation has adverse long run effects, but this is not apparent in the short term. “The absence of obvious near-term adverse effects of the federal deficit, moreover, has contributed to the erosion of the political discipline necessary to enforce a sustainable fiscal policy; if some adverse effects had been more apparent, the normal political incentives of Congress would probably have been sufficient to reduce the growth of the federal debt.” (Niskanen, 1992, p.20) Niskanen therefore argues that “The case for a new constitutional rule on the authority to increase the federal debt is to protect our children from our own lack of fiscal discipline.” (p.20). The effect of this “lack of fiscal discipline” consists in the burden of taxes to pay for the service of the debt and for the increase public expenditures on the future taxpayers. In particular, Niskanen argues that “each new generation of voters and taxpayers would clearly prefer that less borrowing had been authorized in prior years.” One might object that while it is true that each new generation of voters and taxpayers would prefer to have a lower burden of interests on public debt and lower taxes, it may also be true that the past public debt had been devoted to expenditures highly productive for the new generation and that the increased level of public expenditure provides a net benefit. A reply to these two objections may be found in Niskanen’s article where he shows that there is evidence that under simple majority rule as that valid for the 24 US presidential elections, incumbency and growth favor the candidate of the incumbent party while higher taxes favor the opposition candidate and that the negative effect on the incumbent of taxes is higher than that of higher expenditure (likely related to them) “probably because future taxes are more closely related to current taxes than to current expenditure”. In other words there is an incentive to deficit spending as far as it stimulates present growth or is devoted to other popular policies, whereas the increase of expenditures financed by taxes does not help the incumbent party to win the (presidential) elections, likely because its distant beneficial effects are perceived with a lower intensity than the future burden of taxes. One may therefore infer that an investment or current expenditure that gives tangible benefits in terms of present employment and profits to some interest group that, in this way, might be induced to vote for the incumbent may be preferred to a public expenditure that may give important benefits in the future but less tangible benefits in the present to decisive interest groups. And obviously then the policy of deficit to finance public investments is not beneficial for the future taxpayer. These inferences from Niskanen’s statistical test on the Presidential election are reinforced by the subsequent econometric test that he provides as for the relation between increases of taxes to finance new public expenditures and to service past deficits and migrations, for 48 contiguous US states from 1980 to 1986. It results that an increase of taxes reduces the immigration or generates emigration. This, obviously, means that the increase in taxation to pay for present or past public expenditure, is not beneficial for the voters, even if approved by the majority, because it has an

adverse effect on migration. William Niskanen's conclusion is that the simple majority rule does not assure at all that the public choices about public expenditures whether financed by taxes or by debts are beneficial to the majority, not to speak of the minority. In particular, there is no assurance that deficits done under a simple majority rule, without any constitutional constraint, would produce a net benefit for the new generations of voters and taxpayers.

Here, we investigate on a panel of 22 OECD countries (1980-2009) the long run relationship between No Accelerating Inflation Rate of Unemployment, NAIRU, and *fiscal policy's indicators*, such as Underlying government net lending (UNLG), as a percentage of potential GDP, and tax burden. In addition, we also model the short term behaviour of the dependent variable, by testing, in turn, the significance of competitiveness variables, the public consumption to GDP ratio, *the rate of growth of labour productivity* as direct measure of the efficiency of the economy and the *output gap* which helps to identify and isolate the impact of cyclical factors still present in the NAIRU (see below). Our aim is to test the Niskanen proposition that deficits and increases of taxes to finance some public spending that may be popular in the short term and may get the approval of the voters under the existing majority rule have an adverse effect on employment in the longer run. They damage the future voters who have to bear the burden of the taxes to service the debt done in the past and/or the increased level of public expenditures.

In this respect, recall that in the 1970s, the Keynesian approach – according to which market economies are inherently unstable and unable to generate an aggregate demand high enough to guarantee full employment in the economy - advised governments to intervene both in the short and in the long term¹ in order to sustain aggregate demand via public deficit.² The assumption was that, in the presence of unemployment, public debt would have not crowded out private investment. Truly, public deficit would shift resources from taxpayers to bond holders, but taxpayers' wealth would be increased by the positive effect of the debt on growth without disturbing intergenerational equity.³ Inherent to this reasoning is the idea that the new deficit would have not increased the ratio of debt to GDP. However, in the '70s public debt ratios to GDP rose considerably in many countries.⁴ Other

¹ It should be mentioned that Keynes probably believed it was necessary to concentrate on the shorter term to "save capitalism", in periods of great depression, as that during which he wrote his General Theory. The long run negative effects of fiscal policies increasing deficit and debt were not worrying him also because– without any empirical evidence – he assumed that in mature economies there is a structural excess of savings.

² This view basically implies that public debt does not pose a problem if the government runs this debt in the home country: no resources are lost and public deficits merely reallocate resources from taxpayers to bond holders.

³ The intergenerational redistribution also justifies a non Keynesian type of golden rule of public finance according to which government should finance public investments that yield long term benefits through public deficit, in order to make future generation contribute to the financing. If future generations benefit from current investment, their financing of the debt is fair and justified, otherwise they should bear all the costs but only part of the benefits.

