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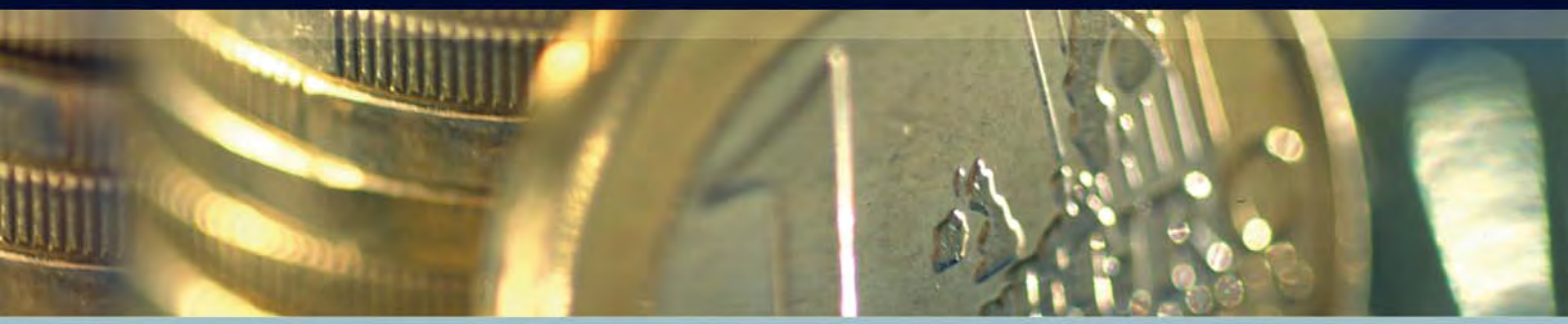

Unexpected changes in tax revenues and the stabilisation function of fiscal policy: Evidence for the European Union 1999-2008

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UNEXPECTED CHANGES IN TAX REVENUES AND THE STABILISATION FUNCTION OF FISCAL POLICY [1]

EVIDENCE FOR THE EUROPEAN UNION, 1999-2008

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Abstract

This paper analyzes the size and the determinants of unexpected changes in EU countries' tax revenues and their impact on the ability of EU governments to use fiscal policy as a macroeconomic stabilisation device. We make use of information taken from the Stability and Convergence Programmes (SCP) setting countries' medium-term fiscal plans and focus on the period preceding the 2008/2009 global financial crisis. Tax revenue surprises are found to have fluctuated widely, alternating periods of sizeable windfalls and periods of substantial shortfalls.. When analysing the determinants of these unexpected changes in tax revenues, we find that GDP growth surprises and, in some cases (i.e. Ireland, Spain the UK and Finland) asset prices fluctuations have exerted the most significant influence. In the sequel we provide evidence on the incidence of these unexpected changes in governments' tax revenues on the ability of governments to conduct counter-cyclical fiscal policies, which are desirable from a macroeconomic perspective. We find that countries that have experienced the largest tax revenue windfalls in the run-up to the 2008/2009 crisis have also tended to run more pro-cyclical fiscal policies although these results vary depending on the use of ex-post vs. real-time data and on the method used to calculate the cyclical position of the economy. Put differently, these results tend to indicate that while tax revenue windfalls may be good for the public purse during favourable times they may also (paradoxically) dwindle the ability of the countries concerned to run counter-cyclical fiscal policies when cyclical conditions revert.

[1] The views expressed in this paper are not necessarily those of the Banca d'Italia nor of the European Commission. The authors are especially grateful to Lucio Pench, Sandro Momigliano and Jacopo Cimadomo for very useful comments and suggestions on previous versions of this paper. A previous version of the paper was presented at the ECB Public Finance Workshop Dec. 2008 under the title: "Governments' revenues windfalls and the stabilisation function of fiscal policies".

1. Introduction

The global financial crisis has severely hit EU economies and has driven to a significant fall in governments' tax revenues which, together with the stimulus measures put in place under the European economic recovery Package (EERP), have led to a substantial deterioration in budgetary balances. While it is too early to devise a definitive picture on the total fiscal cost of the financial crisis, a number of important lessons can be drawn regarding the evolution of EU countries' budgetary balances before the 2008/2009 financial crisis. During the expansionary phase that preceded this crisis many EU governments' had benefited from large tax revenues windfalls allowing them to reach favourable budgetary positions.[2] This was especially the case of economies benefiting from dynamic internal demand and asset price appreciation such as Ireland and Spain, among others. While the surge of large tax revenues windfalls had a clear positive influence on fiscal positions till 2007, recent evolutions suggests that these countries had not exploited the full potential of these tax windfalls to run counter-cyclical fiscal policies and to contain further rise in public expenditure during good times which, with hindsight, proved to be unsustainable.[3] Such pro-cyclical behaviour of fiscal policy during good times has in turn forced many EU governments to severe retrenchments once cyclical conditions reverted, thus driving to more pro-cyclicality during the 2008/2009 recession. The main lesson from these recent evolutions is that the advent of large tax revenue windfalls during periods of economic expansions may deteriorate the ability of governments to conduct counter-cyclical fiscal policy under less favourable circumstances. So far, the evidence on the magnitude of unexpected changes in tax revenues, their determinants and their influence on the pro-cyclicality nature of fiscal policy has been largely anecdotic, however. The goals of the this paper are therefore: (i) to provide a measure of the size of unexpected changes in tax revenues in the EU during the recent period and to analyse the determinants of these changes (ii) to investigate whether unexpected tax revenues variations have had an impact on the stabilisation property of fiscal policies in the EU.

Using information about fiscal plans taken from the Stability and Convergence Programmes (SCP) submitted by the EU Member States, tax revenue windfalls are found to have represented on average 0.21% of GDP in the EU during the period 1999-2008, hiding substantial variations both across time (0.36% in 1999-2001, -0.30% in 2002-2004, 0.41% in 2005-2007) and across countries (0.67% on average per year in Finland vs. -0.38% for Greece during the period 1999-2007).

[2] See in particular European Commission (2008), Turrini (2008) and Morris and Schuknecht (2007).

By contrast, the year 2008 has, in the wake of the global economic slowdown, translated into a shortfall equal to -0.31% of GDP in the EU with countries such as Ireland (-4.3%), or Spain (-4.57%) being most heavily impacted. [4]

Our analysis suggests that the main causes of these large swings in tax revenues in the EU seem to be the unexpected business cycle developments, in particular through composition effects related to changes in the tax bases and in some cases (such as in Spain and Ireland), can be linked to asset prices fluctuations. These unexpected tax revenue changes are, in turn, found to alter significantly the conduct of fiscal policies in EU countries and particularly so in the euro-area, as these policies appear to be more pro-cyclical during years following the occurrence of large tax revenue windfalls. Evidence for this is provided by estimating econometrically fiscal reaction functions. Our estimations suggest in particular that the effect of tax revenue surprises is not symmetrical over the business cycle: while tax revenue windfalls have a bearing on the pro-cyclical nature of fiscal policy, in turn, tax revenue shortfalls do not seem to alter the relationship between the fiscal stance and the business cycle. These results appear to be robust to alternative specification making of use of different methods to estimate the business cycle position and to alternative use of real-time and ex-post information.

The rest of the paper is organised as follows. Section 2 provides a definition of government tax revenues' windfalls based on the use of the information contained in the EU Stability and convergence programmes and provides arguments regarding the relevance of this measure for fiscal surveillance. Section 3 provides estimates of the magnitude of governments' revenues windfalls in the EU during the period 1999-2008 while Section 4 analyses their determinants. Section 5 provides econometric evidence on the link between tax revenue windfalls and the stabilisation function of fiscal policy. Section 6 summarises the main findings and derives policy implications.

[3] Throughout the paper we will make use of the terms "unexpected changes in tax revenues", "tax revenue surprises" or "tax revenue windfalls/shortfalls" interchangeably, referring each time to the gap between forecast tax revenues made in year *t-1* for year *t*.
[4] Weighted (GDP) average across EU countries.

