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DEALING WITH UNEXPECTED SHOCKS TO THE BUDGET

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Abstract

In this paper we assess the impact of unexpected shocks to real interest rates and GDP on government budgets for nine European Union countries. Shocks are estimated as one-step-ahead forecast errors arising from a recursive bivariate VAR model. To assess the impact on the budgets we use available information on budgetary sensitivities with respect to the business cycle and estimate the sensitivities to changes in interest rates on the basis of the maturity structure of public debts. Our analysis is relevant, in particular, to define what safety margins are needed to avoid the deficit exceeding the 3 per cent Maastricht threshold. The approach followed in this paper differs in two respects from standard analyses aiming at defining budgetary positions that satisfy the Stability and Growth Pact. First, whereas the latter examine only fluctuations in economic activity, we also consider fluctuations in interest rates. Second, whereas standard analyses focus on deviations from trends and define margins for the medium-term cyclically adjusted balance, we examine unexpected shocks and define margins for nominal balances. The results point to significant differences in the required margins across countries, depending on the amplitude of past shocks, the magnitude of automatic stabilizers and the size and maturity structure of the debt. In the case of Italy, the country with the highest debt/GDP ratio and the largest fraction of short-term debt, the impact of unexpected shocks to interest rates may be quite substantial. However, when shocks to interest rates and GDP are considered jointly, other countries (Belgium and Finland) seem to require larger margins.

JEL classification: H60, C53.

Keywords: budgeting, Stability and Growth Pact, forecast errors.

Contents

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1. Introduction[1]

The literature on the appropriate targets for government budget deficits within the EMU framework has grown rapidly in recent years. Most studies has attempted to assess the safety margins for the balance that would allow Member States to leave automatic stabilizers to operate during normal cyclical fluctuations while keeping the deficit below 3 per cent of GDP.[2] These margins are often termed “minimal benchmarks” as they do not take into account other sources of variability and uncertainty in the budgets.

A basic reference is the work of Buti, Franco and Ongena (1997), which examines past episodes of recession in the European economies. The results of the study suggest that for most economies a budget balance between zero and 1 per cent of GDP would satisfy the minimal requirements of the Stability and Growth Pact (SGP), while some Nordic countries should aim for a balanced budget or a surplus. Other studies, based on stochastic simulations of different models, tend to be less restrictive, suggesting deficits around 1 per cent of GDP would be suitable for almost all countries in the EMU (Barrel and Pina, 2002; Barrel, Hurst and Pina, 2003[3]; Dalsgaard and de Serres, 1999[4]).

Minimal benchmarks have been used by the European Commission when assessing the stability and convergence programmes. They were first calculated in 1998-99 in connection with the first set of programmes (European Commission, 1999). They were "obtained by multiplying the budgetary sensitivity to the cycle with an output gap estimate which encapsulates the size and frequency of cyclical fluctuations in output for each Member State"

[1] We wish to thank the National Central Banks of Austria, Belgium, Finland, France, Germany, the Netherlands, Spain and the UK for providing us with data on public debt maturity.

[2] The analysis of the fiscal framework provided by EMU has not been limited to just assessing appropriate safety margins. For example, Marin (2002) discusses a fiscal policy rule that is consistent with the legal provisions of budgetary discipline in EMU in both deterministic and stochastic environments.

[3] In Barrel and Pina (2002) and in Barrel, Hurst and Pina (2003) estimates of safety margins are derived from stochastic simulations of the National Institute Global Econometric Model (NiGEM).

[4] Dalsgaard and de Serres (1999) derive estimates of cyclically-adjusted budget balances needed to avoid breaching the 3 per cent limit from stochastic simulations of three disturbances: aggregate supply shocks, real demand shocks and nominal shocks. These disturbances and their impact on fiscal balances are estimated with a structural VAR model. The safety margins depend on the frequency of fiscal adjustments and the desired degree of confidence.

(European Commission, 2000, p. 51).[5] Revised estimates, presented in European Commission (2000 and 2002), took into account new assessments of the budgetary sensitivities and cyclical fluctuations.

These evaluations, while differing in a number of technical aspects, share the following features: i) they focus on the budgetary risks arising from fluctuations in economic activity; ii) they define these fluctuations with reference to some kind of normal (or trend) trajectory of the economy; iii) they calculate safety margins which help to identify an appropriate target for the cyclically adjusted balance and are meant to offset the budgetary effects of the trough of a full business cycle.

In this paper we extend the assessment to include the budgetary risks coming from fluctuations in interest rates, as in many countries of the Monetary Union interest payments are an important part of the budget and can vary significantly in response these fluctuations.[6] Our analysis differs from the studies mentioned also in its definition of budgetary risks: for both GDP and interest rates, we analyze the short-term impact on the budget of unexpected shocks, obtained as forecast errors from a VAR model. Therefore, the safety margins that we calculate refer to nominal balances and are meant to cope with the risk arising from errors in forecasts of GDP and interest rates when budgeting for the following year.

Our safety margins are relevant for at least two reasons: the first rests on the current difficulties of the SGP; the second is valid even if, or when, all EMU countries reach the SGP target of a balanced cyclically adjusted balance.

As to the first reason, it now appears that the transition phase to a balanced cyclically adjusted balance may be rather long, at least for the three largest economies of the Monetary Union and Portugal. For these countries, the political and financial sanctions for breaching

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[5] A similar approach is adopted in OECD (1997) and in IMF (1998).

