The cyclicality of Irish fiscal policy ex-ante and ex-post

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Abstract: The cyclicality of fiscal policy in Ireland in the budgetary plans put before parliament and ex-post is considered. Data in budgetary documents and particular econometric estimation procedures help address endogeneity issues and provide numerous variable-estimation procedure combinations for assessing cyclicality. Fiscal policy in Ireland is found to be pro-cyclical on both ex-ante and ex-post bases. The evidence is mixed between policy being more pro-cyclical ex-post than was intended at Budget time and there being no difference. With the preventive arm of the Stability and Growth Pact now applying to Ireland, a continuation of pro-cyclical fiscal policy would endanger its requirements being met.

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1. Introduction

This paper considers the issue of the cyclicality of fiscal policy in Ireland - that is whether discretionary budgetary decisions by the Irish government are influenced by the economic cycle. The balance of evidence in the international literature points to fiscal policy in developed countries, including Ireland, being pro-cyclical, with increases in expenditure and/or reductions in tax rates occurring when the economy is buoyant and those budgetary decisions being reversed when there is a downturn in economic activity. Such behaviour can be attributed to political economy (governments being profligate when times are good and tightening the public purse when recessions occur) and other considerations. Pro-cyclical fiscal policy exacerbates the economic cycle and offsets the effects of the automatic stabilisers on the budget balance and the economy.

In recent years, part of the focus in the literature has been on two issues considered in the econometric analysis undertaken here. The first relates to using both ex-post and ex-ante data to compare the outcome of fiscal policy with what was intended at the time budgetary policy was enacted. The second addresses the endogeneity that arises between output growth and its fiscal components and that can be left unaddressed in empirical studies of the cyclicality of fiscal policy (Rigobon (2004) and Jaimovich and Panizza (2007)).

Unlike other studies in this area, we use data from budgetary material, rather than secondary sources, to compare ex-ante policy intentions with what came to pass. The annual Budget documents in Ireland give forecasts for government consumption and GDP growth, thus providing the basis for an ex-ante analysis of fiscal policy cyclicality and its comparison to measures of cyclicality based on outturn data.

In assessing the presence, or otherwise, of pro-cyclical behaviour in fiscal policy, controlling for endogeneity in econometric estimations is particularly important. Endogeneity is addressed in two ways here. First, expected current year outturns for GDP and private consumption growth rates in the Budget documents provide substitute variables for next year's GDP growth rate forecast to address the endogeneity issue in the ex-ante estimations, while lagged outturn values for those variables are used in the ex-post regressions. Secondly, the sign and scale of particular parameter estimates denotes the form and magnitude of any cyclical behaviour. Endogeneity, however, results in ordinary least squares (OLS) parameter estimates that are biased downwards. We employ alternative estimation procedures to address this issue. In particular, we use the dynamic ordinary least

squares (DOLS) methodology of Stock and Watson (1993) and the Philips-Hansen (1990) fully modified OLS (FMOLS) procedure. Both approaches have been used for econometric inference purposes where endogeneity may arise.[1]

The paper is structured as follows. The literature in this area is considered in the next section, while section 3 discusses the data and the econometric procedures used. Section 4 then presents the empirical results before the concluding section. We find fiscal policy to be pro-cyclical in Ireland on an ex-ante and ex-post basis but that the evidence on whether policy is more pro-cyclical ex-ante or ex-post is mixed between there being no difference and ex-post policy being the more pro-cyclical.

2. Literature Review

A considerable literature exists on the cyclicality of fiscal policy based on ex-post data. Gavin and Perrotti (1997) and Talvi and Vegh (2000) provide evidence of pro-cyclical fiscal policy in Latin American countries and the world economy, respectively. Arreaza, Sorensen and Yosha (1999) observe budget balances tending to be procyclical in OECD countries. Lane (2003) considers how cyclicality varies across spending categories and OECD countries and shows that both government investment and government consumption are pro-cyclical. Balassone, Francese, Zotteri (2010) attribute asymmetry in the cyclical behaviour of the budget balance in fourteen EU member states between 1970 and 2007 to its government expenditure component. Both overall and primary budget balances deteriorate during times of economic contraction without a corresponding improvement occurring when the economy is expanding. Ilzetzki and Vegh (2008) present evidence of pro-cyclicality of fiscal policy in both developing and high-income countries.

