PUBLIC DEBT DYNAMICS IN SELECTED OECD COUNTRIES: THE ROLE OF FISCAL STABILISATION AND MONETARY POLICY

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Shocks to monetary and fiscal policy have played a major role in public debt developments since the mid-1970s. According to the applied VAR approach, together these shocks explained, on average, about half of the forecast error variation in the debt to GDP ratio while the share of shocks to GDP growth was close to 30 per cent. Instead, shocks to inflation and the debt ratio itself played in most cases a minor role. However, the inflation shocks were vital in initiating the public debt problems as the increase in actual inflation and particularly the persistence of high inflation expectations in the 1980s led to a prolonged period of high real interest rates. This gave rise to "some unpleasant fiscal arithmetic" which aggravated debt problems. In most countries fiscal policy has aimed at correcting the deterioration of fiscal balances, but the progress has in most cases been slow and delayed. Nevertheless, all individual country VARs are stable in the period under consideration. Finally, contrary to general beliefs, in the global financial markets of present day inflation makes debt problems worse through its adverse impact on interest rates.

1 Introduction

What has caused the marked increase in the public debt to GDP ratios in almost all OECD-economies after the mid-1970s? Is it due to the behaviour of fiscal authorities or exogenous economic shocks that have come as a surprise to policymakers? What has been the role of monetary policy in these developments? If the high debt ratios are caused by a mixture of all these factors, what has been their relative importance? These questions have gained new significance in the context of the European Monetary Union (EMU) where national governments do not have recourse to debt monetization, which has historically been the ultimate contingency solution in debt crises. Neither can the governments expect a bailout by the European Central Bank, as this is forbidden by the Treaty. This makes guaranteeing fiscal solvency of utmost importance in the EMU. Moreover, the demographic developments are expected to put heavy pressure on public finances in most OECD countries in the coming decades, mostly in the form of increasing pension and health

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care costs. To face these challenges, the OECD countries have to be capable of managing their fiscal developments and secure the solvency of their public finances in the long run.

Because of the complexity of the factors that affect public debt dynamics, our knowledge of the relative roles of unforeseen economic shocks and discretionary monetary and fiscal policy in shaping the evolution of public debt ratios is rather limited. The political economy literature has extensively studied the influence of fiscal policy and particularly political institutions on the growth of public sector indebtedness (e.g. Roubini and Sachs, 1989a, Alesina and Perotti, 1995). Roubini and Sachs conclude that much of the rise in budget deficits could be explained by the slowdown in economic growth and rise in unemployment after 1973. Moreover, in countries with multi-party coalition governments (as in Belgium and Italy) it has been difficult to find consensus on fiscal consolidation. Alesina and Perotti find out that since the mid-1960s cyclically adjusted budget deficits have been mainly the result of increases in government spending and increased interest expenditures. Masson and Mussa (1995) describe the role of wider economic developments, including population, productivity growth and inflation. They see that the deterioration in fiscal balance sheets is mainly due to rapidly extending expenditures on public pensions and health care programs. However, the significant slowdown in economic growth and increase in structural unemployment have been important contributing factors. As regards the role of inflation, Masson and Mussa point out that, in contrast to previous periods, actual inflation ran somewhat *below* anticipated inflation in 1980 to 1994. Consequently, some of the rise in the real value of public debts reflected the surprise element in disinflation as suggested by the relatively high levels of ex post real interest rates in many countries during the 1980s. Nevertheless, while this literature provides important evidence of the factors that have caused the high public debt levels, it has not tried to quantify the relative importance of these factors.

In this paper we apply a basic recursive, reduced form VAR model to seek tentative answers to the question, what have been the relative roles of unforeseen shocks to output, inflation, interest rates and the primary balance in public debt developments in selected OECD countries in the last three or four decades. Furthermore, we try to find out whether the response of fiscal policy to unforeseen economic shocks has been stabilising and to what extent monetary policy shocks have affected the fiscal outcomes. Although our focus is not in the structural identification of the VAR model, we discuss briefly how the model relates to common knowledge of key structural relationships.