[6] In doing so we partly fulfil the need to extend the analysis of risks to other factors, as stated in the Code of Conduct endorsed by the Ecofin Council in July 2001: "The medium-term budgetary position which respects the close-to-balance-or-in-surplus rule of the SGP has to take account of several elements, such as the possibility to deal with adverse cyclical developments and other unforeseen risks whilst respecting the government deficit reference value, the need to take account of other sources of variability and uncertainty in budgets, and the need to ensure a rapid decline in high debt ratios...".

the 3 per cent deficit threshold make it advisable to include a margin in the budget to reduce the risk of overshooting.

As to the second reason, it should be stressed that respecting the minimal benchmarks or even maintaining a balanced cyclically adjusted balance are not foolproof guarantees that the 3 per cent threshold will never be exceeded. They offer a full guarantee with regular fluctuations, when the cyclical position of the economy can be unambiguously identified. However, the debate on the nature of economic cycles suggests we should be rather cautious about the possibility of accurately identifying cyclical fluctuations and trends (among others, see Canova, 1998). If this is the case, at least with some of the methodologies currently used to assess cyclical positions[7] there is still some likelihood of exceeding the 3 per cent threshold while maintaining a balanced cyclically adjusted balance. If a government is strongly averse to the risk of exceeding the threshold, then when budgeting for the following year it may wish to maintain a margin to cope with forecast errors, independently of its assessment of the cyclical position of the economy.

In this second context, our safety margin can be thought of as an additional constraint on budgetary policies which provides a safeguard against serious failings in the assessment of cyclical positions. The short-term horizon used to define the forecast errors (one year ahead) and the usually limited role of interest rates (apart from the case of Italy) imply that, ceteris paribus, the margin is smaller than those found in the studies based on cyclical fluctuations, and will therefore be binding only under special circumstances.

In what follows we evaluate the appropriate margins to cope with both interest rate and GDP unexpected shocks for nine EU countries. The paper is organized as follows.

In Section 2 we estimate the unexpected shocks registered in the past as forecast errors arising from a bivariate VAR model that includes the short-term real interest rate and the logarithm of the real GDP. We then identify for all countries upper-bound estimates of future unexpected shocks to these variables. To take into account the presence of the new monetary policy regime, common upper-bound estimates for future unexpected shocks to the interest

[7] Especially those which either do not place restrictions on the length of economic cycles or allow them to be relatively long.

rate are obtained by averaging out the values calculated for the individual euro area countries.

Section 3 examines the maturity structure of the debt of the individual countries. Section 4 uses this information to assess the impact on the interest expenditures of future shocks to interest rates. Section 5 evaluates the impact on the primary balance of future shocks to GDP, using estimates of the sensitivities computed by the OECD, the European Commission and, within the European System of Central Banks, by Bouthevillain et al. (2001). The results obtained in the previous two sections are put together in Section 6 to compute the overall safety margins needed to cope with future shocks to GDP and interest rates. Section 7 concludes.

2. Estimating the unexpected shocks

Our assessment of upper-bound values for future unanticipated changes in the short-term interest rates and in the GDP hinges on the shocks, estimated as forecast errors, that occurred to these variables in the past.[8]

In order to identify the shocks we need to specify how forecasts of interest rates and GDP are carried out. In this paper we assume that governments base their assessments of future developments only on the information conveyed by the past behaviour of these two variables. In particular, forecasts are based on a vector auto-regressive (VAR) model which includes only the real short-term interest rate and the real GDP.[9]

We use real variables for two reasons. On one hand, we expect inflation in the future to be much lower and less volatile than it has been in the past, particularly in the 1970s and 1980s. Therefore, including nominal variables in the VAR regression may yield estimates of the shocks that are not suitable to forecast. On the other hand, the overall effect of inflation

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[8] The analysis of forecast errors in fiscal policy analysis is not new. Artis and Buti (2001), drawing on the work of Artis and Marcellino (1999), evaluate the random component of the budget through the difference between fiscal forecasts and outturns.

[9] We add a linear trend to the VAR because of the presence of the GDP.

on the budget tends to be small.[10] We exclude from the VAR the long-term interest rate because for some countries and periods it is significantly correlated with the short-term rate. Hence, we prefer to compute changes in the long-term rate on the basis of the estimated shocks to the short-term interest rate and a standard theoretical relationship between the two rates.

We perform a recursive procedure based on a constant estimation window that moves forward period by period.[11] The length of the estimation window is ten years; the frequency of the data is quarterly. This implies that a first VAR is estimated for the first ten years of the sample, i.e. the first forty observations, and a forecast is computed for the first out-of-sample period on the basis of the estimated VAR parameters. The difference between this forecast and the actual value represents the first forecast error. Another VAR is then estimated for a ten-year sample obtained by extending forward the previous sample by one quarter and dropping the first observation, and so on.

Let Y denote a generic variable (or vector of variables). The shock for period *T+1* to Y is set equal to the one-step-ahead forecast error of the VAR estimation up to time *T*. That is:

(1)
$$fe_{T+1} = Y_{T+1} - Y_T(1)$$

where $Y_T(1) = E_T(Y_{T+1} / I_T)$ and I_T is the information set at time *T*.