There have been some studies of the cyclicality of fiscal policy in Ireland. Lane (1998) estimates regressions of a number of fiscal variables on a measure of the economic cycle using annual data from 1979 to 1996. He detects a pro-cyclical pattern in government expenditure and concludes that fiscal policy more generally is not counter-cyclical. Hunt (2005) finds government consumption not to be influenced by the cycle while government investment is strongly pro-cyclical. He also considers the relative importance of actual and forecast output growth rates (based on Department of Finance and OECD published

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[1] See Fitzpatrick and McQuinn (2007) for an example of an application of these techniques to an endogeneity issue.

forecasts) in determining government expenditure. His analysis indicates growth forecasts having little influence on spending except for government investment. Benetrix and Lane (2012) compare fiscal policy before and after the financial crisis that arose in 2008. In the pre-crisis period, the General Government balance and discretionary government expenditure behave in a manner that indicates fiscal policy to be pro-cyclical. During the crisis years (2008-2010), pro-cyclical fiscal policy is also detected.

Recent years have seen a new dimension to the international literature developing, with analyses of both ex-ante and ex-post data. Fiscal outcomes are compared with initial budget plans and both are related to output developments. The ex-ante budget plans can reveal the intended fiscal stance, while the ex-post data indicate what came to pass. Ex-post fiscal data being regressed on real-time output data helps analyse the relationship between the information available to policymakers at the time budgetary plans were outlined and the actual outcome of the policy.

Beetsma, Giuliodori and Wierts (2009) review the stability and convergence programmes of EU member states and find that implemented budgetary adjustment routinely falls short of that planned. They point out that this is relevant to fiscal surveillance as ex-ante compliance with fiscal rules, such as occurs under the Stability and Growth Pact, could be misguided. Using data for OECD countries between 1995 and 2006, Beetsma and Giuliodori (2010) find that planned fiscal policy is acyclical for EU member states and counter-cyclical for other OECD countries. EU countries, however, react pro-cyclically to unexpected changes in the output gap, while the responses of the other countries are acyclical.

Based on a panel of 19 OECD countries over the period 1993-2003, Forni and Momigliano (2005) compare ex-post structural budget balances and real-time values for the output gap, taken from the OECD Economic Outlook. They observe a counter-cyclical stance occurring during economic slowdowns. Using a panel of fourteen OECD countries, Bernoth, Hughes-Hallett and Lewis (2008) find pro-cyclical fiscal policy being evident in ex-post data, while real-time data indicate a more counter-cyclical stance. Cimadomo (2012) shows a counter-cyclical fiscal stance in the budgetary plans of OECD countries, particularly during the expansion phase of the economic cycle. In a review of fiscal policy analysis based on real-time data, Cimadomo (2014) assesses the balance of the evidence as pointing to the cyclical stance of fiscal policies being more counter-cyclical when real-time data are used rather than ex-post data.

3. Data and econometric methodology

Ireland follows an annual budgetary process with the Budget for the forthcoming year being presented by the Minister for Finance to parliament for its approval in the closing months of the preceding calendar year.[2] Since the 1989 Budget, the accompanying documentation has included percentage real/volume growth rate projections for Gross Domestic Product (real growth rate of which is denoted as y), public/government consumption (real growth rate of which is denoted as g), and private/personal consumption (real growth rate of which is denoted as p) for the forthcoming year, as well as expected outturns ("nowcasts") for the current year. The projections for the forthcoming year (made by the Irish finance ministry, the Department of Finance) take account of the effects of budgetary changes on GDP and its components.[3]

Forecasts of the output gap have only been a feature of the Budget since 1999, limiting its usefulness for econometric analysis.[4] On the fiscal side, measures of the structural budget balance (and its revenue and expenditure components) are also not available before 1999. Government consumption, however, provides a suitable fiscal variable for assessing policy cyclicality as the growth rate of that expenditure is at the discretion of government. Government investment would be another candidate but no forecasts for it are available in the Budget books prior to 2002.

A dataset of nowcasts and forecasts for GDP, government consumption and private consumption can then be compiled from Budget documents (also referred to as the Budget books) from the 1989 Budget onwards.[5] In our view, they constitute an improvement on

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[2] This has been the practice since the 1998 Budget. Before that, the Budget was presented later, in the January or February of the calendar year to which it applied. So, for example, the 1997 Budget was presented on 22 January 1997, while the 1998 Budget was delivered on 3 December 1997.