2. Definition of unexpected change in tax revenues and relevance for fiscal surveillance

Loosely speaking, the expression "unexpected changes in tax revenues", is meant to capture a higher (lower) amount of actually observed revenue compared to a certain *benchmark*. Since there is no clear-cut definition of such benchmark in the specialised literature, the definition and measurement of tax revenue surprises itself may vary. In this paper we make use of the information contained in the Stability and Convergence Programmes (SCP) in order to derive a measure of revenue windfalls/shortfalls. In particular we use governments' revenue projections included in the SCP as our *benchmark*. Since these projections are likely to fully embed both expected business cycle developments and ex-ante plans of national governments (i.e. the impact of recently legislated discretionary measures), the discrepancies between them and the actual revenue outcomes provide a simple and straightforward measure of the revenue windfalls/shortfalls. This definition is thus meant to capture the extent of the Government's tax revenue surprise, either good (windfalls) or bad (shortfalls). Fiscal data reported in the SCPs are also intended to reflect the design of a fiscal strategy for the medium term. Therefore, discrepancies between plans and actual outcomes might reflect the extent to which surprises in tax revenues are likely to alter the conduct of fiscal policy over the business cycle. The use of such fiscal plans announcement and their comparison with ex-post outcome has been used by a number of authors in the fiscal policy literature, see for instance Forni and Momigliano (2005) and Beetsma and Giuliodori (2008). To this regard, it is important to note that this conduct may not have as primary objective to counter unfavourable or favourable cyclical evolutions, however. Put differently, even in the absence of tax revenues surprises, either good or bad, fiscal policy may indeed reflect objectives different from the need to conduct stabilising macroeconomic policies. However, independently of the overall fiscal policy strategy, a better identification of tax revenue surprises may help determining whether countries that have experienced more of such windfalls (or shortfall) are less likely to run counter-cyclical fiscal policy compared to countries with lower revenues windfalls (shortfalls). In formulas, our definition of tax revenue surprise can be expressed as it follows:

$$\textit{Tax revenue surprise}_{(t)} = \Delta R_{(t)}^{ex-post} - \Delta R_{(t),(t-1)}^{SCP} \qquad (1)$$

where $\Delta RS^{SCP}_{(t),(t-1)}$ is the annual percentage change in the year *t* government total revenue-to-GDP ratio as forecasted at the end of year *t-1* and reported in the SCP[5] and $\Delta R^{ex-post}_{(t)}$ is the annual percentage change in government total revenue-to-GDP ratio that has effectively taken place in year *t*.

The definition provided in (1) is straightforward if one is to measure unexpected tax revenues gains or losses. However, other approaches and definitions can be found in the literature. The European system of central banks (ESCB), for example, developed the so-called disaggregated approach and focuses on the concept of "*unexplained" (in contrast with "unexpected")* revenues changes. Basically, in the ESCB disaggregated framework unexplained changes in tax revenue can be defined as the difference between the actual annual change in revenue-to-GDP ratio and the one that would be predicted (benchmark) when accounting for the impact of discretionary measures, changes in the tax bases and fiscal drag.[6] To the extent that the changes in these various ex-ante factors reflect the expected overall tax revenues changes as included in the SCPs, then the two measures should provide similar proxies. They could differ, however, for at least two reasons: (i) the assessment of the impact of discretionary measures; (ii) the different timing: in the ESCB disaggregated approach every information available (even ex-post) is used as explanatory factor of the revenue change, whereas projections included in the SCPs only embed information available at the moment the programme is submitted. The use of up to date information may reduce the degree of uncertainty regarding ex-post revenues development and thus yield lower estimates for the revenues' windfalls/shortfalls. Overall, it emerges that revenue windfall/shortfalls is a relative concept, as it depends on the degree of knowledge embedded in the *benchmark*, to which we compare the actual revenue outcome.

A potential weakness of our measure of unexpected revenue changes concerns the implementation of additional discretionary measures by the Government after the submission of the SCP. Clearly this is a relevant problem for what concerns projections in *t-1* for years *t+1* and *t+2*, as governments often revise their fiscal plans. This is the reason why we do not include in our dataset of revenue surprises the observations concerning the differences between revenue outcome in years *t+1* and *t+2* and projections for years *t+1* and *t+2* made at the end of year *t-1*. This problem is of less concern in the case of the differences between outcome in *t* and projection

[5] SCPs are usually submitted between the end of November of year t-1 and January of year t.

for year *t* made in year *t-1*, which is the focus of this paper. The reason is that usually discretionary measures passed in year *t* and having effect on the same year tend to be small in size and, in any case, one should always take into account the time lag usually required for fiscal measure to have effects. This said, we acknowledge that this remain in few cases a limitation of our measure. Another potential limitation is that the fiscal plans included in the SCPs are likely to be influence by political bias and willingness of governments to provide optimistic projections. By choosing to use the SCP as information source we therefore implicitly assume that this political bias is part of the revenue windfalls/shortfalls. On the one hand this bias becomes relatively important as for instance in years preceding general elections then our estimates of revenue windfall might also be biased. On the other hand, this political bias may also have a permanent effect and features the characteristics of countries which persistently tend to provide overly optimistic projections. These different possibilities are considered in the sequel.

3. Unexpected changes in tax revenues in the EU: how important are they?

Graph 1 depicts the evolution of the average of tax revenue surprises for the EU15 countries, the euro-area (which is represented by the EU15 excepting Denmark, Sweden and the UK) and the recently acceded Member States (RAMS) for the period 1999-2008, using the definition given in (1)[7]. Given that the SCPs for the RAMS only started to be submitted in 2004, the observations for these countries only start in 2005. Revenue windfalls appear to have been relatively large on average in the EU15 in 1999 (where they were equal to 0.8% of GDP) as well as in 2005 and 2006 (0.7% of GDP on average). During this latter two years revenues windfalls appear to be even more pronounced for the euro-area (0.8% of GDP for 1999 and 2005-2006). The relatively large revenue windfalls in the latter period are even more pronounced for the RAMS reaching 0.9 and 1.3 % of GDP in 2006 and 2007 respectively. The year 2008 has witnessed a sharp fall in EU countries' tax revenues with, as a consequence, large slippages from fiscal plans submitted in the SCPs of autumn 2007 which were especially pronounced in euro area (-0.7% of GDP).

It becomes clear that the evolutions of the revenue windfalls match the overall evolution in the business cycle. The period 1999-2008 can be divided into four sub-periodsaccording to the prevalence (on average) of revenue windfalls during the early years 1999-2001 and the years

[6] See Kremer, et al., (2006).
[7] Weighted (GDP) averages.

2005-2007 and the period in-between, i.e. 2002-2004, where on average the EU has experienced revenue shortfalls and finally the year 2008 where big shortfalls have been experienced in the wake of the global financial crisis. Despite the relatively homogeneity of these different sub-period, country-level experiences have sometimes been rather disperse, however. Table 1 provides country-level information on the average value of the revenue windfalls for these three periods and the average (weighted using GDP levels) figures for the relevant country groups. This is evidenced by the last three rows of Table 1 showing that the standard deviation of revenues windfalls/shortfalls was always superior to the average figures suggesting that countries' experiences across countries have differed widely. In the earlier period 1999-2001 some countries such as Luxembourg, Germany, or the Netherlands have benefited from substantial revenue windfalls while other countries such as Denmark or Portugal have experienced rather important revenue shortfalls. On the contrary, during the years 2002-2004 when revenues windfalls have turned to shortfalls in most countries (of around -0.29% of GDP in the EU15), some countries such as Finland, Denmark, Sweden, or Ireland have instead obtained substantial revenues windfalls. During the years 2005-2007, the average revenue windfalls have been the largest representing 0.40 % GDP in the EU15 (0.66 % for the RAMS). During this latter period, again, experiences have been rather diverse with counties like Cyprus, Hungary, Sweden, Spain, Ireland and Portugal experiencing above 1% point of GDP revenue windfalls while other countries such as Latvia, Malta, Slovenia, Slovakia and Greece experiencing revenue shortfalls. The biggest shortfalls following the occurrence of the global financial crisis in 2008 have been experienced in Ireland (-4.30%), Spain (-4.57%) and the Baltic States: Estonia (-4.89%), Latvia (-5.08%), Lithuania (-1.98%) while still some countries, such as Sweden (3.41%), Luxembourg (2.06%), Slovenia (1.51%) or the UK (0.95%) experienced tax revenue windfalls as a result of past tax revenues surprises not et reflecting the sharp deterioration of business cycle conditions which manifested itself more clearly towards the last quarter of 2008.

4. The determinants of tax revenues surprises

The first potential culprit for the existence of these large revenue windfalls/shortfalls is of course the business cycle.[8] During periods of expansion, buoyant economic activity increases tax

[8] Note that the variation of tax elasticities could also play a role. These variations are not considered here and can be thought as already being accounted for in our measure of revenue windfalls. For instance governments use tax elasticities ex-ante to determine their expected tax revenues. If the ex-post tax elasticity varies from its ex-ante forecast, then the final tax yield could differ from the forecasted figure even in case where tax bases and GDP growth were perfectly forecasted. Using our definition of revenue windfall does not allow to further decompose the tax

revenues with unchanged taxation rates if tax yields respond more than proportionally to positive changes in economic activities, i.e., if tax elasticities rise above their normal value. On the contrary, during periods of slowdown, tax yield may contract more than proportionally compared to GDP growth rates and thus drive to lower tax yields. Other (than business cycles) factors could explain the existence of revenue windfalls/shortfalls. For instance, governments can depart from their initial budgetary forecasts by either increasing or decreasing taxation levels or introducing changes affecting the level of tax collection such as the existence of indexation mechanisms, the use of one-off measures or because developments beyond the direct influence of national governments may take place such as increases in international oil prices or significant asset prices changes. However, given that our measure of revenue windfall/shortfalls is represented by the unexpected changes in tax revenues at *t-1*, it is likely that most of these elements may have only a limited influence. Following our definition of revenue windfall/shortfalls, these tax revenues surprises, either positive or negative, should mainly reflect surprises in terms of business cycle evolutions. Indeed, the elements previously mentioned, do also depend on the evolution of the business cycle. It is thus natural to first compare the evolution of revenue windfall/shortfall with business cycles developments and later investigate whether other-than business cycle changes have had an influence on revenue windfalls (shortfalls).