The estimated counterpart of the forecast error when using a VAR model is obtained by replacing $Y_T(1)$ with its estimate:

(2)
$$\hat{Y}_T(1) = \hat{\upsilon} + \hat{A}_1 Y_T + \hat{A}_2 Y_{T-1} + ... + \hat{A}_p Y_{T-p}$$

where p is the lag length.

We limit the lag length of the estimated VAR model to two since a preliminary analysis based on a battery of tests indicates that this structure is sufficient to achieve

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[10] Inflation affects the budget negatively via interest payments and positively via tax components. The negative and positive effects of inflation tend to counterbalance.

[11] A similar approach is followed by Bohn (1990) and Missale (1999).

uncorrelated residuals.[12] The residuals do not turn out to be normally distributed for all countries, however, mainly because of the presence of several outliers. We could include dummies to take such exceptional events into account but we decided not to because our aim is to estimate shocks so as to contain such events, provided they are unexpected.

Our sample consists of nine European Union countries (Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, Spain and the United Kingdom) for which data are available for a reasonable number of years. The sample covers the period 1978 (first quarter) - 2001 (last quarter). This implies that the first VAR is estimated over the period 1978-1987 and the forecast errors we examine refer to the last fourteen years (1988-2001). Data on the interest rate are taken from the Bank of Italy data set and refer to the three-month inter bank rates for all countries but Italy, for which we use the average rate on (three-month, six-month, one-year) Treasury Bills. GDP data are from national accounts.[13]

For the purposes of the analysis that follows we take annual averages of the estimated quarterly shocks. Each shock measures the difference between the expected value of the variable, given the information available at the end of the previous quarter, and its realization. Therefore, by considering the annual averages of such shocks we are implicitly making the assumption that during each fiscal year policy-makers are able to revise their forecasts and correct the budgetary trends of the following quarters. However, the adjustment cannot make up for the budgetary effects of the forecast errors in the previous quarters.[14]

[12] For each VAR estimation we have calculated a Portmanteau statistic and an F-test for autocorrelation. The statistics do not indicate the presence of autocorrelation at 1 per cent significance level for any country and any estimation window, with the exception of very few cases.

[13] GDP data are expressed according to ESA95. Series for Austria, Belgium, Germany and Spain have been reconstructed for the first few years on the basis of the rate of growth of GDP expressed according to ESA79.

[14] In this way we are able, albeit in a rather ad hoc manner, to account for the fact that policy-makers are not completely constrained by the choices made when budgeting at the beginning of the fiscal year. In fact, our framework allows for budgetary adjustments when quarterly information becomes available. The adjustments, however, can only be partial, as they concern just the action to be taken in future quarters.

A graph of the annualized shocks estimated for each country is provided in the appendix. The mean, the standard deviation, the minimum and maximum values of the annualized unexpected shocks are reported in Table 1.

Table 1

DESCRIPTIVE STATISTICS OF THE UNEXPECTED SHOCKS TO GDP AND THE SHORT-TERM INTEREST RATE
(annual averages, percentage points)

	GDP				interest rate			
	mean	std. Dev.	min	max	Mean	std. Dev.	min	max
Austria	0.094	0.568	-1.040	1.270	-0.213	1.519	-3.892	2.878
Belgium	-0.079	0.666	-1.692	1.570	-0.582	1.644	-3.554	4.099
Finland	-0.056	1.144	-3.696	1.487	-0.314	2.300	-7.507	4.522
Finland (1)	0.173	0.787	-2.103	1.487	-0.387	2.249	-7.507	3.965
France	-0.157	0.411	-0.767	0.620	-0.821	1.979	-6.705	2.882
Germany	-0.080	0.628	-1.588	1.355	-0.354	1.592	-3.910	2.741
Italy	-0.082	0.463	-1.289	0.743	-1.363	1.970	-8.070	3.848
The Netherlands	-0.091	0.425	-1.212	0.645	-1.181	1.263	-4.844	1.309
Spain	-0.058	0.724	-2.152	1.171	-0.904	1.902	-6.319	3.236
euro area countries (2)	*-0.090*	*0.554*	*-1.407*	*1.017*	*-0.761*	*1.775*	*-5.687*	*3.034*
UK	-0.017	0.126	-0.429	0.162	-0.081	0.693	-2.476	0.960

(1) Unexpected shocks in 1991 and 1992 are excluded. – (2) Unweighted average of the countries of the area included in the sample. For Finland, statistics based on all estimated shocks are used.

For the euro area (defined here as the set of countries of the area included in our sample), the standard deviation of the GDP shocks is equal to 0.6 points. The country with the lowest standard error of the GDP shocks (0.1 percentage points) is the UK; the country with the highest is Finland (1.1 percentage points including all observations and 0.8 if shocks in 1991 and in 1992 are excluded).

The statistics for Finland based on the entire set of estimated shocks to GDP are appropriate to define the safety margins required to cope with the risk of exceeding a given budgetary threshold, irrespective of the severity of the recession. The use of the restricted set, instead, is more appropriate when the concern is to avoid the sanctions of the Stability and Growth Pact. According to the Pact[15], there is no "excessive deficit" - therefore no basis for imposing sanctions - in a given year if the 3 per cent deficit threshold is exceeded as a result of a fall in real GDP of at least 2 per cent. In 1991 and in 1992, Finnish GDP fell by 6.3 and 3.3 per cent respectively.[16] In the restricted set we exclude the GDP shocks in those years as it is very likely that the severe recession, which prevents sanctions being imposed, is also the cause of the large forecast errors. While, in principle, the exceptional circumstances may have also affected forecast errors on interest rates, the differences between the restricted and the unrestricted statistics are relatively small and only the latter are used in our analysis.