[3] The 1988 Budget was the first where the impact of budget proposals on the economic outlook was taken into account. Specifically, the foreword to the section "Economic Background to the [1988] Budget" includes the following: "It should be noted that this year a change has been made in the way in which the section "Outlook for the Irish Economy" has been prepared. Instead of being based on pre-budgetary trends, this section now takes account of Budget Day proposals."

No specific numerical forecasts for the variables of interest here are included in the 1988 Budget. In the 1989 Budget and subsequent Budgets, they are presented in tabular form and provide the ex-ante data used here.

[4] The output gap is in any case problematic to estimate accurately for a small, open economy such as Ireland, which also makes the calculation of the structural budget balance difficult (see Cronin and McCoy, 1999).

[5] There were two 2009 Budgets, with the first being presented to parliament on 14 October 2008 and a supplementary Budget occurring on 7 April 2009. The latter includes growth rate projections for GDP, government consumption and private consumption for 2009, which we use here. The supplementary Budget

using a source such as the OECD Economic Outlook which has been used, for example, by Cimadomo (2012) in his cross-country assessment of ex-ante fiscal policy. While the OECD publication can facilitate a panel study by providing a consistent definition of, and common source for, variables across countries, the sequencing of OECD forecasts is not necessarily in line with domestic budgets. The forecasts in the Budget books present the Irish government's perception of the economic outlook on which its spending and taxation decisions are made (while taking account of the effect of those measures on output).

Ex-post data for GDP, government consumption, and private consumption growth rates are taken from the EU AMECO database. We use a data sample from 1989 to 2013 in estimating the regression equations below. The initial year is dictated by ex-ante fiscal and macroeconomic data being included in the Budget documentation for the first time in the 1989 Budget. While ex-post data for 2014 and 2015 are available, those data are excluded from the analysis for two reasons. First, ex-post data, particularly for output growth, will only become final with a lag, so it seems appropriate to exclude the most recent estimates. Secondly, the GDP outturn for Ireland in 2015 is a distorted measure of output.[6] It should also be acknowledged that part of the difference between ex-ante and ex-post growth rates may be due to methodological changes and improvements in data sources over time. Such effects may be stronger the further back in time one goes.

It is possible that a political bias may enter the budgetary process and could provide an unduly optimistic forecast of economic activity in the coming year. To assess whether the Department of Finance's GDP growth rate forecasts were too rosy or otherwise, those forecasts are compared to those in the first Central Bank of Ireland *Quarterly Bulletin* published after each Budget (and which take account of tax and expenditure changes in the Budget). Figure 1 shows that the two institutions' forecasts broadly track each over time with only a few instances where sizeable differences arise and with some of those having the Department of Finance being more pessimistic than the Central Bank.

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did not include updated projected outturns for 2008, so those provided in the initial 2009 Budget are drawn upon here.

[6] In July 2016, the Irish statistical institute, the Central Statistics Office, reported real GDP growth of 26 per cent for Ireland in 2015. This mainly reflected the effects of a level shift in the size of the capital stock in Ireland arising from corporate restructuring and balance sheet reclassifications in the multinational sector.

For both ex-ante and ex-post assessments, we follow Ilzetzki and Vegh (2008)'s basic approach of regressing percentage changes in real government consumption on percentage changes in real GDP (or on an instrumental variable). The beta coefficient (β) in the regression estimation indicates the cyclicality of fiscal policy: if it is less than zero, policy is counter-cyclical; if it insignificantly different from zero, it is acyclical; and if it is greater than zero, policy is pro-cyclical.

The basic ex-ante regression is then:

$$g_{t|t-1} = \beta y_{t|t-1} + v_t \qquad\qquad\qquad (a)$$

Where $g_{t|t-1}$ is the one-year-ahead forecast for the real growth rate in government consumption in year t at the time of the Budget being delivered to parliament (in year $t-1$), $y_{t|t-1}$ is the one-year-ahead forecast real growth rate in GDP in year t in the Budget, and v_t is an error term.

The basic ex-post regression is:

$$g_t = \beta y_t + u_t \qquad\qquad\qquad (b)$$

Where g_t is the ex-post real growth rate in government consumption in year t, y_t is the ex-post real growth rate in GDP, and u_t is an error term.