⁴ This evolution has raised the question of the sustainability over time of the public debt path (starting with the seminal paper by Hamilton and Flavin (1986) and up to Greiner and Fincke (2009)).

economists have argued that what matters is not deficit spending *per se*, but rather the type of intervention. A huge literature on this subject appeared in the early '90s - including, among others, Giavazzi and Pagano (1990), Ardagna (2004), Giavazzi, Jappelli and Pagano (2000), McDermott and Wescott (1996), Von Hagen and Strauch (2001), and more recently, OECD (2008) and IMF (2009) and Alesina and Ardagna (2009) – and supported the view that fiscal stimuli based upon tax cuts are more likely to increase growth than those based upon spending increases⁵ After the 2007 crisis, when governmental deficit spending was used to remedy the credit crisis caused by deficit lending due to financial markets malfunction, unemployment remained high in spite of high deficit. Krugman (2010) and Krugman and Wells (2010) argue that, for the US, the reason for this is that there has not been enough deficit yet and they ask for new deficit both by increases of public spending of any kind and reduction of taxes.

On the other hand, Jeffrey Sachs (*Financial Time*, 2010) argued that the US fiscal stimulus policies generating deficit have failed their objectives in terms of GDP growth and employment.⁶ In this line, Bertola (2011) recognises that labour market policies (like most taxes) are expensive in terms of output efficiency but their main purpose is not the maximization of aggregate employment and output, it is rather the protection of workers from wage variability and job losses and the distribution of incomes to disadvantaged individuals. Further, he argues that labour market policies might not directly increase government deficits if the revenue of labour taxes is used to finance unemployment and employment subsidies. Nevertheless, interfering with labour markets they reduce aggregate employment and productivity. Therefore, it will be harder for policymakers to address risk and distribution issues when those effects are more detrimental (Bertola, 2011). Fedeli and Forte (2011) have found a cointegrating relation between unemployment rate and net lending government ratio to

⁵ In a VAR framework, Romer and Romer (2007) considered changes in the US federal tax legislation undertaken either to solve an inherited budget deficit problem or to achieve long-term goals, and estimated the effect of such changes on real output. Blanchard and Perotti (2002) identified exogenous changes in fiscal policy and estimated fiscal multipliers both on the tax and on the spending side of the government. They found that positive government spending shocks increase output and consumption and decrease investment, while positive tax shocks have a negative effect on output, consumption and investment. Mountford and Uhlig (2008) found that both tax and spending increases have negative effects; however, spending increases do not generate an increase in consumption, whereas deficit-financed tax cuts are the most effective way to stimulate the economy. The positive effect of government spending on private consumption was also challenged by Ramey (2008), who found that consumption declines after increases in government spending.

A substantial literature has investigated political and institutional effects on fiscal policy and, in particular, on the propensity of different parties in different institutional settings to prolong fiscal imbalances, or to reign them in promptly. On politico-institutional effects, such as the role of electoral laws, on the occurrence of loose or tight fiscal policy, see Persson and Tabellini (2003) and Milesi Ferretti, Perotti and Rostagno (2002). On delayed fiscal adjustments, see Alesina and Drazen (1999). Alesina Perotti and Tavares (1998) study which parties are more (or less) likely to run fiscal stimuli or fiscal adjustments.

⁶ He argues that the US fiscal policies used to re-launch the US economy both in the short and in the long run have always found the public consensus, even in the presence of increasing debts, because of the *mere political appeal* of both tax cuts and rising public expenditures. On the other hand “Governments are fighting for market credibility via draconian cut in spending. This too is the wrong approach. We should avoid a simplistic austerity to follow the simplistic stimulus of last year. (...) First, governments should work within a medium-term budget framework of five years, and within a decade-long strategy on economic transformation. Deficit cutting should start now, not later, to achieve manageable debt-to-GDP ratios before 2015.”

GDP for OECD countries. This was interpreted as supporting the view that fiscal deficit policies in the long run aggravate unemployment and *viceversa*. The tests, repeated for the OECD countries belonging to the European Union, that have on average higher NAIRU, reveal a stronger negative effect of the deficit on employment for the EU countries as compared to the whole sample. The insight of Fedeli and Forte (2011) is that public deficit and unemployment are intertwined in the long run. Here we further investigate the issue in order to verify if additional fiscal policy variables, jointly with public deficit, find room in a cointegrating relationship. Thus we want to provide more insight on the influence of fiscal policy on the labor market equilibrium in the long term. As mentioned, when estimating cointegration vectors we abstract from the short term interaction between deficit and unemployment and concentrate upon structural issues. In fact, we choose to analyze the determinants of the NAIRU (on this issue see also Gianella et al. (2009)).

In section 2 we report evidence on the relation between NAIRU as dependent variable and the considered fiscal policy variables. We refer to a panel of 22 OECD countries for a maximum time period from 1980 to 2009. In section 3 we test for co-integration among the considered variables. Conclusions follow in section 4.