The maximum negative unexpected shock to GDP lies between -0.4, in the case of the UK, and -3.7 (-2.1, excluding 1991 and 1992) in the case of Finland. It is equal to -1.4 on average for the euro area as a whole.

The standard error of the unexpected shocks to the short-term interest rate is equal to 1.8 on average for the euro area. It ranges from 0.7 (UK) to 2.3 (Finland). The maximum positive unexpected shock is equal to 3.0 percentage points in the average of the euro area. It lies between 1.0 points (UK) and 4.5 (Finland).

The results for Finland and the UK for both GDP and interest rate statistics are mainly driven by the volatility of GDP and interest rate processes observed in these countries in the period 1988-2001: particularly low in the case of the latter and high in the case of the former.

2.1 Upper-bound estimates of future shocks

The limited number of years for which we estimate forecast errors[17] seriously limits the type of statistical analysis we can perform. The limitations also apply to the criteria we can use to assess upper-bounds for future shocks, relevant to define budgetary safety

[15] Council Regulation (EC) 1467/97 "on speeding up and clarifying the implementation of the excessive deficit procedure".

[16] Over the period in which unexpected shocks are estimated only in Finland did GDP decline by more than 2 per cent.

[17] Even if it were feasible, extending backward the number of observations may not be appropriate, as more distant past episodes may not be relevant for assessing future shocks.

margins. In view of the fact that our analysis seems especially appropriate for very risk averse governments, we have selected two particularly cautious criteria.

Under the first criterion, the upper-bound value of future shocks is equal to twice the standard deviation of past shocks. With normally distributed phenomena it should approximately exclude a subset of extreme positive (for interest rate) and negative (for GDP) outcomes with probability equal to 2.5 per cent.[18] Under the second criterion, the estimate is equal, instead, to "the worst outcome" recorded in the sample. This means selecting the minimum value of the forecast errors for the GDP and the maximum for the interest rate.[19]

The two criteria tend to produce similar results: a relatively large difference emerges only for Finland when all shocks are included.

The minimum benchmarks proposed by the European Commission, while differing in a number of aspects, are broadly based on the same kind of statistics. In European Commission (2002), the safety margins are computed by multiplying the budgetary sensitivity to the cycle by an output gap estimate, which is obtained as the simple average of the two worst outcomes among: (a) the largest negative output gap recorded in the Member State between 1980 and 2000; (b) the unweighted average of the largest negative output gaps in EU Member States over the period 1980-2000; (c) the volatility of the output gap in the Member State, as measured by two times the standard deviation.

To evaluate the impact of changes in the short-term interest rate on interest expenditure, and hence on the budget balance, it is important to assess their effect on long-term interest rates. To this end we use the relationship between the short-term and the long-term interest rate implied by the "expectation theory" of the term structure:

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[18] Because it was decided not to include dummies for exceptional events, normality is not respected for both GDP and interest rate shocks in the case of the UK and for GDP shocks only in the case of Finland and France.

[19] Notice that, as far as the interest rate is concerned, for all countries with the exception of Belgium the maximum shock is lower than twice the standard deviation. This seems in contrast with the non normality of the VAR residuals, which was previously attributed to the presence of outliers. However, the non normality affects more the quarterly shocks than their annual averages, used in this paper to assess the impact of interest rate shocks on the budget. Moreover, outliers are mainly represented by large negative values.

(3) $$i_{t,h} = \frac{1}{h}(i_{t,1} + i^e{}_{t+1,1} + i^e{}_{t+2,1} + ... + i^e{}_{t+h-1,1})$$

where $i_{t,h}$ is the interest rate at time t on an h-period bond and $i^e{}_{t+i,1}$ is the expected short-term interest rate at time $t+i$.

Since, in this paper, expectations are assumed to be formed according to the VAR model, we use the estimated coefficients to calculate the forecasts at time t for the short-term interest rate $t+1$, $t+2$, …, $t+h-1$ steps ahead. Given the relationship between short-term and long-term interest rates assumed above, the change in the long-term interest rate induced by a 1 per cent shock occurring at time t to the short-term interest rate is given by the cumulated sum of the impulse responses of the short-term interest rate to its own shock divided by h.

As long-term bonds typically have ten-year maturity in most of the countries considered in this study, we set h equal to ten. The cumulated response to a 1 per cent interest rate shock varies significantly across countries. However, the impact of a 1 per cent change in the short-term interest rate on the long-term rate is in all cases very small, ranging from 0.008 percentage points for the Netherlands to 0.139 percentage points for Austria.[20]

3. Maturity structure of public debts

The direct impact of a change in interest rates on interest expenditure and hence on the government budget balance depends on the size and the maturity structure of the debt. To evaluate this impact for our sample of nine EU countries we use data on the debt structure provided by the national central banks. The information generally regards (i) debt with residual maturity below one year and other variable interest rate instruments (short-maturity); (ii) debt with residual maturity between one and five years (medium-maturity); (iii) debt with residual maturity above five years (long-maturity debt). For most countries, figures are obtained by extrapolating to general government debt information available for

[20] The change in the long-term interest rate induced by a 1 per cent shock to the short-term rate is estimated to be equal to 0.139, 0.042, 0.023, 0.013, 0.038, 0.036, 0.008, 0.060, 0.032 percentage points in Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, Spain and the UK, respectively.

central government debt only, which, however, accounts in all countries for a large fraction of total debt. Within the sample, information on the amounts of variable interest rate debt is available only for Finland, Italy, Germany, the Netherlands and Spain. For all the remaining countries we assume that no variable interest rate instruments exist. This hypothesis should not affect the results significantly, as in all cases the fraction of indexed debt is likely to be very small (evidence up to 1995 is coherent with this assumption and is shown in Missale, 1999) . Figures reported in Table 2 are based on these data.