Drawing on Cimadomo (2012), a third regression is also estimated:

$$g_t = \beta y_{t|t-1} + w_t \qquad\qquad\qquad (c)$$

Where g_t is the ex-post real growth rate in government consumption in year t and $y_{t|t-1}$ is the one-year-ahead forecast real growth rate in GDP in year t at the time of the Budget, and w_t is an error term.

Estimation of equations (a) and (b) permit an assessment of the ex-ante and ex-post cyclicality of fiscal policy, while a comparison of the beta coefficients from (a) and (c) will point to whether implemented fiscal policy was more or less pro- or counter-cyclical than intended initially.

Ilzetzki and Vegh (2008) highlight an important issue in assessing the cyclicality of fiscal policy: the endogeneity that arises between measures of national output and fiscal variables

that are a component of that output. An observed rise in both government consumption expenditure and GDP, for example, does not necessarily imply that output growth motivated government to increase expenditure. It could be that the greater spending by government had an expansionary effect on output, which otherwise could have fallen or been unchanged. A positive correlation between discretionary government expenditure and GDP may be a case of fiscal policy driving output. The difficulty with an OLS estimation of the three equations above then is that the covariance between the output growth rate and the error term may not be zero.

Different output variables and econometric estimation procedures are used here to address this endogeneity issue. Initially, OLS estimates of equations (a) to (c) are reported. These estimates are of interest in their own right and for comparison with beta coefficients produced by other estimation procedures employed here. Beyond these initial estimations, the empirical approach has two distinct features. First, instruments for GDP growth are substituted for it in estimations of equations (a) to (c). The two instruments chosen are available on an ex-ante basis in the Budget material, as well as ex-post. One is the first lag of private consumption growth rate (p). It is a component of the GDP growth rate but distinct from government consumption so that endogeneity between private and government consumption is not to be expected, particularly when lagged values of private consumption are used. The other instrument is the first lag of real GDP growth. It is also unlikely to be correlated with the contemporaneous growth rate of government consumption. For equations (a) and (c), it is the nowcast (Budget day forecast) of real private consumption growth and real GDP growth for the current year that are used, i.e. $p_{t-1|t-1}$ and $y_{t-1|t-1}$ to follow the notation used heretofore. Consequently, in what follows we use three different output/expenditure variables on the right-hand side of the regression estimations.

The other feature of the empirical approach is the use of alternative estimation procedures. The first is two-stage-least-squares/instrumental variable (IV) estimation that follows from the employment of two instrumental variables for GDP growth. Fully modified OLS (FMOLS) and dynamic OLS (DOLS) are the two other estimation techniques used to address the endogeneity issue.

As noted by Stock and Watson (1993), possible endogeneity of some of the explanatory variables causes second order asymptotic bias in coefficient variables. This issue can

particularly arise in small samples. The dynamic OLS (DOLS) approach can be explained in the context of the following relationship:

$$y_t = \beta_0 + \beta_1 x_{1t} + \beta_2 x_{2t} + \varepsilon_t \qquad \text{(d)}$$

Where either x_{1t} or x_{2t} may be endogenous, DOLS involves adding both leads and lags of the differenced regressors to the specification to correct for correlation between the error process ε_t and the level regressors

$$y_t = \beta_0 + \beta_1 x_{1t} + \beta_2 x_{2t} + \sum_{j=-k}^{k} \theta_{1j} \Delta x_{1,t+j} + \sum_{j=-k}^{k} \theta_{2j} \Delta x_{2,t+j} + \pi_t \quad \text{(e)}$$

An F-test with respect to the β's has an asymptotic $\mathcal{X}^2$ distribution. The error term in (e) is liable to be serially correlated so the covariance matrix of the estimated coefficients must be adjusted accordingly. Therefore, OLS estimates of the residuals are obtained as an estimator of π_t and the serial correlation of π_t is assumed to be approximated by the following AR (p) model

$$\pi_t = \gamma_1 \pi_{t-1} + \gamma_2 \pi_{t-2} + \cdots \gamma_p \pi_{t-p} + \sigma_t \qquad \text{(f)}$$

Equation (f) is then estimated by OLS to achieve coefficient values for γ's. The estimated standard error of ε_t denoted by $\hat{\delta}_\epsilon$ as calculated by an OLS regression of (e) is adjusted accordingly to

$$\widehat{\delta'_\pi} = \frac{\widehat{\delta_\pi}}{(1 - \widehat{\gamma_1} - \widehat{\gamma_2} - \widehat{\gamma_3} - \cdots \widehat{\gamma_p})} \qquad \text{(g)}$$

The modified covariance matrix is this $\widehat{\delta'_\pi}$ squared times the inverse of the second moment of the regressors of (g).