2. Unemployment rate and government policies

In the recent years policies of fiscal deficits have played a major role *vis a vis* the financial crisis with controversial results in terms of effectiveness. On the one side, one may argue that government deficits can smooth out the implications of temporary shocks caused by malfunctioning of the financial markets. For this reason, policies targeted to the labour market have been prominent in many countries. On the other side, the need to service or reduce public debt, originating from such policy choices, might result in higher unemployment and lower quality employment and output, that decrease the denominator of public debt/GDP ratios and endanger the sustainability of public finances. (Bertola, 2011)⁷

Although it is too early to assess by an econometric research the appropriateness of these policies for the last financial crisis, here we want to throw some light on the issue by examining what the past experience may teach. Therefore, based on Fedeli and Forte (2011) who find a cointegrating relation between unemployment rate and net lending government ratio to GDP, we further explore the fact that labour market and fiscal policies are intertwined not only in the short term but also in the long term. In facts, short term links are due to automatic stabilizers and to the reaction of discretionary policy to the economic cycle. The latter can be procyclical or countercyclical according to the

⁷ Bertola (2011) analyses the specific impact (on employment and unemployment rates) of unemployment insurance generosity and active labor market policies as compared with labour tax rate and public interest payments in different groups of countries: Nordic (Denmark, Finland, Norway, Sweden), Anglo-Saxon (Australia, Canada, Ireland, United Kingdom, United States), Continental (Austria, Belgium, France, Germany, Netherlands), Mediterranean (Italy, Portugal, Spain).

priorities of the policy maker; the Keynesian approach calls for expanding the deficit in case of economic downturns, but the policy maker with a different orientation might want to attempt to consolidate the budget. We investigate the issue in order to find out whether a set of variables that are traditionally credited to influence the labor market equilibrium can, jointly with public deficit, find room into a cointegrating relationship. Following Gianella et al. (2009), who studied the impact of structural factors directly on the Natural Rate of Unemployment (NAIRU), as a first approach we abstract from the interactions that takes place in short term and that are linked to the cycle. Thus when estimating the parameters of cointegrating vector we include in its specification only those variables that are considered **long term determinants of the NAIRU**. Within this new framework, however, the correct measure of the public finance stance is represented by “*underlying government net lending as a percentage of potential GDP*”. In fact this variable provides an estimate of the public deficit to GDP ratio once the impact of cyclical conditions and of temporary fiscal policy intervention has been removed. The actual budget balance encompasses the cyclical component of economic activity and therefore fluctuates around the structural budget balance. In contrast, the structural budget balance reflects what government revenues and expenditures would be if the output was at its potential level and therefore it does not reflect cyclical developments in economic activity.

We also test the presence in a cointegrating relationship of other *fiscal policy's indicators*. Amongst the policy variables we have evaluated the statistical significance of a few budget items that, in addition to the deficit, are deemed to convey the impact of fiscal policy and that could affect directly or indirectly the equilibrium rate of unemployment. To start with, we included *general government total receipts as a percentage of GDP*, which represents the overall tax burden imposed on the economy and therefore on all factors of production. In this respect, one may also argue that a high tax burden particularly implies an high tax on labour whether directly or indirectly through consumption taxation.⁸ We also consider the *total government expenditures as a percentage of GDP* and *underlying primary expenditure as a percentage of GDP*. Both variables provide a measure of the share size of the public sector which, in a strand of the economic literature, is credited to crowd out productive (private) expenditure. The latter represents the amount of expenditure directly (at least in the medium term) controlled by the fiscal policy. We, finally, took into account *public consumption and investment*, again as a percentage of GDP. The grasp provided by the usage of these “simple”

⁸ More in general in this paper we do not attempt to benchmark our effort against the empirical works that assess the influence of that explains the changes of the NAIRU with imperfective competitive labor and product markets. Typically, in addition to the tax wedge, the proxies used for assessing the impact of market imperfections are measures of unemployment benefit generosity, the degree of stringency of employment protection legislation; union membership rates. For a comprehensive review of this wide strand of literature see Bassanini and Duval (2006). A similar approach contemplates dueling on the interaction between institutions and adverse economic shocks, where the former could amplify and lengthen fluctuations by delaying and/or weakening the required adjustment of wages and prices and cause unemployment hysteresis. For an assessment of the impact of the latest financial crisis carried out using this framework see Boil et Al. (2011).

public finance variables is that the public sector size might generate inefficiencies and costs which, in turn, will affect the structural unemployment.

Using very much the same argument, i.e. controlling for factors that in the medium term could drive output behaviour, we tested also competitiveness variables such as labour productivity and trade openness. Indeed public investment could fall also in this category. However it can be anticipated that all the above variables *except for the total receipts as percentage of GDP* failed to enter in a cointegrating relationship; i.e. we did not find a long term impact on unemployment.

In addition to including complementary variables in the cointegrating vector, we also model the **short term behaviour of the dependent variable**. As already stated, interactions between unemployment rate and the budget deficit which are due to the cycle should be cancelled out by our choice of using the NAIRU as dependent variable and the underlying deficit to GDP as a percentage of potential GDP as explanatory variable. However, although the NAIRU is a medium term notion, we postulate the presence of short term factors that affects its year on year changes (i.e., its annual dynamics). In modelling the short term we have evaluated, in turn, the significance of the above mentioned competitiveness variables and of the public consumption to GDP ratio. In our list of regressors we also included *the rate of growth of labour productivity* as direct measure of the efficiency of the economy.

Productivity is not a policy variable but may be influenced by structural reforms.⁹ Its impact on the NAIRU is disputed and two main explanation of its relevance have been recently put forward. One related to wage formation mechanisms, states that wage increases are based on worker ‘aspirations’, which are determined by past wage increases (Ball and Moffitt 2002). Past wage behaviour, in turn, is related to past productivity trends. If productivity shocks occurs then workers wage claims will – for some time – continue to be driven by past productivity performance with effects on unemployment. In this model a permanent increase in the growth rate of productivity has only transitory effects on unemployment, as the growth of wage aspirations eventually catches up with productivity growth. An alternative approach (Pissarides 2000) is provided by search models which contemplate job creation and job destruction. In this frameworks new jobs are created at a cost, which increases with labour market tightness, but they yield rents into the future. Whilst an increase in productivity growth increases future returns to a job match, higher interest rates reduces its present value. Wages are determined through a wage curve that reflects labour’s bargaining strength. In these models permanently faster productivity growth, relative to the interest rate, causes permanently lower equilibrium unemployment. Using a panel of OECD countries Pissarides and Vallanti (2005) find that unemployment rates are reduced by productivity growth and increased by interest rates.