Table 2

MATURITY STRUCTURE OF GENERAL GOVERNMENT GROSS DEBT IN 2001
(as a percentage of GDP) (1)

Residual maturity	AUS	BEL	FIN	FRA	GER	ITA	NDL	SPA	UK
Below 1 year and variable interest rate instruments	5.5	18.2	15.1	16.3	11.3	39.9	10.9	10.7	13.0
of which: short-term debt (2)	2.8	11.4	12.0	6.2	4.4	23.3	3.9	6.9	10.4
Between 1 and 5 years (excluding var. rate instr.s)	25.6	40.1	14.7	17.1	23.7	33.8	19.2	20.9	7.0
Above 5 years (excluding var. rate instr.s)	30.5	49.4	13.8	23.7	24.5	35.6	22.9	25.6	19.0
Total debt	61.6	107.7	43.6	57.1	59.5	109.3	53.0	57.2	39.0

(1) Data for Austria are constructed applying the maturity structure of 1999 debt to total debt in 2001. – (2) Debt with initial maturity below 1 year and variable instruments. Given the lack of information for Austria, we assume that one half of the debt with residual maturity below 1 year is made of short-term instruments.

In the exercises that follow we assume that debt comes evenly to maturity.[21]

Based on these assumptions, the estimate of the sensitivity of the interest expenditure to changes in the interest rate cannot be precise. Nonetheless, as the focus of our analysis is to estimate safe budgetary positions, which are expressed as a percentage of GDP, the approximation can be considered satisfactory.

In Table 3 we report for all countries the estimated impact of a 1 per cent increase in interest rates on all maturities (i.e. a parallel shift of the whole yield curve). This exercise allows us to compare the relative sensitivity of interest payments to interest rate shocks across countries. Italy exhibits the highest overall sensitivity, Austria the lowest.

Table 3

CHANGE IN INTEREST EXPENDITURE INDUCED BY A ONE PER CENT INCREASE IN THE INTEREST RATE (FOR ALL MATURITIES)
(as a percentage of GDP)

	AUS	BEL	FIN	FRA	GER	ITA	NDL	SPA	UK
1st year	0.03	0.09	0.08	0.08	0.06	0.20	0.05	0.05	0.07

4. Safety margins against shocks to interest rates

In this section we calculate the effects on interest expenditure of the upper-bound estimates for future shocks to short-term interest rates calculated in Section 2, also taking into account their impact on long-term rates. The hypotheses on debt composition by instruments and residual maturity are the same as in Section 3. However, since here we envisage different shocks for the short-term and the long-term interest rate, additional assumptions must be made to match each type of debt to the appropriate rate.

We suppose that the amount of bonds with a residual maturity below one year that are not short-term are all long-term bonds with a ten-year life. We also assume that maturing debt is rolled over with bonds of the same category.

[21] From this assumption it follows that the impact on expenditure in the first year is as if one-half of the debt with residual maturity below one year and variable interest rate debt were renewed at the beginning of the year at the new interest rate.

The first upper-bound estimate of the future positive shocks to the short-term interest rate is equal to twice the standard deviation of the past forecast errors. The second estimate is equal to the maximum positive forecast error. The shocks to the long-term interest rate are computed multiplying the country-specific coefficient presented in Section 2 (footnote 20) by the relative shock to the short-term rate.

In view of the common monetary policy, we assume that the same shock to the interest rate will hit all euro area countries. Therefore, for these economies we use common upper-bound estimates for future shocks on interest rates, obtained by averaging out the values computed for the individual countries. For the UK we use the information stemming from its country-specific shocks.

Table 4

SAFETY MARGINS AGAINST FUTURE INTEREST RATES SHOCKS
(as a percentage of GDP)

	2*std.dev.	Max
Austria	0.077	0.065
Belgium	0.265	0.227
Finland	0.241	0.206
France	0.201	0.172
Germany	0.142	0.121
Italy	0.566	0.484
The Netherlands	0.132	0.113
Spain	0.158	0.135
euro area countries (1)	0.223	0.190
UK	0.081	0.056

(1) Unweighted average of the countries of the area included in the sample.

The impact on interest expenditures of shocks to interest rates equal to our upper-bound estimates is reported in Table 4.[22] Owing to the size and the maturity structure of its

[22] The information on the maturity structure that we show in Table 2 allows us, with few additional assumptions, to compute the impact of shocks to interest rates on expenditure also in the second and subsequent years. In view of the purpose of this paper we do not present the results here. However, they are available on request.

public debt, Italy is the country in which the impact of the shocks is largest under both criteria. The impact is smallest in Austria under the first criterion and in the UK under the "maximum shock" criterion.