Having allowed for correlation between the regressors and the error process and for serial correlation, DOLS enables inferences to be drawn on the basis of the adjusted standard errors. FM-OLS estimation is concerned with allowing statistical inference within multivariate regressions where the regressors have I(1) processes. If in (d), both x_1 and x_2 have the following first difference stationary processes

$$\Delta x_{1t} = \mu + \theta_{1t} \qquad \text{(h)}$$

$$\Delta x_{2t} = \alpha + \theta_{2t}$$

in which μ and α are drift parameters and θ_{1t} and θ_{2t} are I(0) or stationary variables, then the computation of the FM-OLS estimator β is carried out in a multi-stage process, where, initially, y_t, is corrected for the long-run interdependence of θ_t and π_t.

Before turning to the econometric estimates in the next section, forecast errors, that is the differences between the ex-post growth rate and the ex-ante/Budget day forecast growth rate for the same year, for each of the four variables used in the various estimations are shown over the years 1989 to 2013 in Figure 2. Panel (i) indicates that the ex-post growth rate for government consumption is higher than that projected at Budget time in most years, suggesting slippage from budgetary expenditure targets. Moreover, those cases (only five in all) where government consumption growth is less than initially projected involve an undershooting that is, in average percentage terms, much lower than that recorded in the other years, where an overshooting of the Budget forecast growth rate occurs.

For the measures of output activity, ex-post GDP growth rates are most usually ahead of the Budget forecast (panel (ii) of Figure 2), so that the Department of Finance tended to under-predict output growth. This may be due to government consumption growth turning out higher than expected at Budget time or it could be due to the other components of GDP growing more strongly than projected, or both. Forecast errors for lagged private consumption growth (panel (iii)) – one of the instruments for GDP growth - are more balanced in number between outturns exceeding or being less than Budget forecast, although the outturn growth rate being in excess of target still predominates. Finally, panel (iv) indicates that initial estimates of the GDP growth rate outturn for the current year (the nowcast in the Budget) also tend to be less than the final outturn in most cases.

4. Econometric Results

The layout of Tables 1, 3 and 4 are the same. From left to right, the three columns of results report estimates of the beta coefficients from equations (a), (b) and (c), respectively. In panel (i), the right-hand-side variable is real GDP growth (y_t), while in panel (ii) it is lagged real private consumption growth (p_{t-1}) and in panel (iii) lagged real GDP growth (y_{t-1}), with ex-ante and ex-post values of those variables being used as appropriate to the equation being estimated. A common feature of the four tables is that all estimates of equations (a) to (c) render beta coefficients that are positive and statistically significant. Fiscal policy in Ireland can then be adjudged to be pro-cyclical on both an ex-ante and an ex-post basis.

Looking at each table in turn, equations (a) to (c) were initially estimated by OLS, with the results reported in Table 1. Substituting lagged private consumption growth and lagged GDP growth for GDP growth provides higher beta coefficient estimates. For all tables, Z-scores are calculated to ascertain whether, for each panel, beta coefficient estimates in the second and third columns are different from that in the first. In both the second and third panels, but not in the first panel, the beta coefficients in the second column are each higher than that in the first column. Thus, the evidence from Table 1 is mixed as to whether fiscal policy is more pro-cyclical ex-post than ex-ante. Equation (c) can be viewed as the ex-post outturn for government consumption growth being substituted into the left-hand-side of equation (a) for the Budget/ex-ante forecast for that variable. The beta coefficient of (c) being higher than the estimate in (a) would point to budgetary slippage having occurred during the year consistent with the direction of the cycle. The Z-score values in the third column of Table 1 support the beta coefficient in that column being higher than that in the first column.

The results of the instrumental variable procedure are shown in Table 2. The beta coefficient estimates are higher than those in panel (i) of Table 1. As can be seen in Table 2, standard tests of endogeneity reject the null of exogeneity for the independent variables, suggesting that endogeneity in the data is an issue and, thus, poses a difficulty for a standard OLS specification. In Tables 3 and 4, we present the DOLS and FMOLS estimations of the beta coefficient. They share the common features with Tables 1 and 2 that all beta coefficients are statistically significant and positive. The comparison, using Z-scores, between the beta estimates in the first and second columns of Tables 3 and 4 indicate that fiscal policy is more pro-cyclical ex-post than ex-ante for four of the six panels involved, with those four being where lagged private consumption growth and lagged GDP growth are employed as regressors. All Z-scores point to the beta coefficient values in the third column being higher than those in the first.