⁹ There is an ever growing literature on policy impact on productivity. This out of the scope of this paper, for a discussion on the issue see for instance IMF (2008).

One additional reason for allowing for its presence in the specification is that it acts as a control with respect to the underlying deficit to GDP ratio. Indeed the latter variable could have a different impact on the unemployment rate depending on the productivity behaviour. A rising productivity drives up the denominator of the ratio of deficits to GDP and a better performance of productivity may encourage to undertake new investments. However it remains to be seen whether this implies additional employment. Finally, particularly important for our short term analysis, the inclusion of a variable representing the *output gap* helps to identify and isolate the impact of cyclical factors still present in the NAIRU. Thus, short-term improvements in NAIRU due to a pick-up in economic activity may be reversed as activity slows down and should therefore not be seen as an underlying structural improvements.

Table 1 reports the summary statistics of the considered variables.

Table 1. Summary statistics of the considered variables

Variable	Obs	Mean	Std.Dev.	Min	Max
Year	660	1994.5	8.662006	1980	2009
NAIRU	660	6.272481	2.903082	0.607588	15.42445
UNLG/pot.GDP	632	-2.58852	3.523067	-14.7297	6.120251
Gov.tot.receipts/GDP	634	43.27274	8.275034	26.3093	63.47088
Und.primary disbursement/pot.GDP	634	41.74304	7.777732	28.03563	61.12514
Public consumption/GDP	604	0.079891	0.022031	0.030885	0.179458
tc_lab_prod	660	1.381496	1.728864	-6.87508	7.627972
Trade openness	660	74.97041	46.55131	16.01212	321.5754
Output gap	659	-0.37691	2.372412	-8.93089	7.010947

3. The model

We verify co-integration by using a panel consisting of 22 OECD countries and spanning the years 1980 to 2009; the data have annual frequency and the variables are taken in levels. The countries considered are Japan, New Zealand, the USA, Australia, Canada, Iceland, Norway, plus 15 OEDC countries belonging to the European Union (i.e. Austria, Belgium, Denmark, Finland, France, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Swiss, Sweden, the UK).

In what follows we report only the final outcome of our analysis; i.e. we do not provide results for those variables and specifications that do not pass the cointegration test and therefore do not enter in a cointegration vector. They are available from authors on request.

The model we postulate is the following:

$$NAIRU_{it} = \theta_{1i}(UNLG/pot. GDP)_{it} + \theta_{2i}(X)_{it} + \dots + \mu_i + \varepsilon_{it} \quad (1)$$

Where: X is a set of additional variables entering the cointegrating relationship, μ_i are intercept country effects and ε_{it} are white noise errors.; $i = 1, 2, \dots, N$ is the number of nations; $t = 1, 2, \dots, T$ represents the number of periods. If the variables are $I(1)$ and cointegrated, then the error term is $I(0)$. The long-run coefficients θ_{1i} , and θ_{2i} are of particular interest.

As for the short term behaviour, the error correction specification is

$$\Delta NAIURU_{it} = \delta_{0i} + \Phi_i [NAIURU_{i,t-1} \theta_{0i} + \theta_{1i} (\text{UNLG/pot.GDP})_{it} + \theta_{2i} (X)_{it}] + \delta_{1i} Z_{it} + \varepsilon_{it} \quad (2)$$

With the inclusion of θ_{0i} , a nonzero mean of the cointegrating relationship is allowed. θ_{0i} are the long-run coefficients as from equation (1). Φ_i is the error-correction speed of adjustment parameter, Z_i is a vector of stationary variables entering the dynamic specification and δ_i are the corresponding coefficients. ε_{it} are white noise errors.

The setting of equation (1), can be modified if accounting for cross-section dependence in the data. This can be generated by unobserved factors which in this framework can be regarded as common shocks affecting all countries, but to a different degree.

Considering a vector K_i that includes all the regressors included in equation (1); i.e. $\text{UNLG/pot.}, \text{GDP}, X_i$, the model can be described as follows:

$$NAIRU_{it} = \theta_{1i} (K)_{it} + \gamma_i (f)_{it} + \mu_i + \varepsilon_{it} \quad (3)$$

$$(K)_{it} = \alpha_i + \varphi_i (f)_{it} + \psi_i (g)_{it} + u_{it}$$

Where: f and g are unobserved factors affecting the NAIRU directly or indirectly (i.e. impacting on the set of variables K) the NAIRU; φ_i and ψ_i are the country specific factor loads which cause an heterogeneous response to the common shocks.

Failure to detect cross section correlation and thus to take it into account when producing estimates with the MG methodology will give rise the omitted variables problems, thus causing bias in estimates and erroneous inference.

The outcome of the analysis, to be commented in the final part of this section, is that we found a specification that provides a cointegrating relationship which is in line with Fedeli and Forte (2011) as it includes the underlying GDP to potential output ratio as explanatory variable. Moreover, the NAIRU is also explained by total government revenues as a percentage of GDP. The results provided are divided into two sections. The first one assumes the absence of cross-section dependence in the data; the second, which is supported by statistical evidence, accounts for its presence.