In order to single-out the role played by business cycle evolution, we consider separately the changes of tax revenue levels (i.e. no longer as percentage of GDP) and their link with changes in business cycle conditions. Given that governments GDP growth forecasts errors are likely to play a role, we calculate an indicator for the growth surprise similar to the indicator of revenue windfall by making use of the information contained in the SCPs regarding GDP growth forecasts made by national governments in year *t-1*. The growth surprise (measure in %-point of GDP) is thus equal to:

$$growth\ surprise_t = \Delta GDP_t^{ex-post} - \Delta GDP_{t,t-1}^{SCP} \quad (2)$$

Where $\Delta GDP_{t,t-1}^{SCP}$ is the annual percentage change in nominal GDP forecasted at *t-1* and made for the year *t* and $\Delta GDP_t^{ex-post}$ is the percentage change in nominal GDP that has effectively taken place at *t*. As for government revenues, we take the forecast for year *t* made in year *t-1* and

revenue windfalls given that only information on the expected governments revenues is available without further

calculate the difference between this figure and the ex-post GDP growth figure taken from the Spring 2009 Ameco database which in turn represent the ex-post value of the annual GDP growth at year *t*. Note that nominal rather than real GDP figures are considered in order to account for the influence of inflation developments. We thus link the forecast error in terms of GDP growth as described in (2) with the forecast error in terms of tax revenues as defined below:

$$Tax\ revenue\ surprise\ \ in\ level\ _t = \Delta R\_level_t^{ex-post} - \Delta R\_level_{t,t-1}^{SCP} \quad (3)$$

Graph 2 displays the evolution of tax revenue surprises expressed as the difference as defined in (3) together with the value of growth surprise as defined in equation (2) for each EU15 country considered individually.[9] Graph 2 shows that great variations in tax revenue surprises have taken place in EU15 countries and that, overall these variations have closely followed (nominal) GDP growth surprises. Interestingly, the surprises on the side of government tax revenues are in general less pronounced than the surprises concerning the growth outcomes. The gap between growth surprises and tax revenues surprises thus indicates than other-than-growth factors may play a role in determining tax revenue windfalls/shortfalls. In order to further investigate the potential determinants of tax revenues surprises we estimate econometrically the following equation:

$$Tax\ revenue\ surprise\ in\ level_{i,t} = \beta_0 + \beta_1\ growth\ surprise_{i,t} + \alpha_i + \varepsilon_{i,t} \quad (4)$$

where β_s are the coefficients to be estimated, α_i is a country-specific constant and $\varepsilon_{i,t}$ is an error term which is assumed to have the usual (*i.i.d.*) properties. The coefficient α_i is of particular importance as it represents country-effect which may affect the relationship between government tax revenue surprises and business cycle developments. For instance, some countries may systematically under-estimate their future tax revenues if an expansionary cycle is expected to reverse soon. Government may also announce lower taxation rate for political reasons such that the taxation forecast always fall short of the true taxation levels. These unobserved effects can reasonably be considered as having a permanent influence on the relationship between revenue windfalls and the business cycles, especially during a relatively short time period as this is the case here. Fixed-effect OLS estimators can thus be used in order to remove the influence of (time invariant) country-specific features embodied in the term α_i. An estimation of equation (4) can thus provide a predicted value of the revenue windfall controlling for country-specific effects

details on tax elasticities.

[9] The RAMS are not considered in detail as these countries only have three years of observations.

which may affect the relationship between revenue windfalls and growth surprises. The predicted values for the variable *Tax revenue surprise in level*$_{i,t}$ can be obtained after estimating (4) and can be considered as the estimated revenue windfalls net of the influence of the business cycle (i.e. the growth surprise) and unobserved country-specific effects. The evolution of these "net" tax revenue surprises are reported in Graph 3 for the EU15 countries. Interestingly, controlling for the influence of the business cycle and country-specific effect indeed appears to lower substantially both the size and variability of the revenue windfalls. This result suggests that these two elements play a major role in determining the size and variability of tax revenues surprises. A more general analysis of the determinants of revenues windfalls can be undertaken including other potential determinants to the equation (4). These determinants are:

- A composition effect measuring the effect of change in the composition of GDP growth. For an unchanged rate of GDP growth, tax revenues can change depending on the composition of GDP growth if, for instance, GDP growth is driven by tax-poor rather than by tax-rich GDP components. The growth rates of each tax basis can thus be compared to the overall GDP growth rate in order to investigate whether GDP growth composition is likely to influence tax yields. The following formula can thus be used in order to obtain an aggregate measure of the composition effect:[10]

$$composition\_effect = \sum_{i=1}^{4}\left(\frac{\Delta Taxbase}{Taxbase} - \frac{\Delta GDP}{GDP}\right)\times\frac{Tax_i(-1)}{GDP(-1)} \qquad (4)$$

where the tax bases considered are considered at *t-1* and includes private consumption (for indirect consumption taxation), the gross operating surplus (as proxy of the tax bases for profit taxation) and the total wage bill (for wages and social security expenditures). These different tax bases are added-up in (4) in order to obtain an aggregate measure of the influence of the composition effect. The data used to calculate (4) is taken from Ameco.

- Asset prices development including the stock market and housing market may also play a role in explaining revenue windfalls given that taxation of capital revenues and transactions in housing market (VAT and/or stamp duty) can significantly influence tax revenues, especially during periods of fast prices (de-)increases. The variables used are the annual change in equity prices and housing prices are taken from the Bank of International Settlements database. It must be noted that this

[10] See PFR 2008 for further details on the construction of the indicator on composition effects used here.

data only contains information for Belgium, Germany, Denmark, Spain, Finland, France, Ireland, Italy, the Netherlands, Sweden and the UK such that estimations using this information could yield results different from the overall EU25 sample.

- Finally the effect of trade balance can be investigated separately by calculating the annual change in the deficit/surplus in total international trade (including intra-EU trade) in percentage of GDP of each country. The data used is taken from Ameco.

The influence of these different determinants are considered in Table 2 which provides the estimations of equation (4) extended by including the variables listed above and using fixed effect estimation technique in order to control for non-observed country-specific effects.[11]

The first column of Table 2 provides the results of the estimation using only the growth surprise as explanatory variable. This variable appears to be positively related to the tax revenue surprise variable and is highly statistically significant. The results depicted in Graph 2 are thus confirmed by this econometric estimation since revenue windfalls appear to be explained to a large extent by the growth surprise. Column (ii) of Table 2 includes the measure of the composition effects given by (4) into the equation estimated. This variable does not appear to be statistically significant, however. A possible explanation for this result is that the effects of GDP composition on revenue windfall/shortfall is already accounted for in the growth surprise. Indeed, the growth surprise may itself be due to composition effects such that it is difficult to identify the influence of the composition effect separately from the growth surprise. In order to provide an estimate of the link between growth surprises and composition effects, we have calculated an interaction term between both variables (by multiplying them) and included this new variable into the equation estimated while dropping the composition effect variable in order to avoid co-linearity. The result of this estimation is shown in column (iii). This interaction term, which is intended to capture the influence of the composition effects on the revenue windfalls through growth surprises, appears to be positive and statistically significant suggesting that composition effects have indeed played an important role in explaining revenues windfalls/shortfalls in the EU25 during the period considered, although only to the extent that these compositions effects have led to large growth surprises. In the sequel we include other explanatory variables such as equity and residential prices and trade balance. It must be noted however that most of these other variables are only available for a sub-sample of EU15 countries (the number of countries covered is now 11 against

[11] All regressions also include non-reported year-specific effects.