5. Conclusion

This paper has considered the issue of the cyclicality of fiscal policy in Ireland on an ex-ante and an ex-post basis. Budget books provide the ex-ante data, including for two variables that help address an endogeneity issue. Not only can those variables substitute for GDP growth when least squares estimation procedures are used but they also allow an instrumental variable procedure to be employed. Using an instrumental variables estimator, we find

evidence that endogeneity needs to be addressed in assessing the issue of the cyclicality of fiscal policy in Ireland. We also use two least-squares estimation procedures, DOLS and FMOLS, both of which are typically used to derive inference in cases of potential endogeneity. A benefit of our approach is that numerous (in this case, ten) variable-estimation procedure combinations are employed in assessing the cyclicality of fiscal policy and in comparing ex-ante and ex-post stances.

The findings are that, first, fiscal policy in Ireland can be adjudged to be pro-cyclical on both ex-ante and ex-post bases according to all variable and estimation procedure combinations. Secondly, on the question of whether fiscal policy is more pro-cyclical when ex-ante data or ex-post data are used, the evidence is mixed with some estimates (in four of the ten cases) indicating no statistical difference and others (the remaining six) a larger beta coefficient for the ex-post data. Finally, when ex-post government consumption is substituted for its ex-ante counterpart in regressions where ex-ante measures of economic activity are on the right-hand-side, the beta coefficients are larger in nine out of ten cases. This is interpreted as support for fiscal policy being more pro-cyclical than that planned at Budget time.

These results imply that fiscal policy in Ireland is pro-cyclical, consistent with some of the findings in Lane (1998), Hunt (2005), and Benetrix and Lane (2005). Such a fiscal stance is undesirable because it indicates budgetary policy exacerbating the growth cycle when it having no effect or a counter-cyclical effect would be preferable. What is new among the findings here is that budgetary policy is pro-cyclical at the time Budgets are presented to parliament. This contrasts with international studies such as Beetsma and Giuliodori (2010) and Bernoth, Hughes-Hallett and Lewis (2008) where ex-ante fiscal policy is found to have an acyclical or counter-cyclical stance in OECD countries.

Ireland exited the corrective arm of the Stability and Growth Pact in 2015 with its preventive arm now applying. This requires the setting of a medium-term objective of a balanced budget in structural terms and adherence to an expenditure benchmark, constraining spending by the potential growth rate of the economy. Adherence to these rules will be assessed formally on an ex-post basis. The analysis on the historical data conducted here indicates that a change in fiscal behaviour from that of the past may be required for Ireland to observe the Pact's requirements over time. If future fiscal policy were to be pro-cyclical in nature then its effect would be to cause the structural budget balance to start to move away from the medium-term objective once that target had been initially attained. Expenditure growth

could also rise above benchmark values at times, such that a breach of the spending ceiling could occur. Finally, the data here point to a greater degree of pro-cyclicality in fiscal policy occurring after the Budget than was planned in it. If maintained over time, this would increase the susceptibility of the sovereign to an infringement of the Pact rules.