3.1 Absence of cross-section dependency

The first step in our analysis has been to test whether the variables are nonstationary. We employ the test of Im *et al.* (2003) based on the assumption of no cross-sectional dependence. The tests are normally distributed under the null hypothesis of nonstationarity and permit the individual autoregressive roots to differ across the cross-sectional units. For the implementation of the test, all bandwidths and lag lengths are chosen according to $4(T/100)^{2/9}$. The number of lags is chosen according to the Akaike criterion. The test results reported in Table 2 indicates a rejection of the null at the 5% level of significance. Thus, based on the panel unit root test proposed by Im et al. (2003), we are not able to reject the presence of a unit root in either variable. We therefore conclude that the variables appear to be nonstationary.

Table 2. Im-Pesaran-Shin (2003) test on 22 OECD countries.
Deterministics chosen: constant and trend; augmented by 2 lags (average)

NAIRU						
t-bar test, N,T = (22,30)			Obs = 594			
t-bar	cv10	cv5	cv1	W[t-bar]	P-value	
-2.036	-2.380	-2.450	-2.560	0.320	0.625	
Und.primary disbursement/pot.GDP						
t-bar test, N,T = (19,30)			Obs = 513			
t-bar	cv10	cv5	cv1	W[t-bar]	P-value	
-2.116	-2.410	-2.480	-2.610	-0.104	0.458	
Gov.tot.receipts/GDP						
t-bar test, N,T = (19,30)			Obs = 513			
t-bar	cv10	cv5	cv1	W[t-bar]	P-value	
-2.005	-2.410	-2.480	-2.610	0.449	0.673	

The second step is to test whether the variables are co-integrated. We apply first the Kao (1999) tests on co-integration to data on NAIRU, UNLG/pot.GDP, Gov.tot.receipts/GDP. Thus the results presented in Table 3 show cointegration among NAIRU, UNLG/pot.GDP, Gov.tot.receipts/GDP.

Table 3. Kao Residual Cointegration test on 22 OECD countries

Series: NAIRU, UNLG/pot.GDP, Gov.tot.receipts/GDP		
Sample: 1980 2009		
Included observations: 30		
Null Hypothesis: No cointegration		
Trend assumption: No deterministic trend		
User-specified lag length: 1		
Newey-West automatic bandwidth selection and Bartlett kernel		
	t-Statistic	Prob.
ADF	-3.097721	0.0010
Residual variance	0.169088	
HAC variance	0.290535	

To provide further evidence in favour of the cointegration hypothesis we apply the Westerlund (2007) (see also Persyn and Westerlund, 2009) tests on co-integration. This tests lifts a restriction that is embedded in previous tests for cointegration requiring that the long-run parameters for the variables in their levels are equal to the short-run parameters for the variables in their differences; when the above restriction is not correct it causes a significant loss of power and the failure to reject the null of no cointegration.

Table 4 reports the outcome of four tests; in the first two the hypothesis alternative to the null is that the panel is cointegrated as a whole, while the other two test the alternative that at least one unit is cointegrated. The values of the statistics suggest that we can reject the null hypothesis of no co-integration at the 1% level for both cases.

Table 4. Westerlund ECM panel co-integration tests NAIRU, UNLG/pot.GDP, Gov.tot.receipts/GDP

Results for H0: no cointegration			
With 22 series and 2 covariates			
Average AIC selected lag length: .9500000000000001			
Average AIC selected lead length: 0			
Statistic	Value	Z-value	P-value
Gt	-2.291	-4.069	0.000
Ga	-9.974	-3.560	0.000
Pt	-16.146	-8.843	0.000
Pa	-7.789	-5.062	0.000

The following set of tables shows the estimates for the 22 OECD countries presented as a two-equation model: the normalized cointegrating vector (labelled as EC) and the short-run dynamic coefficients (labelled as SHORT RUN). The results we provide stem from three estimation methods that are coherent with different approaches to estimating the intercept and slope coefficients.

The first estimation method, Dynamic Fixed Effect regression, allows only for panel-specific intercepts and it imposes homogeneity on both the long term coefficients of the cointegrating vector and on the coefficients of the dynamics specification. Also the speed of adjustment of the error correction term is, of course, the same across all countries. An allowance for intragroup correlation in the calculation of standard errors is made with the cluster on countries.

Results are displayed in table 5.

Table 5. Dynamic Fixed Effects Regression: Estimated Error Correction Form

Standard errors adjusted with cluster(country_numerico) option.

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
EC						
UNLG/pot.GDP	-.6633376	.1793339	-3.70	0.000	-1.014825 - .3118496	
Gov.tot.receipts/GDP	.2979104	.1197416	2.49	0.013	.0632211 .5325996	
SHORT RUN						
ec	-.0852432	.0177091	-4.81	0.000	-.1199524 -.050534	
output gap	-.0446222	.0072584	-6.15	0.000	-.0588484 -.030396	
Dl.lab.prod.growth rate	.0128012	.0047484	2.70	0.007	.0034944 .0221079	
Constant	-.6750662	.4651095	-1.45	0.147	-1.586664 .2365318	

The estimated cointegrating vector (i.e. the ec term) is significant and negative as expected. The underlying primary balance coefficient is negative, this is in line with the result of Fedeli and Forte (2011). Remind, however, that here we refer to the structural budget balance which measures what the balance of tax revenues less government expenditure would be if actual GDP corresponded to potential GDP. The result that underlying structural deficits increases NAIRU in the long run indicates the need for effort and specific policy actions to redress the situation. The estimated coefficient for Gov.tot.receipts/GDP is significantly positive. This result confirms that a reduction of the tax burden, under an invariant UNLG/pot.GDP, stimulates GDP growth and employment. Indeed high taxes may weigh heavy on labour (directly by the fiscal wedge or indirectly taxing mass consumptions), on capital or on entrepreneurs, thus, discouraging employment, savings, investments, productivity and the development of enterprises.