The result obtained for the UK is attributable to the relatively low variability of interest rates compared to that observed on average in the euro area. In fact, owing to the maturity structure of its public debt, the UK does not exhibit a particularly low sensitivity of government expenditure to shocks to the interest rates (Table 3).

5. Safety margins against shocks to GDP

In this section we compute fluctuation bands for the primary budget balance using the analysis of unexpected GDP shocks presented in Section 2 and the estimates of the sensitivities of the primary balance to the business cycle computed by the OECD, the European Commission (EC) and, within the European System of Central Banks, by Bouthevillain et al. (2001). The differences of the estimates for each country across institutions are usually small (Table 5).

Table 5

SENSITIVITIES OF THE PRIMARY BUDGET BALANCES TO THE BUSINESS CYCLE

	ESCB	OECD	EC
Austria	0.47	0.31	0.30
Belgium	0.56	0.61	0.65
Finland	0.55	0.64	0.65
France	0.53	0.42	0.45
Germany	0.45	0.51	0.50
Italy	0.48	0.48	0.40
The Netherlands	0.69	0.64	0.85
Spain	0.40	0.40	0.40
UK	0.65	0.50	0.45

Source: Bouthevillan et al. (2001).

The sensitivity of the budget balance (as a ratio to GDP) with respect to output measures the change in the budget balance due to a 1 per cent change in real GDP. It is given by the following semi-elasticity:

(4) $$\sigma = \frac{\Delta(B/Y)}{\Delta Y_r / Y_r}$$

For each country, in Table 6 we present the impact on the budget of shocks to GDP of a size corresponding to the two criteria described in Section 2: twice the standard deviation of the forecast errors; the minimum of the past forecast errors.

Table 6

SAFETY MARGINS AGAINST GDP SHOCKS
(as a percentage of GDP)

	ESCB		OECD		EC	
	2*std.dev.	min	2*std.dev.	min	2*std.dev.	min
Austria	-0.534	-0.489	-0.352	-0.322	-0.341	-0.312
Belgium	-0.746	-0.947	-0.813	-1.032	-0.866	-1.100
Finland	-1.259	-2.033	-1.465	-2.365	-1.488	-2.402
Finland (1)	-0.866	-1.156	-1.008	-1.346	-1.024	-1.367
France	-0.435	-0.407	-0.345	-0.322	-0.370	-0.345
Germany	-0.565	-0.715	-0.640	-0.810	-0.628	-0.794
Italy	-0.444	-0.619	-0.444	-0.619	-0.370	-0.516
The Netherlands	-0.586	-0.836	-0.544	-0.776	-0.722	-1.030
Spain	-0.579	-0.861	-0.579	-0.861	-0.579	-0.861
euro area countries (2)	-0.644	-0.863	-0.648	-0.888	-0.670	-0.920
UK	-0.164	-0.279	-0.126	-0.214	-0.114	-0.193

(1) Unexpected shocks in 1991 and 1992 are excluded. – (2) Unweighted average of the countries of the area included in the sample. For Finland, statistics based on all estimated shocks are used.

Using all estimates of budgetary sensitivities and criteria to identify the size of the shock, the UK is the country in which the safety margins for the primary balance are smallest, notwithstanding the relatively high sensitivity of the primary balance to the business cycle, and Finland is the country in which they are largest as a consequence of above average budget sensitivity and the size of the upper-bound values for future shocks to the output, which are the largest in the sample (this remains true even when 1991 and 1992 unexpected GDP shocks are excluded). With the sensitivities estimated by Bouthevillain et al. (2001), in all remaining countries the safety margins range between 0.4 and 0.7 percentage points of GDP under the first criterion and between 0.4 and 0.9 under the second.

6. Safety margins against simultaneous shocks to GDP and interest rates

In the previous sections we evaluated separately the impact of shocks to interest rates and GDP on interest expenditure and primary balance, respectively. We now combine the two analyses and provide what we consider prudential safety margins for the overall budget balance.

A cautious approach to budgetary targeting would require the setting of safety margins that can avoid overshooting a given threshold in a scenario in which unfavourable shocks to output and interest rates occur simultaneously. In practice, this means adding up the margin on the primary budget balance and that on the interest expenditure. Following this approach, in Table 7 we report the overall fluctuation in the budget under the two criteria for the shocks. For the primary balance we refer to the estimates of the sensitivities presented in Bouthevillain et al. (2001).

When future shocks are set equal to twice the standard deviation of past occurrences, the overall impact on the budget balance ranges from -0.2 per cent of GDP in the case of the UK to -1.5 in the case of Finland (-1.1, if the observations concerning unexpected GDP shocks in 1991 and 1992 are excluded[23]). Instead, if we consider the second criterion (i.e. the greatest - in absolute terms - positive shock to interest rates and negative shock to GDP) the impact lies between -0.3, in the case of the UK, and -2.2 in the case of Finland (-1,4, if the observations concerning 1991 and 1992 are excluded). On average, the safety margin that we estimate for the euro area countries is equal to 0.9 and 1.1 per cent of GDP, respectively, according to the two criteria.

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[23] As already mentioned, in our analysis future unexpected shocks to interest rates for individual euro area countries are set equal to the area average to take account of the presence of the new monetary policy regime. The average is computed using all Finnish forecast errors on interest rates, 1991 and 1992 errors included. The impact of this decision is negligible.