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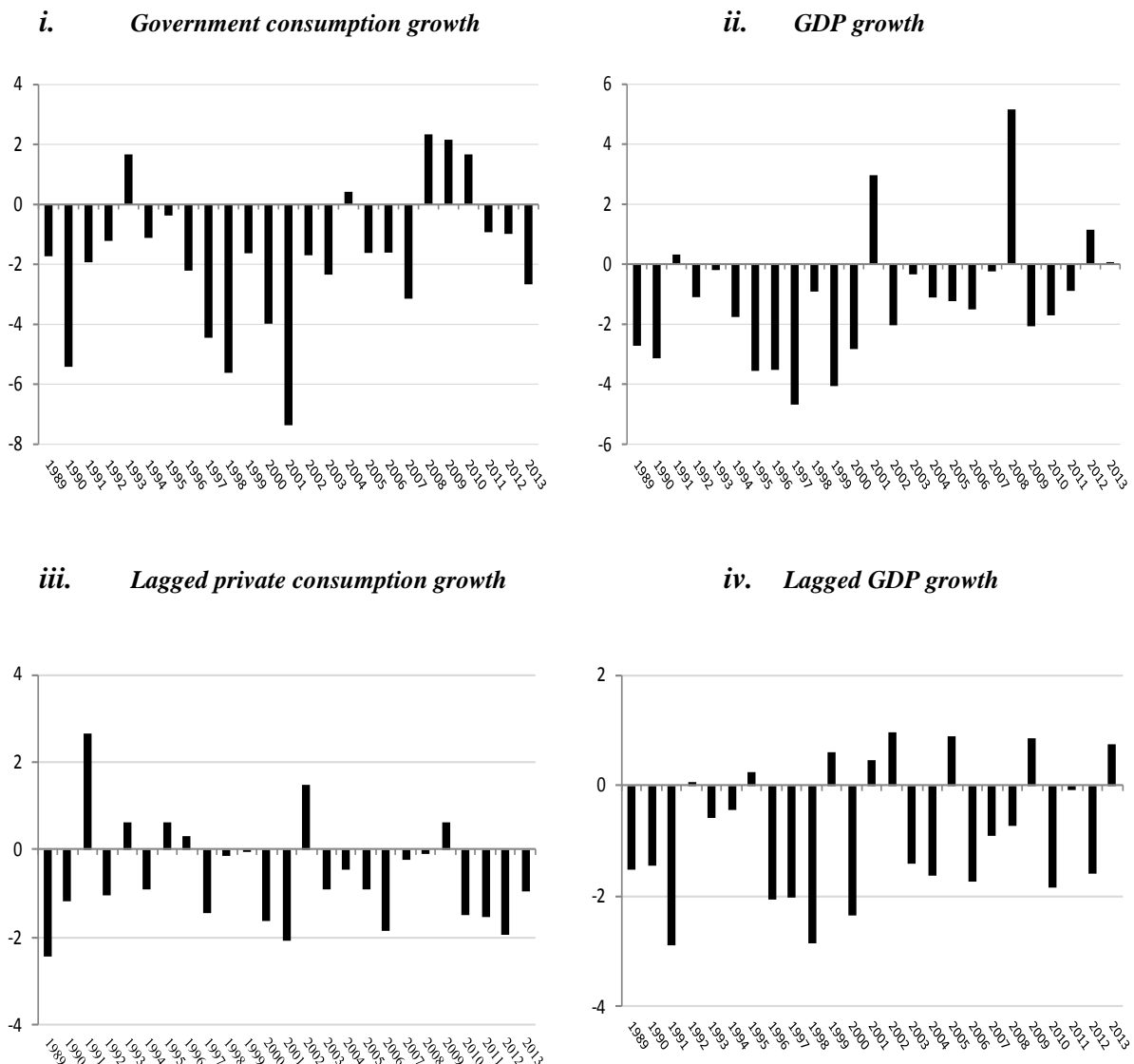
Figure 1. Department of Finance and Central Bank of Ireland GDP growth rate forecasts (%)
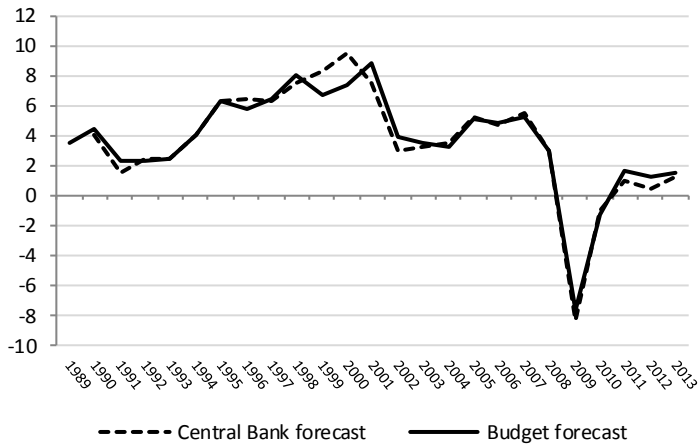
Source: Department of Finance annual Budget material and Central Bank of Ireland *Quarterly Bulletin*.

Note: The Central Bank of Ireland GDP growth rate forecast is taken from the first *Quarterly Bulletin* published after the Budget.

Figure 2. Forecast Errors, 1989-2013 (%)

i.   *Government consumption growth*

ii.   *GDP growth*

iii.   *Lagged private consumption growth*

iv.   *Lagged GDP growth*

Source: Department of Finance annual Budget material for ex-ante data; EU AMECO for ex-post data.