In the short term the NAIRU results to be affected by the output gap which takes negative sign and by the rate of growth of labour productivity (taken in first differences) which takes positive sign. The negative impact of the output gap shows that cyclical factors are still present in the NAIRU and therefore that short-term improvements in NAIRU may be reversed as activity slows down. The positive sign of the rate of growth of labour productivity (taken in first differences) *prima facie* might seem a questionable result. However it is not so. Indeed, a quickly rising productivity in the up turn reduces the need to hire new employee. A good performing economy- only later on- needs more manpower to grow.

We adopted two additional estimation strategies: the Pooled Mean Group and the Mean Group estimation. The pooled mean group estimation **PMG** allows for heterogeneous short term dynamics and common long run effects of GDP. Often only the long run effects are of interest, the short run parameter estimates are averaged. The full estimates of a N+1 multiple equation model are available upon request. The mean group estimates **MG** are the unweighted mean of the N individual regression coefficients.

Tables 6 and 7 below provide respectively results of the PMG and MG estimators stemming from the same specification as in table 5. They are reported, as in the case of the DFE estimates, as a

two equation model: the normalized cointegrating vector and the short term dynamic coefficients. The full model estimates are, again, available upon request.

Table 6. Pooled Mean Group Regression: Estimated Error Correction Form

Panel Variable (i): country_nu~o	Number of obs	=	638
Time Variable (t): anno	Number of groups	=	22
	Obs per group: min	=	29
	avg	=	29.0
	max	=	29
	Log Likelihood	=	306.2153

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
ec					
und_lend_g~P	-.2970098	.0246492	-12.05	0.000	-.3453214 -.2486982
gov_rec_gdp	.1407651	.0272075	5.17	0.000	.0874394 .1940908
SR					
ec	-.096649	.0110036	-8.78	0.000	-.1182156 -.0750824
out_gap	-.0499179	.0082217	-6.07	0.000	-.0660322 -.0338036
tc_lab_prod					
D1.	.0161806	.0044766	3.61	0.000	.0074067 .0249544
_cons	-.0151435	.0551312	-0.27	0.784	-.1231987 .0929117

Table 7. Mean Group Regression: Estimated Error Correction Form

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
ec					
und_lend_g~P	-.4659257	.3477541	-1.34	0.180	-1.147511 .2156598
gov_rec_gdp	.5401541	.4589414	1.18	0.239	-.3593544 1.439663
SR					
ec	-.0841468	.0189164	-4.45	0.000	-.1212222 -.0470714
out_gap	-.0350606	.0061046	-5.74	0.000	-.0470253 -.0230959
tc_lab_prod					
D1.	.0124785	.0039126	3.19	0.001	.00481 .0201471
_cons	.2402274	.6223915	0.39	0.700	-.9796375 1.460092

The different estimation methods provide different outcomes. As explained above, their main difference concerns assumption on coefficients with the DFE – at one extreme – imposing more restrictions and the Mean Group estimation representing the most flexible specification and allowing even slope coefficients to vary across countries. The validity of the restrictions can be tested via Hausman test. It turns out, as shown in table 8, that the restriction enforced by the DFE estimators are accepted by data.

Table 8. Hausman (1978) restriction test on coefficients.

<p><u>MG vs PMG</u> Test: Ho: difference in coefficients not systematic chi2(2) = 0.11 Prob>chi2 = 0.9452 (The PMG estimator, under the null hypothesis, is preferred)</p>
<p><u>MG vs DFE</u> Test: Ho: difference in coefficients not systematic chi2(2) = 0.01 Prob>chi2 = 0.9973 (The DFE estimator, under the null hypothesis, is preferred)</p>
<p><u>DFE vs PMG</u> Test: Ho: difference in coefficients not systematic chi2(2) = 620.90 Prob>chi2 = 0.0000 (The DFE estimator, under the null hypothesis, is preferred)</p>

The first insight we gather from the above tables is that the Hausman test has provided some evidence in favor of the DFE estimation strategy. In addition to that, the usage of three different estimators provides indications on the specification of the cointegrating vector. The results are robust in that the sign of the long term variables coefficients are always confirmed, only their size is affected by the estimation method, with the DFE model providing larger estimates (in terms of absolute values) for the long-term parameters. This is consistent with the insight provided by Pesaran and Smith (1995). The coefficients of the dynamics and the speed of adjustment terms are, however, very similar in size.

3.2 Presence of cross-section dependency

The presence of cross-section dependence within the framework of our dataset is highly likely. Developed economies tend to be hit by globally common shocks even though they are affected in an heterogeneous manner, i.e. the impact varies according to their institutions and, in particular, to their fiscal framework. For a review of the panel time series literature see Eberhardt and Teal (2011).

Here we investigate this issue by implementing the most commonly used test for cross section dependency (Pesaran, 2003 and 2004). The CD test allows for the computation of the tests statistics both when variables are considered individually and when multiple variable series are tested at the same time.