Table 7

SAFETY MARGINS AGAINST SHOCKS TO GDP AND INTEREST RATES
(as a percentage of GDP)

	2*std.dev.	min /max
Austria	-0.611	-0.554
Belgium	-1.011	-1.174
Finland	-1.500	-2.239
Finland (1)	-1.107	-1.363
France	-0.636	-0.578
Germany	-0.690	-0.822
Italy	-1.011	-1.103
The Netherlands	-0.718	-0.949
Spain	-0.737	-0.996
euro area countries (2)	-0.864	-1.052
UK	-0.245	-0.335

(1) Unexpected shocks in 1991 and 1992 are excluded. – (2) Unweighted average of the countries of the area included in the sample. For Finland, statistics based on all estimated shocks are used.

The estimates of the minimal safety margins presented in European Commission (2002) differ significantly from those obtained in our analysis. This is not surprising, given the large methodological differences between the two approaches. In particular, the estimates of the Commission are higher for all countries, even though they refer to fluctuations in the primary budget balance only. This result mainly reflects the fact that, as explained above, our margins are meant to cope with errors in forecasting when budgeting for the following year, while the margins calculated by the Commission are meant to offset the budgetary impact of the trough of a full business cycle.

In the European Commission estimates as well, Finland is the country which needs the highest margins (3.8 per cent of GDP); in Belgium and in the Netherlands the minimal safety margin is estimated to be equal to 2.3 per cent of GDP. Elsewhere, safety margins are close to the euro area average (1.6 per cent of GDP).

The results shown in Table 7 refer to the case in which unfavourable shocks to GDP and interest rates occur simultaneously.

An adequate evaluation of the safety margins would require an analysis of the correlation between the shocks. In the first column of Table 8 we report the simple correlation coefficient.[24] We also regress shocks to GDP on the shocks to the interest rate and report the estimated coefficient in the second column of the table, together with its probability value for all countries.[25] In fact, with the linear regression we are able to evaluate the significance of the covariance between the two variables.

Table 8

CORRELATION BETWEEN GDP AND INTEREST RATE SHOCKS

	simple correlation	regression coefficient	
		value	p-value
Austria	0.284	0.0042	0.0337
Belgium	0.165	0.0021	0.2256
Finland	-0.161	-0.0021	0.2348
France	-0.090	-0.0006	0.5109
Germany	0.378	0.0055	0.0041
Italy	0.045	0.0003	0.7424
The Netherlands	0.240	0.0023	0.0743
Spain	-0.252	-0.0030	0.0612
UK	0.539	0.0036	0.0000

The linear regression coefficients for Germany and the UK turn out to be significant.[26] For those countries, therefore, ignoring the link between GDP and interest rate shocks would lead to an incorrect assessment of the safety margins. The coefficients for both Germany and the UK are positive, implying that when there is a slowdown in GDP interest rates are likely to decline too, to some extent offsetting the impact on the budget balance of the negative shock to output. Thus the safety margins reported in Table 8 for these countries are probably too cautious. Belgium, Finland (we include all observations), France, and Italy present a low simple correlation and the regression coefficient is non significant. Austria is a borderline

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[24] The analysis of the correlations has been performed using country-specific shocks to both GDP and interest rate.

[25] When residuals are heteroschedastic, we use heteroschedasticity consistent standard error.

[26] The p-value is lower than the significance level, here set at 1 per cent.

case since the regression coefficient is positive and significant at 5 per cent but not at the 1 per cent level.

7. Conclusions

In this paper we evaluate the first year impact of unexpected shocks to interest rates and GDP on government budgets in nine EU countries. Shocks which have occurred in the past are estimated as forecast errors arising from a vector auto-regressive model which includes two variables: the short-term real interest rate and the real GDP. On the basis of these estimates we build up two scenarios for future forecasts errors and we calculate the safety margins required to cope with them.

The first scenario assumes that shocks equal to twice the standard deviation of the estimated forecast errors hit both GDP and interest rate simultaneously. In the second scenario the “worst” estimated shocks for GDP and interest rate are assumed to occur at the same time. As far as euro area countries are concerned, in both scenarios we focus on a common interest rate shock, computed as a weighted average of the shocks estimated for each individual country in the area. This allows us to take into account the presence of the monetary union.

The results for the two scenarios are relatively similar. In the first scenario the required safety margins, when budgeting for the following year, range between 0.2 percentage points of GDP in the case of the UK (and, among the euro area countries, 0.6 points in the case of Austria and France) and 1.5 points in the case of Finland (1.1 points if GDP unexpected shocks in 1991 and 1992 are excluded). In the second scenario the margins range between 0.3 percentage points of GDP in the UK (0.6 points in Austria and France) and 2.2 points in Finland, (1.4 points if GDP unexpected shocks in 1991 and 1992 are excluded). Italy should aim at a margin of between 1.0 and 1.1 percentage points of GDP, depending on the scenario.