25 in Column (i)). We thus re-estimated the coefficient on the growth surprise variable for this sub-sample of countries to check whether the general result concerning the relationship between tax revenue surprises and growth-surprises holds for this sub-sample of countries. Column (iv) indicates that this is indeed the case although the coefficient appears to be half the level of the one for the EU25, suggesting that EU15 countries tax revenues are less sensitive to growth surprises.[12] Column (v) thus further adds to the estimated equation the effect of the other variables namely the annual change in the trade balance (as measured by the net trade balance in percentage of GDP), the annual change in residential prices and the annual change in equity prices. These estimations show that residential prices and the trade balance do not seem to explain much of the variation in tax revenue surprises although equity prices increases appear to affect positively tax revenue surprises. The result concerning residential prices appears at first glance rather puzzling given that recent revenues windfalls have often been associated with booming tax revenues related to asset prices, see in particular Morris and Schuknecht (2007) and Hilbers et al. (2008) for recent evidence. Two remarks must be made with regards to this result. First, as noted above, the length of the panel (i.e. 1999-2008) might be too short to properly capture the impact of asset price changes. These price changes have in particular been especially important in some EU15 countries such as the UK, Spain or Ireland and not so much in the recently acceded Member States. Second, changes in asset prices can also influence economic growth and consumption in particular through wealth effects. For instance, Mohr and Morris (2007) who undertake a similar exercise although with different methodology and less countries, find that changes in stock market prices have played a positive and significant role in favouring the emergence of large government revenues windfalls. Martinez-Mongay et al. (2007) further showed that a large part of extra-tax revenues Spain benefited from during the expansionary period 1995-2006 was linked to asset price increase, in particular house prices. These authors also suggested (rightly so with hindsight) that most of these extra tax revenues would vanish should the expansionary phase suffer sudden stop as this would be the case with the 2008/2009 global financial crisis. Third, residential and equity prices appear to be positively correlated such that including both variables in the same regression can entail multicolinearity problems. More generally, the estimates provided above represents only an average effect across countries. A detailed inspection of the evolution of asset prices reveals that, during the period considered, Ireland, Spain, the UK (for both asset prices) and Finland (in particular for equity prices)

[12] This assertion is confirmed by (unreported) estimation of column (i) equation for recently acceded Member States only suggesting as the coefficient of the growth suprise variable equals 0.550 and significant at 1%.

experienced particularly sharp price increases. A way to test whether these evolutions had any significant impact on tax revenue surprises and to avoid colinearity issues is to interact a dummy variable equal to one for these four countries with the evolution of an asset prices indicator (which is just the average residential and equity price indices). The results of estimating this new variable are displayed in Column (vi) and 6 of Table 2. The coefficient obtained on the interaction between the country dummy variable (which is equal to one for Ireland, Spain, the UK and Finland) and the asset prices indicators appears to be positive and statistically significant, indicating that for these countries recent sharp boom in asset prices have had a positive and significant influence on tax revenue surprises. The coefficient estimate for the asset price variable alone is insignificant, however, suggesting that the influence of asset prices evolution on tax receipt was only limited to certain countries.

5. Evidence on the link between unexpected changes in tax revenues and the stabilisation function of fiscal policy

As shown earlier, EU governments' revenue windfalls have been sizeable during the period preceding the financial crisis, averaging 0.41% of GDP in the EU25 during the years 2005-2007, and have been followed by sharp deterioration in EU countries public budget with, on average, a tax revenue shortfall amounting to -0.3% of GDP in 2008, with wide variations across country groups as indicated in Table 1. The fact that growth surprises seem to explain the largest part of these unexpected changes in tax revenues is particularly revealing for the analysis of the consequences of tax revenue surprises on the counter-cyclicality property of fiscal policy. Given that unexpected growth developments lead to unexpected change in tax revenues, this is likely to alter the conduct of counter-fiscal policy in real-time. For instance during phases of positive growth surprises, governments could use these unexpected revenues to increase expenditure (or reduce taxation) beyond what would be otherwise advisable from a medium-term perspective. In the following downward phase of the cycle, revenue shortfalls could mean that tax revenues are insufficient to meet the planned increased expenditure and drive to deterioration of fiscal positions.

These questions are investigated in a simple manner here following the usual approach making use of fiscal reaction functions where annual change in the cyclically adjusted primary balance (CAPB) are related to past developments in the business cycles and the CAPB and the debt level.[13] Business cycles evolutions are measured through the output gap which is used in the context of

the EU fiscal surveillance framework (see Denis et al. (2007). Graph 4 plots the average values of the annual change in the cyclically adjusted balance (CAB) across countries and years according to two variables: the value of the output gap in year *t-1*, which indicates the position of a given country in the cycle and the value of the revenue windfall (shortfall) as calculated in (1) for the year *t-1* assuming that the impact of revenue slippages on the fiscal stance do have a lagged effect.[14] The grouping in terms of windfall/shortfall is determined by splitting the whole set of observations across countries and years into three groups according to the values taken by the revenue windfall (shortfall) expressed in percentage of GDP.[15]

According to Graph 4, a positive and large change in the CAB in year *t* has usually been associated with periods of negative output gaps and of large revenue windfalls in year *t-1*. However, during expansionary periods (i.e. OG>0), the average change in the CAB does not appear to be very different from the one prevailing during periods of revenues shortfall or neutral revenues surprises. The evidence for the EU25 thus seems support only partially the idea expressed above according to which the occurrence of large revenue windfalls has a strong bearing on the counter-cyclicality of fiscal policy. It is important to note that the data used to construct the Graph 4 concerns the EU25 as a whole and thus include both EU15 countries for which data are rather complete for the period 1999-2007 and the recently acceded Member States (RAMS) for which the data are only available starting in 2005 onward. Graph 5 and Graph 6 instead perform the same calculation as for Graph 4 but considering only the EU15 and euro-area MS in order to get a more time-consistent picture of the influence of revenue windfall on the counter-cyclical nature of fiscal policy.

The results depicted in Graph 5 are more conclusive than the ones of Graph 5. As before the annual change in the CAB appears to be positive and large in absolute term (+1%) during periods of negative output gaps. Now, in addition, the decrease in the CAB appears to be negative on average and large in absolute terms (-0.4%) during periods of positive output gap. These results would thus tend to confirm that revenues windfalls do promote pro-cyclical fiscal policies. It must be said, however, that the annual change in the CAB is rather similar in the case of large revenue windfalls to the case of neutral change in governments' revenues during periods of expansion. A

[13] See in particular, European Commission (2006).

[14] Such an approach is similar to the one taken in the European Commission's Public Finances Report (2006) to measure the counter-cyclicality of fiscal policy.

similar exercise in carried out for the euro-area countries and results are reported in Graph 6. Here the differences in the CAB between periods of large windfalls is even more pronounced compared to the previous case: the annual average change in the CAB is equal to 1.3% during periods of large revenue windfalls and positive output gap and to -0.6% during periods of large revenue windfall but negative output gaps. These figures are also markedly different from the cases where the surprises in government revenue changes are either negative (shortfall) or not very different from 0 (neutral).

In the sequel we provide econometric analysis of the possibility for revenues surprises to influence the pro-cyclical nature of fiscal policy in the EU15. The Member States that entered the EU after May 2004 are not considered given that only two years are available on the revenue windfall variable for these countries which is insufficient to provide valuable information on business cycle evolutions in these countries. In order to investigate the influence of revenue windfalls on the stabilisation properties of fiscal policies, we estimate the fiscal reaction function for the EU15 countries. These fiscal reaction functions have been widely used in the fiscal policy literature in particular in order to assess the counter-cyclicality nature of fiscal policy where the fiscal stance is related to an indicator of the cyclical position of the economy, see for instance, European Commission (2006). As mentioned earlier, the dependent variable is the annual change of the cyclically adjusted primary balance ($\Delta CAPB_t$) expressed in percentage of GDP and is assumed to depend on initial budgetary positions represented by the lagged (one year) of the cyclically adjusted balance (CAB_{t-1}) and the lagged level of the debt to GDP ratio (B_{t-1}). In addition to the fiscal policy variables we also include the lagged output gap measuring the cyclical position of the economy (OG_{t-1}).[16] The equation tested is indicated below, each variable being indexed by *i*, the country-specific subscript:

$$\Delta CAPB_{i,t} = \beta_0 + \beta_1 CAPB_{i,t-1} + \beta_2 B_{i,t-1} + \beta_3 OG_{i,t-1} + \alpha_{i,t} + \varepsilon_{i,t} \qquad (5)$$

[15] More specifically, the revenue windfall group if defined as those value where the revenue surprise is greater than 1% of GDP, the revenue shortfall includes the revenue surprises lower than -0.5% of GDP and the neutral revenue surprises are those values that lie between the first two groups.