The main conclusion of our study is that shocks to economic growth and monetary and fiscal policy have played a major role in public debt developments since the mid-1970s. Together these shocks explain, on average, about 80 per cent of the forecast error variation in the debt to GDP ratio while the average share of the policy shocks is more than 50 per cent. Instead, shocks to inflation and the debt ratio itself play in most cases a minor role. However, shocks to inflation were important in initiating the debt problems since the increase in actual inflation and particularly the persistence of high inflation expectations in the 1980s led to a prolonged period of high real interest rates. This raised significantly the interest burden of public debts. It seems that in most OECD countries fiscal policy aimed at correcting the deteriorating fiscal balances by improving the primary balance, but the progress was in most cases slow and delayed, particularly when taking into account the large magnitude of the increase in the interest burdens. Finally, the high persistence of the impact of policy shocks to the debt to GDP ratio has contributed to the seriousness of public debt problems.

The plan of the paper is the following: Section 2 gives a brief overview the relevant literature, Section 3 describes the variables and the data and the overall macroeconomic background for the public debt dynamics since the mid-1970s. Section 4 reports the results of the impulse response functions and variance decompositions of the individual country VARs which illustrate the impact of the different shocks that have affected public debt dynamics, Section 5 discusses the results and Section 6 concludes.

2 Overview of the literature

There are some authors, who have applied the so called debt dynamics identity which defines the change in the public debt level in terms of the real interest rate, output growth and the primary balance to calculate the exact contribution of these variables on the evolution of public debts (e.g. Shigehara, 1995, and Hallett and Lewis, 2004). The problem, however, with this approach is that identities as such do not reveal the underlying economic relationships and conclusions based on them can be misleading. Examples of studies which have tried to quantify the impact of monetary and fiscal policy on macroeconomic variables like output, inflation and the interest rates using the VAR methodology are Blanchard and Perotti (2002), Christiano, Eichenbaum and Evans (1999), Fatas and Mihov (2002), Melitz (1995) and Moutford and Uhlig (2002). Furthermore, an increasing number of authors have started to model monetary and fiscal policy effects jointly in a VAR context (e.g. Favero, 2002, Marcellino, 2006). Yet, there are relatively few studies which have used the VARs in analysing public debt dynamics (Giannitsarou and Scott, 2006, Reade and Stehn, 2006).

Giannitsarou and Scott applied a log linearised version of the inter-temporal budget constraint to answer three questions: is current fiscal policy in OECD economies sustainable; how OECD governments have financed fiscal deficits in recent decades and; what implications rising deficits have for inflation. They found that, against historical background, fiscal policy is sustainable with the possible exception of Japan; major part of fiscal consolidation has come from changes in the primary balance with only a minor role for inflation, interest rates and growth – *i.e.* a result which is in a stark contrast with ours – and; fiscal imbalances had only a very weak role in forecasting future inflation.

Reade and Stehn apply the cointegrated VAR method to study the interaction of monetary and fiscal policy and its effect on the sustainability of public debt developments in the US in 1960-2005. They conclude that fiscal policy has ensured long-run debt sustainability by responding to the increase in debt in a stabilising way though the feedback has been moderate. However, according to their findings, discretionary fiscal policy has not ensured counter-cyclical behaviour. Moreover, monetary policy has followed a Taylor type rule and corrected disequilibrium both in the short and in the long run.

Melitz (1995) analyses the effect of monetary and fiscal policy on the public debt and deficits in 19 OECD countries from 1960/78 to 1995 using pooled data. He achieves several interesting results: First, fiscal policy reacts to the ratio of public debt in a stabilising manner as in our case. Second, loose fiscal policy leads to tight monetary policy and vice versa. Third, automatic stabilisation of fiscal policy is much weaker than generally perceived. Expansion raises tax receipts but also government expenditures.

Polito and Wickens (2005) examine the sustainability of fiscal policy of the US, the UK, and Germany over the last 25 years and carry out counter-factual experiments of the likely consequences on fiscal sustainability of using a Taylor rule to set monetary policy over this period. Among their findings is that the recent fiscal stance of the three countries is not sustainable, and that using a Taylor rule in the past would have improved the fiscal performance of the US and the UK, but not that of Germany. Polito and Wickens use a VAR including monetary policy and fiscal variables, as well as the deficit and debt ratios.