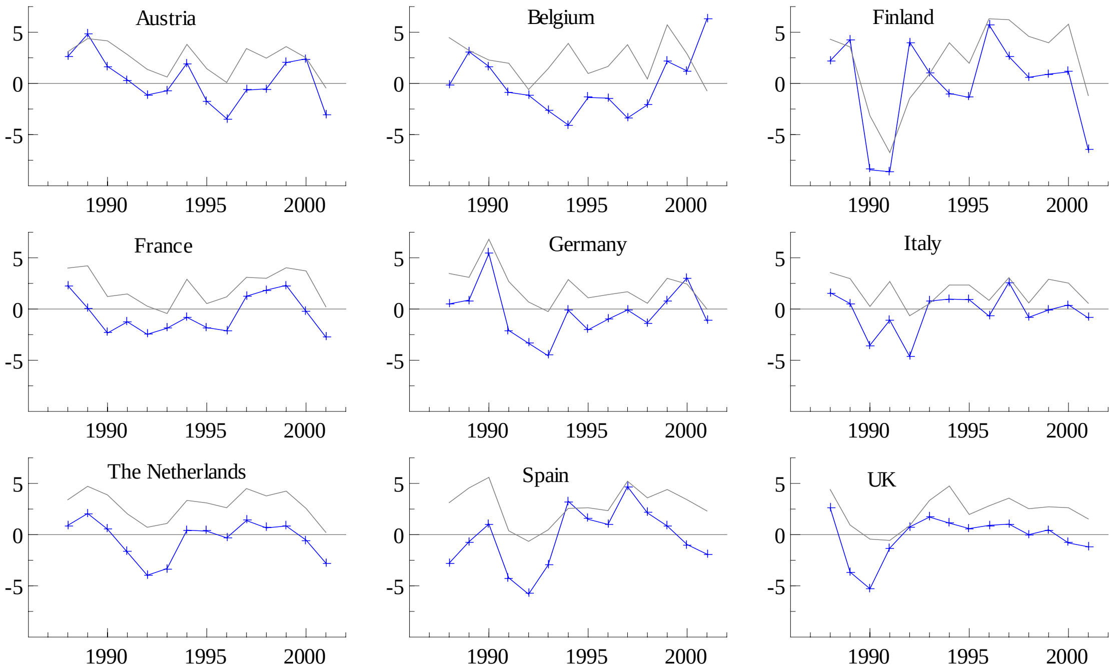
Not surprisingly, in view of the short-term horizon used to define the forecast errors, for all countries our estimates are lower than the safety margins for the medium-term cyclically adjusted balance recently computed by the European Commission, even though they refer to fluctuations in the primary budget balance only.

To assess the probability that both unfavourable shocks to GDP and interest rate occur at the same time, we performed an analysis of the correlation between the two shocks. In most of the countries in our sample, shocks to GDP and interest rate appear not to be significantly correlated. Our estimations of the margins should therefore be considered appropriate according to prudential criteria. In Germany and in the UK the correlation is significant and positive, suggesting that in these countries the margins estimated in this study may be excessively large.

Appendix

Figure 1

SHOCKS TO REAL GDP

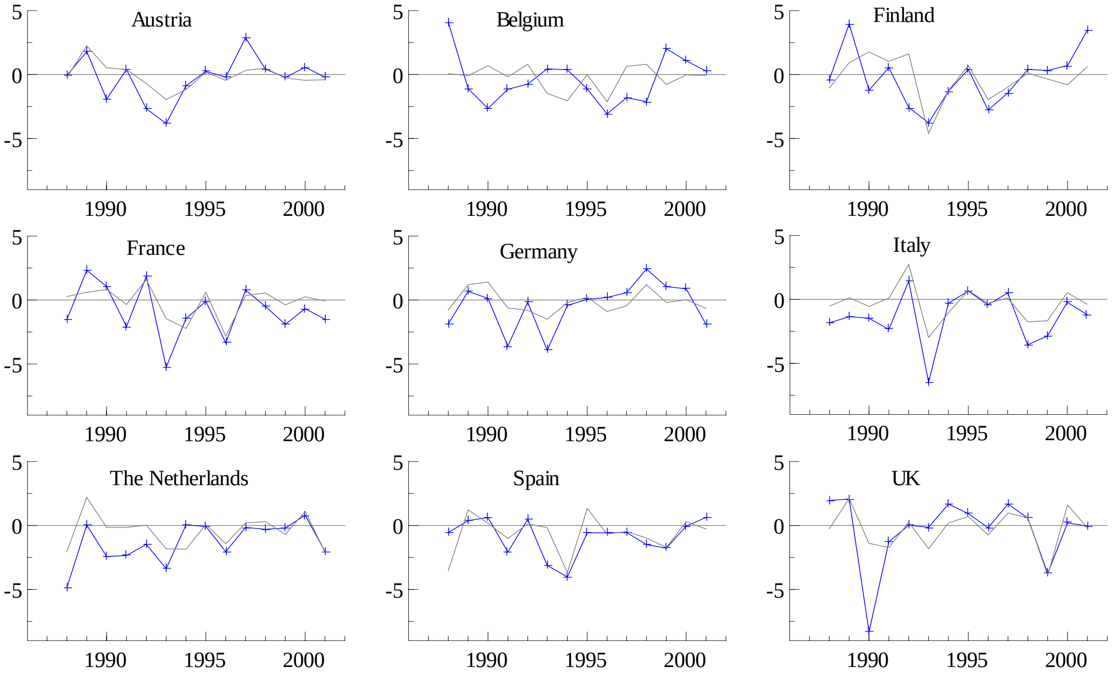


–+–+– annualized forecast error

____ GDP rate of change

Figure 2

SHOCKS TO REAL INTEREST RATE



–+–+– annualized forecast error

_____ rate of change of the short-term interest rate

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