[16] The existing literature has also considered other explanatory variables that could influence the fiscal stance in order to control for the institutional setting, the level of government decentralisation, the occurrence of elections, etc. In the current paper we do not consider these other potential determinants due to the short time span and low number of observations available which strongly limit the degree of freedom of the estimation reported here. Given that we control for country-fixed effect, elements relating to the institutional setting or level of government decentralisation

Our prior expectations are that a higher deficit level at t-1 (i.e. negative value of $CAB_{i,t-1}$) and debt level induce governments to tighten their fiscal stance thus β_1 is expected to display a negative value while β_2 is expected to display a positive sign. The main variable of interest in *(5)* is the output gap $OG_{i,t-1}$. Here we make use of the output gap estimated by the European Commission, see in particular Denis et al.(2007). Alternatively, we will also consider the output gap estimates making use of the Hodrick Prescott filter (thereafter HP) to calculate the growth potential and also provided by the European Commission. The fiscal stance in a given country is said to be pro-cyclical if during periods of expansions (i.e. positive output gap) the fiscal position of this country deteriorates and if during periods of contractions (i.e. negative output gap) it improves. The terms $\varepsilon_{i,t}$ and $\alpha_{i,t}$ represent an idiosyncratic error term and a country-specific fixed effect respectively. The country-specific effect is taken care of using within-panel estimations are before.

All variables in *(5)* are constructed using the latest available information at the time this paper was written, i.e. using the Autumn 2009 DG Ecfin forecast. Given that the latest year of observation is 2008, the variables used are therefore considered ex-post. Importantly in this respect, a number of papers have advocated for the use of real-time rather than ex-post data to assess the extent to which fiscal policy is counter or pro-cyclical by analogy to the analysis carried out by Orphanides (2001) for the analysis of monetary policy stance. The reason for using real-time data in the fiscal policy context is that this data is more likely to reflect the intentions of national governments with respect to the fiscal stance and, eventually, may indicate the intention by fiscal authorities to use fiscal policy as macroeconomic stabilisation tool. A problem with the use of real-time data for assessing the business cycle using the information included in the SCPs however is that one may is that these may be subject to political bias (e.g. government making over-optimistic assumption for future growth in order to justify increased spending). As an alternative, a number of authors have resorted to use international institutions' fiscal projections instead which are less prone to suffer from political bias. For instance, Forni and Momigliano (2005) make use of real-time OECD projections on the output gap to assess the counter-cyclicality of OECD countries fiscal policies advocating that the political bias is less binding. However, in our case we are mostly interested to analyse the intentions of fiscal policy makers, the political bias issue is less of an inconvenient to the extent that we consider it as part of the national fiscal strategy announced ex-ante. In a recent paper Cimadomo (2008) also advocated that the use of real-time data for the fiscal projections

for instance, which can be considered to vary little over time, are also unlikely to influence our result in a significant way.

given that ex-post figures are likely to be biased as well. This author suggests in particular that measurement errors in both the dependent variable (i.e. ΔCAPB) and explanatory variables (i.e. OG) may blur the assessment of the intended stance of fiscal policy with respect to the business cycle. Indeed, Cimadomo (2008) finds that fiscal policies have tend to be pro-cyclical using ex-post data period while the use of real time figures suggest instead that these policies were intended to be counter-cyclical. Following Forni and Momigliano (2005) and Cimadomo (2008) we thus also tried out alternative specifications using real-time figures on the output gap and the CAPB using different vintages of the Ameco database as released in autumn each year.

Table 3 provides the estimates of equation (5) for the EU15 countries for alternative specification using real-time and ex-post variables as indicated above:[17]

- Columns (i)-(ii) use as dependent variable ΔCAPB (and the lagged value of CAB) ex-post the ex-post output gap estimates making use of the production function method (thereafter FP) and the Hodrick Prescott (HP) filter alternatively to calculate the output gap (all variables are constructed using the Autumn 2009 DG ECFIN forecast data)
- Columns (iii)-(iv) also use as dependent variable ΔCAPB (and the lagged value of CAB) ex-post but use real-time information to calculate the output gap using the HP and PF methods alternatively (using the different Autumn vintage of the Ameco database, DG Ecfin). [18]
- Columns (v-vi) use real-time information for both ΔCAPB (and the lagged value of CAB) and the output gap using the HP and PF methods alternatively

The results displayed in Table 3 show coefficients in accordance with prior expectations: the annual change in the CAB is positively correlated with the initial debt level and negatively correlated with the initial budgetary position. The sign of the coefficient β_3 concerning the output gap varies depending on whether on whether real-time or ex-post data are considered and also on whether HP or PF methods are used to determine the potential growth level. This coefficient is

[17] In addition to the explanatory variables listed below, we also controlled for indicator of fiscal governance on expenditure rules, which are deemed to influence the pro-cyclical nature of fiscal policy (see in particular Debrun et al., 2008), the output gap of the EU15 and the differential of the output gap in each country with respect to the output of the EU15 as whole in order to capture the possible influence of EU-wide cyclical position and a dummy variable indicating whether general elections took place during the same or preceding year. The coefficients of these variables, although included in all specification were not reported in Table 3 and 4 to simplify the presentation.

[18] Because old Ameco vintages are only available starting in 2000 when using hte HP method and 2002 when using the production function framework, the number of observations was also lower when using real-time information on the output gap and the CAPB as indicated in Table 4.

insignificant In all but one case, however (as shown in Column (v), when using real-time CAB and OG using the HP method) such that it is difficult to derive conclusions regarding the pro-cyclical (or counter) cyclical nature of the fiscal stance taking these estimations at face value.

We now consider more closely the potential influence of tax revenue surprises on the coefficient obtained for the output gap in estimating equation (5). Factual evidence mentioned earlier suggests that in Europe fiscal policies have tended to be pro-cyclical in the wake of large revenue windfalls and has thus tended to impair the ability of EU governments to run counter-cyclical fiscal policy. Accordingly the occurrence of large revenue windfalls would tend to alter the value of the coefficient β_3 in equation (5). In order to investigate the possibility that tax revenue surprises influence the relationship between the output gap and the annual variation in the CAB, we consider the interaction between the one-year lag of our measure of revenue windfall as described in (1) and the lagged output gap using the four methods. One must note that, in order to derive a meaningful interaction between tax revenues surprises and the OG variable, one also needs to standardise the variables being interacted in order to possibly interpret the results in terms of tax revenue windfalls, shortfalls and neutral as done in Graphs 4-7. Ideally one would like to compare the coefficients obtained for separate sample corresponding to these three possible scenarios. However, the low number of observations available prevents us to do so. An alternative is to use the simple approach described Aitken and West (1991) by centering the variables around their mean such that results interpreted depending on the values taken by the conditioning variable, i.e., in our case, the level of tax revenue surprises at *t-1* (Annex 1 provides more details on this method). This simple method therefore allows us to estimate three different slope coefficients for the output gap variable according to whether the revenue surprise variable is set at the mean value (neutral revenue surprise), at +1 standard deviation (revenue windfall) or at -1 standard deviation (revenue shortfall) of the revenue surprise.

Table 4 provides the results of this exercise for the four different measures of the output gaps and of the CAPB (i.e. ex-post, real-time, using the PF and HP method) and for alternative benchmarks of the level of tax revenue surprises (i.e. windfalls, shortfalls and neutral tax revenue surprise). The results in Table 4 indicate the elasticity of $\Delta CAPB_{i,t}$ with respect to $OG_{i,t-1}$ for given values of, respectively 0.9% and 1.8% of revenue windfall in percentage of GDP as calculated in (1) and corresponding to one and two standard deviation of the revenue surprise. The calculation of the corresponding standard deviation of these estimated is described in Annex 1. The results displayed

in Table 4 show that the elasticities have different signs depending on the specification considered and when revenue shortfalls or neutral revenue surprises are considered. The coefficient on the interaction of the revenue surprise and the output gap is always negative in the case where tas revenue windfalls arise in preceding year, excepting when using CAPB and OG in real-time with the PF method. This result suggests that tax revenue windfalls tend to promote a pro-cyclical fiscal stance in all specifications. It must be noted, however that the interaction of the revenue windfall with the output gap for the case where revenue surprises are considered are only significant in a number of cases: when using the OG and CAB ex-post, when using the OG in real-time but only with the HP method and when using the OG and CAB in real-time but only when using the HP method. It must be noted in addition that in some case neutral tax revenue changes appear to favour pro-cyclical fiscal policy as indicated by the results reported in the third and fourth column of Table 4. The occurrence of tax revenue shortfall, however, yield mixed results and coefficients on the OG variable which are never significant.