Marcellino (2006) studies the effects of non-systematic fiscal policy on macroeconomic variables in the euro area in a VAR also including both monetary policy and fiscal variables, but his focus is not strictly on debt dynamics, although the debt ratio is included in some simulations. Marcellino concludes that the systematic component of fiscal policy, which he defines as the impact of automatic stabilisers and budget plans, explains major part of the fiscal policy effects. Adding the public debt ratio in his basic VAR doesn’t affect the results.

Benjamin Friedman (2006) analyses the persistence of the effects of fiscal shocks on deficit and debt developments in the US from 1960 to 2004 in four and five variable VAR models including GDP growth, inflation, public expenditure or revenue items or the actual deficit, and the debt to GDP ratio. He identifies the size and persistence of fiscal shocks to the evolution of debt and deficit ratios and finds a high persistence in the responses as in the present study.

3 The variables and the econometric methodology

3.1 The VAR

The discussion on the evolution and sustainability of public debt developments often starts with the definition of the government budget constraint:

$$B_t - B_{t-1} = rB_{t-1} - (T_t - G_t) \tag{1}$$

where B_{t-1} is general government debt at the end of year t–1, r is the real interest rate, T_t is total general government revenue during year t, and G_t is total general government expenditure during year t excluding interest payments on the debt. Normally the budget constraint is written in a form that expresses the evolution of the debt to GDP ratio in terms of the difference between the real interest rate and the output growth rate, and the ratio of the primary deficit to GDP:

$$b_t - b_{t-1} = (i_t - \pi_t - y_t)b_{t-1} - (t_t - g_t) \tag{2}$$

where b is the general government debt to GDP ratio, i is the nominal interest rate on general government debt, π is inflation, y is the real GDP growth rate; t is the share of public revenues in GDP and g is the share of government spending in GDP excluding interest payments on debt. Equation 2 which is an identity is also called the debt dynamics equation. According to this equation, a robust GDP growth and low real interest rates are vital in restraining the growth of public debts. Furthermore, the current fiscal position of the public sector, as measured by the primary balance, is a significant contributor. In fact, since monetary and fiscal authorities have less control over real interest rates and the growth rate of the economy, the primary balance is an important fiscal policy variable in the equation.

The variables most commonly included in a standard monetary policy VAR are some measure of output, inflation and the interest rate, implying that the central bank follows a sort of Taylor rule in the conduct of monetary policy.[1] The two other relationships in these now standard three equation models are the IS-Curve and the Phillips Curve. Instead, a standard fiscal policy VAR includes typically government revenue and expenditure and a measure of output. Since the debt dynamics equation contains, by definition, all these variables, we believe that by including the variables of the equation in our basic reduced form VAR model we can capture the interaction of monetary and fiscal policy in a VAR setting and, consequently, provide a rich macroeconomic framework for the study of public debt developments. However, since we are particularly interested in the relative importance of monetary and fiscal policy on debt dynamics, we replace the effective interest rate on general government debt – which is the relevant nominal interest rate in the debt equation – with an interest rate which is either the exact target rate of the monetary authorities or a close substitute for it. Figure 1 overleaf provides evidence of the connection of the short term interest rate and the effective interest rate on government debt to justify this choice.[2]