Note: In panels (i)-(ii), forecast errors are calculated as the ex-ante real/volume growth forecast for the Budget year in question less the ex-post real/volume growth outturn for the same year. In panels (iii) and (iv), forecast errors are the real-time Budget day expected outturns for real private consumption growth and real GDP growth, respectively, in the pre-Budget year less their ex-post outturns.

Table 1. OLS Regression Results, 1989-2013

	Dependent variable		
	$g_{t\|t-1}$	g_t	g_t
		Beta coefficient estimates	
(i)			
$y_{t\|t-1}$	0.415 (0.131)		
y_t		0.642 (0.132)	
$y_{t\|t-1}$			0.916** (0.136)
R^2	0.305	0.507	0.664
(ii)			
$p_{t-1\|t-1}$	0.547 (0.082)		
p_{t-1}		0.88** (0.0973)	
$p_{t-1\|t-1}$			0.86** (0.11)
R^2	0.65	0.788	0.73
(iii)			
$y_{t-1\|t-1}$	0.449 (0.0976)		
y_{t-1}		0.765** (0.096)	
$y_{t-1\|t-1}$			0.852*** (0.096)
R^2	0.479	0.743	0.774

Note: Entries in parentheses are standard errors of coefficient estimates.   *** indicates coefficient estimate being statistically different from entry in $g_{t\|t-1}$ column at 1 per cent significance level; ** at 5 per cent level; * at 10 per cent level.

Table 2.   Instrumental Variable Regression Results, 1989-2013

		Dependent variable	
	$g_{t|t-1}$	g_t	g_t
(i)			
$y_{t|t-1}$	0.466 (0.176)		
y_t		0.8 (0.140)	
$y_{t|t-1}$			0.96 (0.249)
H_O: Variable is Exogenous			
F-Test	4.85 (0.04)	5.77 (0.03)	3.05 (0.09)
χ^2	3.2 (0.07)	5.12 (0.02)	2.23 (0.14)
First-stage regression summary statistics			
R^2	0.95	0.73	0.95

Note: Entries in parentheses are standard errors of coefficient estimates.

Table 3.   DOLS Regression Results, 1989-2013

		Dependent variable	
	$g_{t\|t-1}$	g_t	g_t
(i)			
$y_{t\|t-1}$	0.680		
	(0.125)		
y_t		0.889	
		(0.096)	
$y_{t\|t-1}$			1.279***
			(0.110)
R^2	0.6	0.92	0.94
(ii)			
$p_{t-1\|t-1}$	0.613		
	(0.091)		
p_{t-1}		1.095***	
		(0.099)	
$p_{t-1\|t-1}$			1.028***
			(0.107)
R^2	0.78	0.87	0.88
(iii)			
$y_{t-1\|t-1}$	0.572		
	(0.106)		
y_{t-1}		0.889**	
		(0.098)	
$y_{t-1\|t-1}$			1.025***
			(0.096)
R^2	0.56	0.83	0.86

Note: Entries in parentheses are standard errors of coefficient estimates.   *** indicates coefficient estimate being statistically different from entry in $g_{t|t-1}$ column at 1 per cent significance level; ** at 5 per cent level; * at 10 per cent level.

Table 4. FMOLS Regression Results, 1989-2013

	$g_{t\mid t-1}$	Dependent variable g_t	g_t
(i)			
$y_{t\mid t-1}$	0.564 (0.113)		
y_t		0.801 (0.095)	
$y_{t\mid t-1}$			1.104*** (0.100)
R^2	0.29	0.54	0.67
(ii)			
$p_{t-1\mid t-1}$	0.591 (0.063)		
p_{t-1}		0.957*** (0.095)	
$p_{t-1\mid t-1}$			0.895** (0.094)
R^2	0.53	0.56	0.83
(iii)			
$y_{t-1\mid t-1}$	0.516 (0.091)		
y_{t-1}		0.863** (0.086)	
$y_{t-1\mid t-1}$			0.933*** (0.076)
R^2	0.49	0.73	0.78

Note: Entries in parentheses are standard errors of coefficient estimates.   *** indicates coefficient estimate being statistically different from entry in $g_{t\mid t-1}$ column at 1 per cent significance level; ** at 5 per cent level; * at 10 per cent level.

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