6. Conclusion

Using information about fiscal plans taken from the Stability and Convergence Programmes (SCP) we analyse the size and potential causes of governments' revenues windfall in the European Union. Unexpected changes in tax revenues varied substantially both across time with some EU Member States alternating large tax windfalls in 2005-2007 with substantial shortfalls in 2008, as for instance Spain (1.06% in 2005-2007 vs. -4.57% in 2008) and Ireland (1.15% in 2005-2007 vs. -4.30% in 2008). When considering potential determinants of these unexpected swings in tax revenues, growth surprises and GDP growth composition effects (although only indirectly through their correlation with growth surprise) are found to play the most significant (and positive) role. In certain cases, however, asset prices evolutions (in particular for countries such as Ireland, the UK, Spain and Finland) are found to also exert a significant influence on tax revenues surprise. In the sequel we provide some evidence on the incidence of these tax revenues' surprises on the ability of government to conduct counter-cyclical fiscal policies which are desirable from a macroeconomic perspective. We find that countries that have experienced the largest revenue windfalls in the UE during the period 1999-2008 have also tended to run more pro-cyclical fiscal policies, although the significance of these results varies depending on the method used to calculate cyclically adjusted primary balance and on the use of ex-post or real-time data. Overall these results suggest that: (1) The assessment and identification of past revenue windfalls/shortfalls should be improved in the context of the EU fiscal framework in particular by

making use of information contained in the SCPs concerning differences between plans and outcomes and possibly by complementing it with more detailed country-specific information on the transitory/permanent nature of recent tax revenues developments (2) Past revenues windfalls/shortfall should be considered when assessing countries' fiscal stance and in particular to gauge the ability of governments to conduct counter-cyclical fiscal policies as our results suggest in particular that past tax revenue windfalls occurring during expansionary phase can hinder the ability of governments to run counter-cyclical fiscal policy once business cycle conditions revert.

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Tables

Table 1: Governments' unexpected changes in tax revenues in the EU25
in % of GDP, 1999-2008

	1999-2001	2002-2004	2005-2007	2008
AT	0.10	0.09	0.35	0.77
BE	0.26	0.30	0.11	-0.59
CY			3.04	1.70
CZ			0.37	0.43
DE	0.73	-0.73	0.64	0.47
DK	-0.28	0.89	0.65	1.07
EE			0.25	-4.89
EL	-0.05	-0.73	-0.25	-1.57
ES	0.05	0.07	1.06	-4.57
FI	0.33	1.06	0.63	1.40
FR	0.37	-0.05	0.10	-0.44
HU			1.52	-0.18
IE	-0.10	0.61	1.15	-4.30
IT	0.12	-0.38	0.85	-1.27
LT			-0.18	-1.98
LU	2.18	-0.24	-0.01	2.06
LV			-0.92	-5.08
MT			-0.38	-0.10
NL	0.49	0.64	0.46	0.95
PL			0.63	-0.18
PT	-1.23	0.12	1.02	-0.17
SE	0.51	0.78	1.27	3.41
SI			0.27	1.51
SK			-0.43	0.08
UK	0.30	-0.91	-0.41	0.95
*Average euro-area**	0.35	-0.22	0.56	-0.72
*average EU15**	0.33	-0.29	0.40	-0.31
*average RAMS**			0.66	-0.23
*average EU25**			0.41	-0.30
*std. dev. Euro-area**	0.64	0.68	0.63	1.78
*std. dev. EU15**	0.94	0.88	0.93	1.83
*std. dev. RAMS**			1.66	1.30
*std. dev. EU25**			1.25	1.78

Sources: Commission services, Stability and convergence programmes and Ameco. (*) weighted (GDP) figures.

Table 2: The determinants of tax revenue windfalls/shortfalls in the EU, 1999-2008

	(i)	(ii)	(iii)	(iv)	(vi)	(vii)	(viii)
(1) Growth surprise (%)	0.314***	0.558***	0.230***	0.151**	0.156**	0.140**	0.134**
	(0.052)	(0.085)	(0.066)	(0.070)	(0.074)	(0.066)	(0.065)
(2) Composition effects		0.546					
		(0.345)					
Interaction (1) & (2)			0.349***				
			(0.046)				
(3) Change in (export- import)/gdp					-0.329***	-0.317***	-0.293***
					(0.101)	(0.097)	(0.096)
(4) Change in asset prices (residential and equity prices)						2.909**	0.971
						(1.390)	(1.635)
(5) Boom asset prices							3.047**
							(1.424)
(6) Change in residential prices					0.056		
					(2.900)		
(7) Change in equity prices					1.606**		
					(0.762)		
Constant	0.103	-1.132***	-0.293	-1.322***	-1.049***	-1.105***	-1.203***
	(0.395)	(0.409)	(0.342)	(0.318)	(0.357)	(0.338)	(0.334)
Observations	181	141	141	105	105	105	105
Number of group(country)	25	21	21	11	11	11	11
R-squared	0.44	0.47	0.64	0.43	0.51	0.51	0.54
F test for fixed effects	4.40	3.54	3.94	1.30	1.17	1.71	2.05

Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3: Estimations of fiscal reaction functions for the EU15, 1999-2008

Panel fixed-effects estimation results, EU15 countries included

	(i) ΔCAB ex-post	(ii) ΔCAB ex-post	(iii) ΔCAB ex-post	(iv) ΔCAB ex-post	(v) ΔCAB real-time	(vi) ΔCAB real-time
$CAB_{i,t-1}$	-0.420***	-0.429***	-0.542***	-0.538***	-0.645***	-0.404***
	(0.080)	(0.078)	(0.085)	(0.082)	(0.121)	(0.073)
$B_{i,t-1}$	0.085***	0.064**	0.088***	0.089***	0.095***	0.097***
	(0.025)	(0.025)	(0.028)	(0.028)	(0.031)	(0.023)
$OG_{i,t-1}$ (ex-post, PF method)	-0.111					
	(0.114)					
$OG_{i,t-1}$ (ex-post, HP method)		-0.254***				
		(0.093)				
$OG_{i,t-1}$ (real-time, PF method)			0.044		0.434*	
			(0.145)		(0.232)	
$OG_{i,t-1}$ (real-time, HP method)				0.051		-0.118
				(0.160)		(0.133)
Constant	-4.698***	-3.605**	-4.093***	-4.169***	-2.560	-3.619***
	(1.418)	(1.497)	(1.555)	(1.529)	(1.842)	(1.329)
Observations	135	135	118	118	88	118
Number of group (country)	15	15	15	15	15	15
R-squared	0.25	0.27	0.36	0.36	0.37	0.34
F test for fixed effects	2.70	2.45	3.64	3.63	2.81	2.83

Note: Standard errors in parentheses

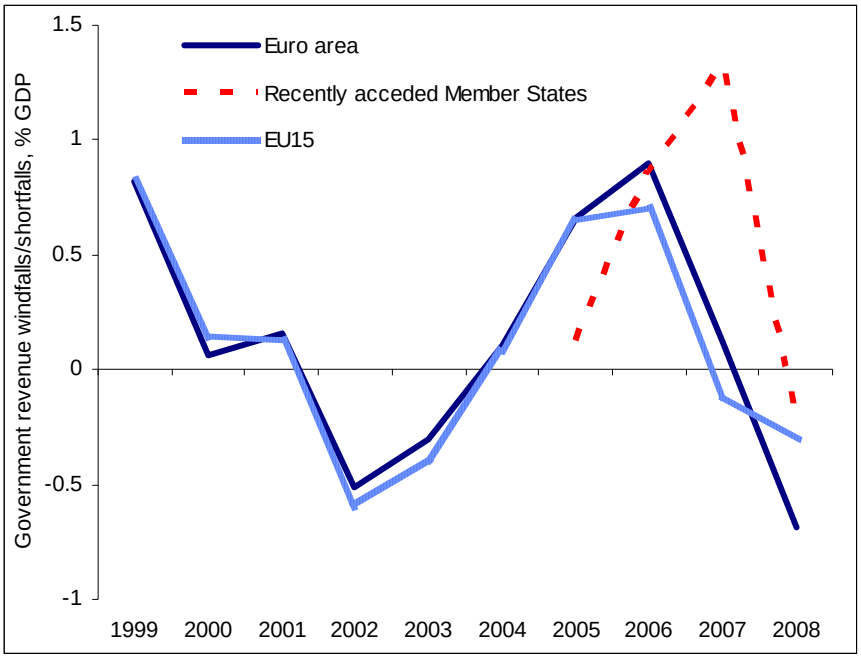
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4: Fiscal policy and the business cycle for given values of tax revenues surprises in the EU15, 1999-2008*