Table 9 provides the results when variables are considered individually. Table 16 refers to the same statistics applied to the groups of variables included the specifications under investigation.

Table 9. Average correlation coefficients & Pesaran (2004) CD test. Individual variables

Variables series tested: NAIRU				
Group variable: country_numerico				
Number of groups: 22				
Average # of observations: 31.43				
Panel is: unbalanced				
-----	-----	-----	-----	-----
Variable	CD-test	p-value	corr	abs(corr)
-----	-----	-----	-----	-----
NAIRU	16.41	0.000	0.197	0.587
-----	-----	-----	-----	-----
Notes: Under the null hypothesis of cross-section independence CD ~ N(0,1)				
Variables series tested: und_lend_gov_potGDP				
Group variable: country_numerico				
Number of groups: 22				
Average # of observations: 28.95				
Panel is: unbalanced				
-----	-----	-----	-----	-----
Variable	CD-test	p-value	corr	abs(corr)
-----	-----	-----	-----	-----
und_lend_g~P	26.34	0.000	0.333	0.426
-----	-----	-----	-----	-----
Notes: Under the null hypothesis of cross-section independence CD ~ N(0,1)				
Variables series tested: gov_rec_gdp				
Group variable: country_numerico				
Number of groups: 22				
Average # of observations: 29.10				
Panel is: unbalanced				
-----	-----	-----	-----	-----
Variable	CD-test	p-value	corr	abs(corr)
-----	-----	-----	-----	-----
Gov.tot.receipts/GDP	11.60	0.000	0.140	0.499
-----	-----	-----	-----	-----
Notes: Under the null hypothesis of cross-section independence CD ~ N(0,1)				

Table 10. Average correlation coefficients & Pesaran (2004) CD test. Pooled variables

Variables series tested: NAIRU und_lend_gov_potGDP gov_rec_gdp				
Group variable: country_numerico				
Number of groups: 22				
Average # of observations: 28.95				
Panel is: unbalanced				
-----	-----	-----	-----	-----
Variable	CD-test	p-value	corr	abs(corr)
-----	-----	-----	-----	-----
NAIRU	10.93	0.000	0.125	0.604
-----	-----	-----	-----	-----
und_lend_g~P	26.34	0.000	0.333	0.426
-----	-----	-----	-----	-----
gov_rec_gdp	11.05	0.000	0.134	0.495
-----	-----	-----	-----	-----
Notes: Under the null hypothesis of cross-section independence CD ~ N(0,1)				

The above tests reject the null of lack of cross-section dependence. We thus proceed by repeating the same sequence of procedures of the above paragraph – i.e. testing for unit root and for

the presence of cointegration and finally estimating cointegrating relationships – but allowing for cross section dependence.

We first run the t-test for unit roots in heterogenous panels with cross-section dependence (CADF), proposed by Pesaran (2003), which is the homologous of Im, Pesaran and Shin (IPS, 2003) test. This test is based on the mean of individual DF (or ADF) t-statistics of each unit in the panel and it assumes as the null hypothesis that all series are non-stationary.¹⁰ We provide also the statistics of a truncated version of CADF statistics which has finite first and second order moments. It allows to avoid size distortions, especially in the case of models with residual serial correlations and linear trends (Pesaran, 2003). As in this case the size of T is fixed (and is not large enough to rely on asymptotic properties) the test is applied to the deviations of the variable from initial cross-section mean assuring that the CADF statistics do not depend on the nuisance parameters. Lags of the dependent variable are introduced with the aim of controlling for serial correlation in the errors. We investigated results for a number of lags spanning from 1 to 4, with the ensuing statistics $Z[\bar{t}]$ is distributed standard normal under the null hypothesis of nonstationarity. The vast majority of the statistics confirmed the nonstationarity already found in the previous section (results are available upon request).

This prompts a further test to confirm that the variables are still cointegrated. Following Westerlund (2006) and Persyn and Westerlund(2008), we assume their same data generating process for their error correction test and test for cross sectional independence in its residuals by means of the Breusch-Pagan statistic. In this respect, notice that this test requires $T > N$. As our time series are rather short, given that some periods are lost in the calculation of differenced variables and lags, we tested only for independence of the first 20 cross-sectional units and assume the same short-run dynamics for all series. In the case of the relation among NAIRU, UNLG/pot.GDP, Gov.tot.receipts/GDP we obtain Breusch-Pagan LM test of independence: $\chi^2(91) = 398.173$ (Pr = 0.0000). As these results strongly indicate the presence of common factors affecting the cross-sectional units, we bootstrapped robust critical values for the test statistics related to the Westerlund ECM panel cointegration tests. Given that the Akaike optimal lag and lead search is time-consuming when combined with bootstrapping, we held the short-term dynamics fixed. Results shown in table 11 should be considered bearing in mind that Gt and Pt tests are robust to the cross-section correlation. The outcome is that, when we take into account cross-sectional dependencies, the tests still reject the null hypothesis of no cointegration.

¹⁰ To eliminate the cross dependence, the standard DF (or ADF) regressions are augmented with the cross section averages of lagged levels and first-differences of the individual series.