	Tax windfall		*Neutral tax revenue change*		*Tax shortfall*	
	sd(1)	sd(2)	sd(1)	sd(2)	sd(1)	sd(2)
$OG_{i,t-1}$ ex-post, PF method	-0.235*	-0.329*	-0.139	-0.139	-0.044	0.051
	(0.126)	(0.175)	(0132)	(0.131)	(0.186)	(0.261)
$OG_{i,t-1}$ ex-post, HP method	-0.325***	-0.406**	-0.243**	-0.243**	-0.162	-0.080
	(0.098)	(0.136)	(0.098)	(0.098)	(0.136)	(0.191)
$OG_{i,t-1}$ real-time, PF method	-0.214	-0.352	-0.077	-0.80	0.060	0.198
	(0.190)	(0.281)	(0.144)	(0.144)	(0.181)	(0.269)
$OG_{i,t-1}$ (real-time, HP method)	-0.343	-0.540*	-0.146	-0.146	0.052	0.249
	(0.228)	(0.320)	(0.162)	(0.162)	(0.180)	(0.265)
$OG_{i,t-1}$ and ΔCAPB real-time, PF method	0.171	0.260	0.082	0.082	-0.70	-0.096
	(0.228)	(0.348)	(0.173)	(0.173)	(0.235)	(0.357)
$OG_{i,t-1}$ and ΔCAPB (real-time, HP method)	-0.430**	-0.586**	-0.274**	-0.274*	-0.118	0.037
	(0.186)	(0.268)	(0.133)	(0.037)	(0.147)	(0.214)

** Estimation based on Aitken and West (1991) method, centered (mean) values of the variables. sd(1) and sd(2) indicate that estimations are made on the one and two-standard deviation of the (centered) value of the tax revenue surprise variable. Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.*

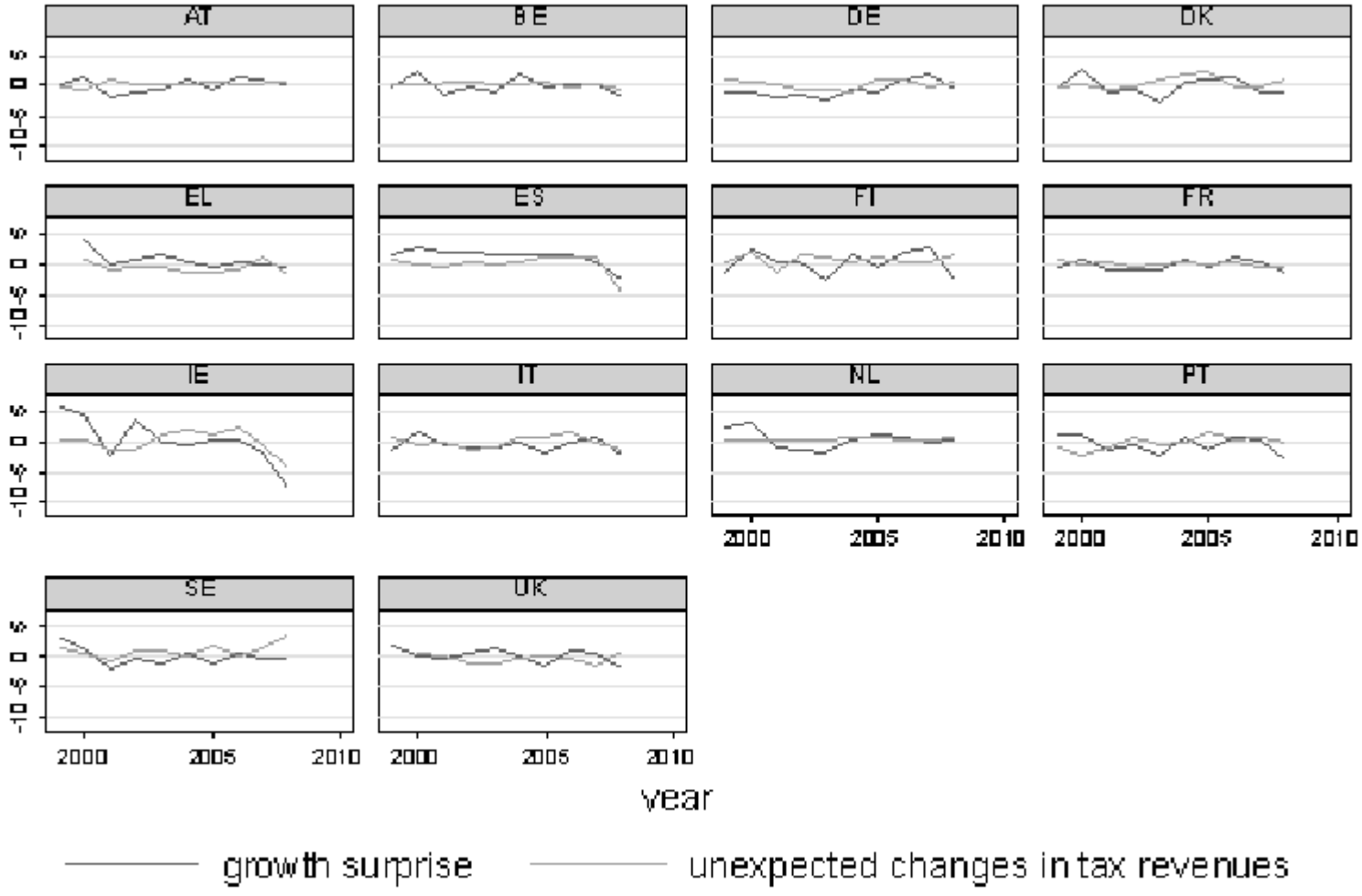
Graph 1: Governments' revenue windfalls and shortfalls in the EU, 1999-2008
Figures in %-point of GDP



Note: weighted (GDP) averages
Sources: Commission services, Stability and convergence programmes and Ameco

Graph 2 : Unexpected changes in tax revenues and growth surprises in the EU15, 1999-2008

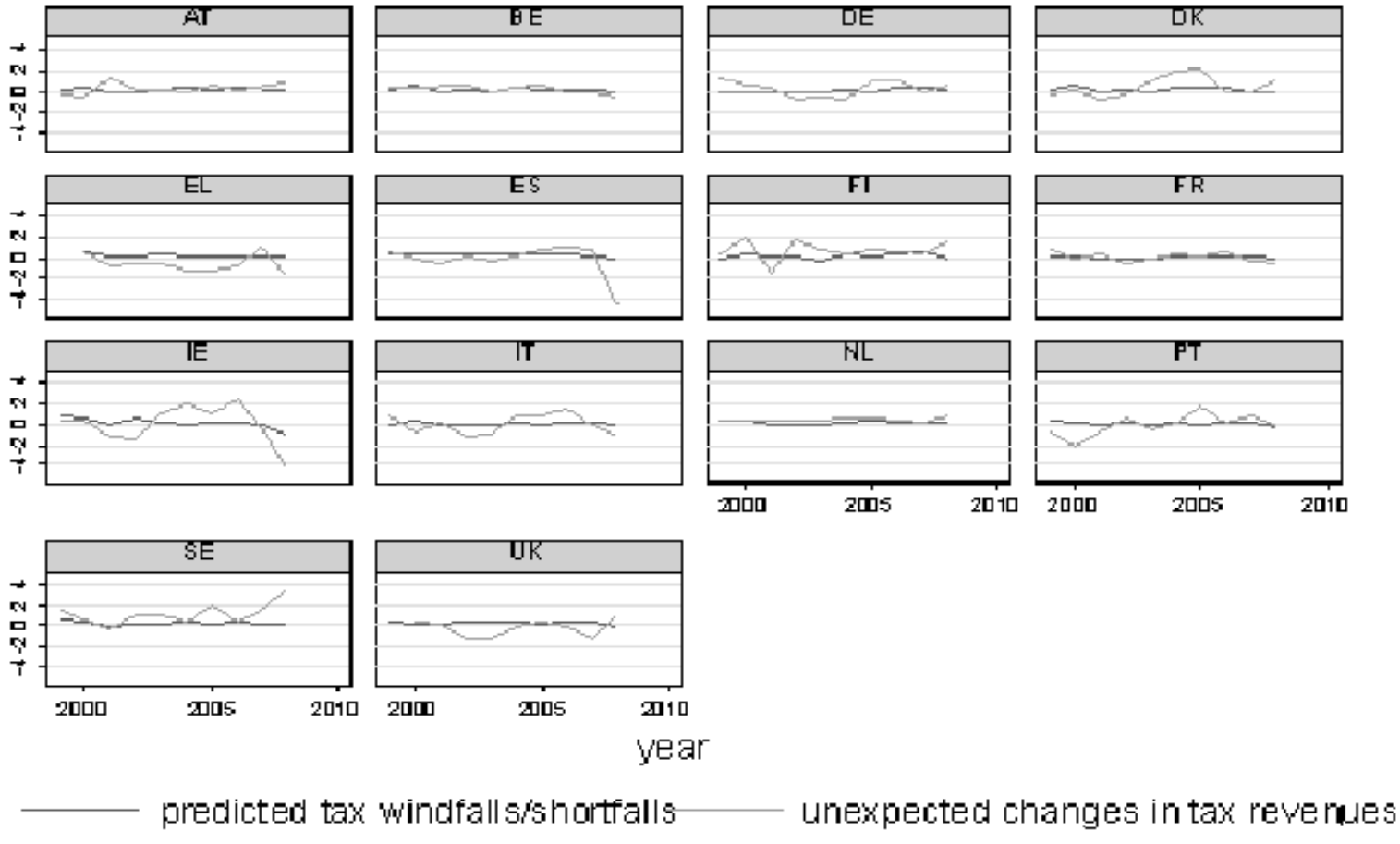
Figures in % GDP



Sources: authors' calculations, Stability and Convergence Programmes and Ameco

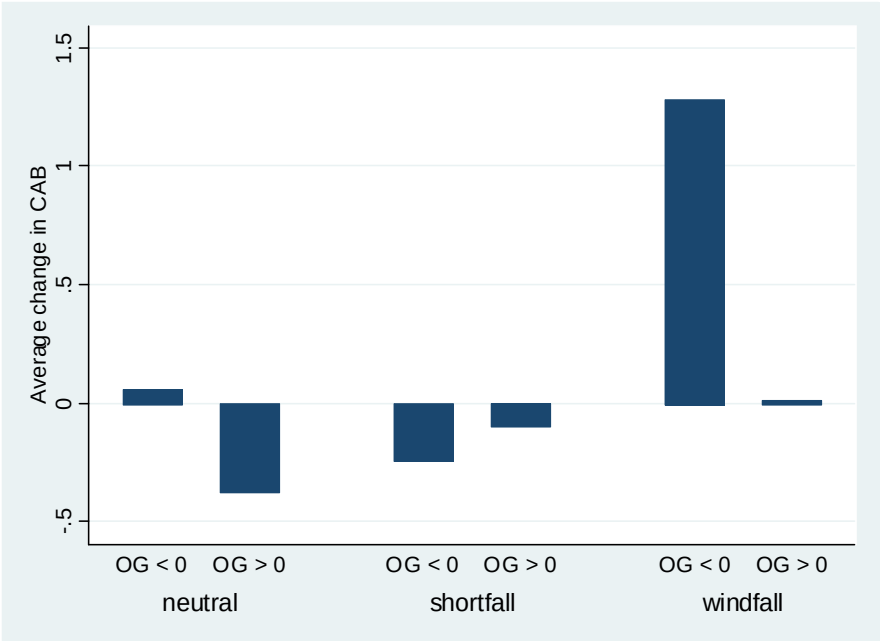
Graph 3: Tax revenues surprises: actual vs. predicted values, 1999-2008

Figures in % GDP



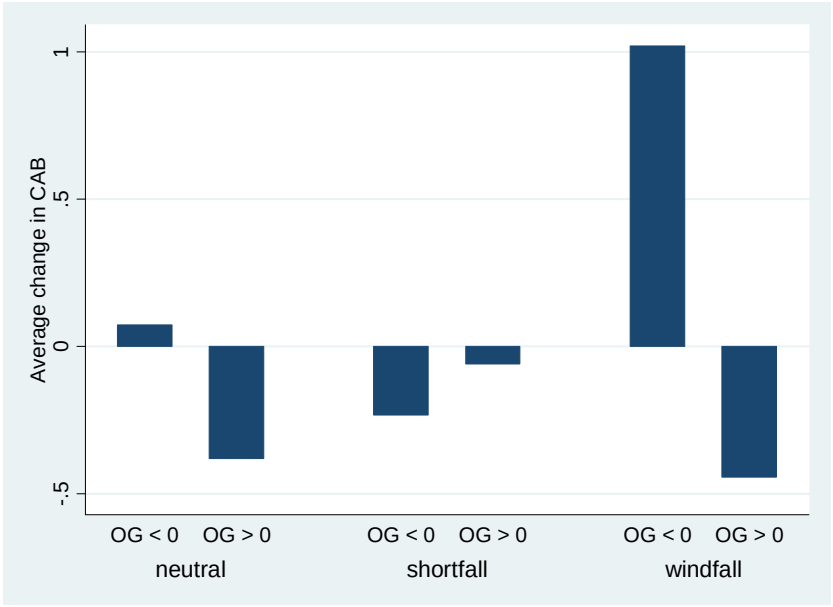
Sources: authors' caluclations, Stability and convergence programmes and Ameco

Graph 4: Change in the cyclically adjusted balance, output gap and revenue windfall(shortfall) in the EU25, 1999-2008



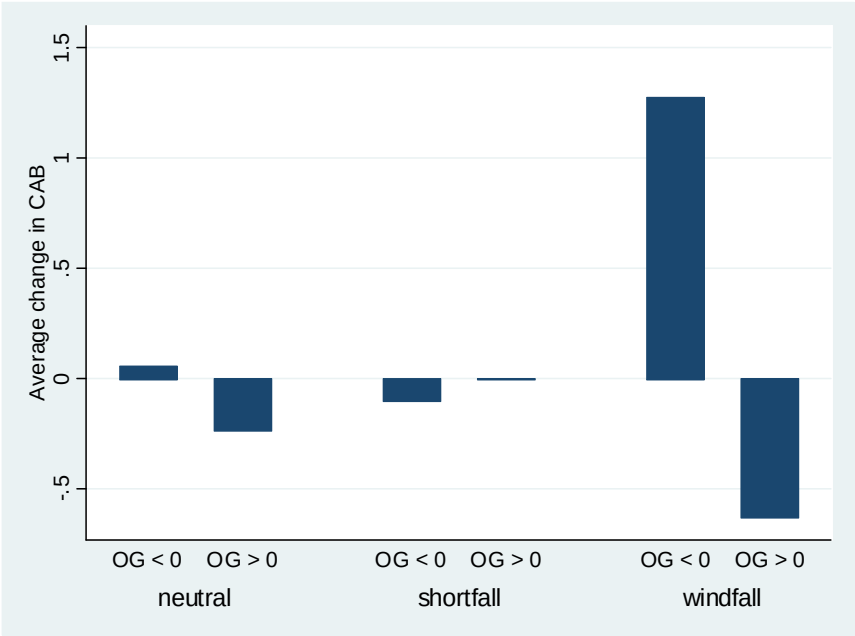
Source: Commission services, Stability and convergence programmes and Ameco

Graph 5: Change in the cyclically adjusted balance, output gap and revenue windfall(shortfall) in the EU15, 1999-2008



Source: Commission services, Stability and convergence programmes and Ameco

Graph 6: Change in the cyclically adjusted balance, output gap and revenue windfall(shortfall) in the euro-area, 1999-2008



Source: Commission services, Stability and convergence programmes and Ameco

Annex 1: Interpreting interaction coefficient between revenue surprises and output gap

Equation (5) is tested including an interaction term between the output gap (OG_{it}) and the lagged revenue windfall variable. As shown in Aitken and West (1991) the coefficient on the interacted variable can be interpreted at given levels of the conditioning variable using simple transformations of the estimated coefficients on the centered variables. Standard errors can also be easily choosing the appropriate terms in the variance-covariance matrix. Given that variables are centered the benchmark for interpreting the values of the estimated coefficient is zero. Aiten and West therefore suggest to consider deviations from this benchmark given by the value of the standard deviation of the conditioning variable. For instance, when estimating equation (5) one can estimate the coefficient β_5 below (for simplicity we omit the subscripts and the other variables although these are also included in the estimations)

$$\Delta CAPB = \beta_0 + \beta_1 OG + \beta_2 RS + \beta_3 (OG * RS) \qquad (A1)$$

Where *RS* denotes the revenue surprise as calculated in (1). The terms in (A1) can be rearranged the following way:

$$\Delta CAPB = (\beta_0 + \beta_2 RS) + (\beta_1 + \beta_3 RS) OG \qquad (A2)$$

Equation (A2) thus indicates that the slope of the regression of $\Delta CAPB_{i,t}$ on $OG_{i,t-1}$ and depends upon the particular value of $RS_{i,t-1}$ at which the slope is considered. Different values of *RS* can be chosen. A standard practice is to just consider one standard deviation of the centered data which in the present case represents a value of *RS* equal to 0.009, i.e., 0.9 percentage points of GDP. Alternatively, we also try out our estimation using this value multiplied by 2, i.e., 1.8 pp of GDP. The standard error of the slope $(\beta_1 + \beta_3 RS_{i,t-1})$ in equation *(A2)* above will be equal to:

$$s_b = \sqrt{s_{11} + 2RSs_{13} + RS^2 s_{33}} \qquad (A3)$$

where the values s_{11} and s_{33} are the variances of β_1 and β_3 and s_{13} is the covariance between β_1 and β_3 taken from the sample estimate of the variance-covariance matrix. One can then obtain different estimates of the interaction term (and their corresponding standard errors) for different values of *RS*. The t-test for whether a simple slope differs from zero is simply the value of the slope divided by its standard deviation with *n-k-1* degrees of freedom, where n is the total number of observations and k the number of explanatory variables