**Table 11. Westerlund ECM panel co-integration tests, bootstrapped critical values
NAIRU, UNLG/pot.GDP, Gov.tot.receipts/GDP**

Results for H0: no cointegration
With 22 series and 2 covariates
Average AIC selected lag length: .95
Average AIC selected lead length: .36

Statistic	Value	Z-value	P-value	Robust P-value
Gt	-2.353	-4.348	0.000	0.001
Ga	-9.238	-2.928	0.002	0.009
Pt	-16.146	-8.843	0.000	0.023
Pa	-7.789	-5.062	0.000	0.039

Given this outcome we evaluated if, first of all, the presence of cross section correlation changes at all the results when estimating the cointegration vector. The long run coefficients estimated by means of the Common Correlated Effects Mean Group estimators (CCEMG, Pesaran 2006) are reported in table 12

**Table 12. Common Correlated Effects Mean Group estimator and CD residual test
NAIRU und_lend_gov_potGDP gov_rec_gdp**

All coefficients present represent averages across groups
Coefficient averages computed as outlier-robust means (using rreg)

Mean Group type estimation
Group variable: country_num~o

Number of obs	=	632
Number of groups	=	22
Obs per group: min	=	20
avg	=	28.7
max	=	30
Wald chi2(2)	=	10.13
Prob > chi2	=	0.0063

NAIRU	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
UNLG/pot.GDP	-.0916602	.0402844	-2.28	0.023	-.1706161 - .0127043
Gov.tot.receipts/GDP	.1248601	.0560882	2.23	0.026	.0149292 .2347909
cons	-3.813541	3.333862	-1.14	0.253	-10.34779 2.720708

Cross-section averaged regressors for:

NAIRU	.9535777	.267807	3.56	0.000	.4286855 1.47847
UNLG/pot.GDP	.0487082	.0707226	0.69	0.491	-.0899056 .1873219
Gov.tot.receipts/GDP	-.0239514	.0929905	-0.26	0.797	-.2062095 .1583067

Root Mean Squared Error (sigma): 0.4121

Residual series based on country regressions stored in variable: cce_res

Average correlation coefficients & Pesaran (2004) CD test

Residual series tested: cce_res

Variable	CD-test	p-value	corr	abs(corr)
cce_res	-0.08	0.936	-0.005	0.266

Notes: Under the null hypothesis of cross-section independence CD ~ N(0,1)

Results of the CCEMG estimator provide additional evidence in favour of our specification. The regressors are still significant and correctly signed. Interestingly, their size is smaller. We then move on to achieve an error correction representation likewise it was made in the case of absence of cross section correlation. In order to do so we use the PMG estimator to which we impose the long term specification estimated with the CCEMG estimator¹¹.

**Table 13. Pooled Mean Group Regression: Estimated Error Correction Form.
Constrained long term**

Pooled Mean Group Regression (Estimate results saved as pmg)						
Panel Variable (i): country_nu~o		Number of obs		=	638	
Time Variable (t): anno		Number of groups		=	22	
		Obs per group: min		=	29	
		avg		=	29.0	
		max		=	29	
				Log Likelihood	=	302.0699
D.NAIRU	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
ec	Z	-1
SR	ec	-.0789654	.0180731	-4.37	0.000	-.114388 - .0435428
	out_gap	-.0524487	.0086824	-6.04	0.000	-.0694658 - .0354316
	Dltc_lab_prod	.0147703	.0046613	3.17	0.002	.0056343 .0239063
	_cons	.1491263	.0708877	2.10	0.035	.0101889 .2880636

The results are quite aligned with those presented in the “no cross section dependence” section, in particular they are very similar to the estimates produced with the MG models.

4. Preliminary Conclusions

According to William Niskanen the lack of constitutional fiscal rules limiting borrowing and taxes may lead to fiscal choices that while useful to get electoral consensus in the short run have an adverse effect in the long run. With a panel of 22 OECD countries (1980-2009), we investigated the long run relationship between NAIRU as dependent variable and the underlying government net lending as a percentage of potential GDP, UNLG/pot.GDP and other fiscal policy variables, in their relation to GDP, i.e., several public expenditures aggregates (total, net of interests, public consumption and investment), total receipts of general government (taken as a proxy of the fiscal burden) as well as proxies of external competitiveness. Moreover we tested for the short term behaviour of NAIRU,

¹¹ The variable Z corresponds to the expression $-3.813541-.0916602*\text{und_lend_gov_potGDP}+.1248601*\text{gov_rec_gdp}$

controlling for additional structural variables which may be credited to affect it, in particular the rate of growth of labour productivity and the output gap.

When considering structural variables, in addition to UNLG/pot.GDP, also the fiscal burden is relevant in affecting the NAIRU in the long run: *ceteris paribus*, the increase of the fiscal burden increase the NAIRU. Thus one can say that high deficits not only do not reduce unemployment but aggravate it, in the long run. Moreover high tax burdens needed to finance the service of the debt and other public expenditures, under an invariant UNLG/pot.GDP, further increase the NAIRU. Thus the taxpayers that have to pay high taxes on labour (directly by the fiscal wedge or indirectly mass consumptions' taxation), on capital or on business, because of the debt directed to reduce unemployment through Keynesian or other policies, popular in the short run do not see any positive result from their costly effort. And the high taxes discouraging employment, savings, investments, productivity and the development of enterprises, increase NAIRU even aside their task of servicing a high public debt. Therefore, William Niskanen proposition about the need of a fiscal constitution limiting debt and taxes in order to protect the future voters from short sighted fiscal choices appears well grounded in the empirical evidence as far as the OECD countries characterized by democratic institutions are concerned.

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