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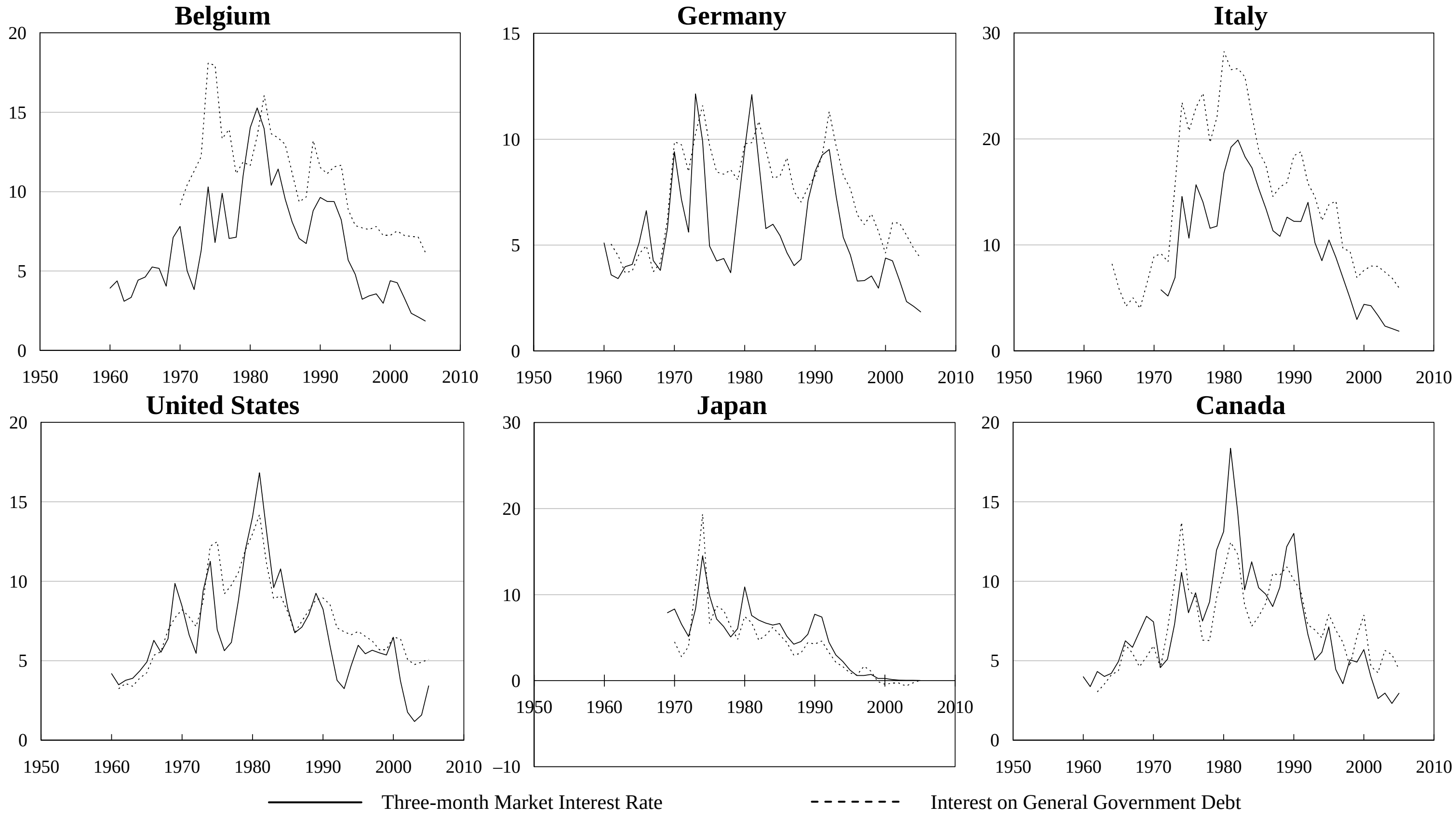
1 More sophisticated models often include some measure(s) of central bank reserves and a monetary aggregate.

2 A proxy for the effective interest rate on government debt is achieved by dividing the general government interest payments to GDP ratio by the general government debt to GDP ratio.

Figure 1

Three-month Market Interest Rate and the Interest on General Government Debt in Selected OECD Countries



Our choice of output growth instead of the output gap deviates from the standard practise of using the difference between output and potential output in monetary and fiscal policy VARs. Moreover, our version of the debt dynamics equation expresses the public debt, expenditures and revenues as shares of the GDP. This complicates the interpretation of the impulse response functions of the standard VAR analysis compared, for example, to using logarithmic levels of these variables. The main motivation for our choice is the fact that the rules of the Stability and Growth Pact for the critical levels of public debt and deficits are expressed as ratios to the GDP. Consequently, as we are also interested in assessing the reactions of these variables to economic, monetary and fiscal policy shocks, we use the same definitions as in the Pact.

One intricate questions regarding the VAR method is the interpretation given to the error terms of the equations. Ideally, they could be seen as providing information on deviations from policy rules, because it is thought that only when policy makers deviate from their rules, it becomes possible to collect interesting information on the response of macroeconomic variables to monetary and fiscal policy impulses (e.g. Bagliano and Favero, 1998). The problem with this interpretation is that the residuals of the equations are often correlated with each other and therefore it is difficult to attach them to particular monetary or fiscal policy actions. Consequently, to isolate shocks to one of the variables in the system it is necessary to decompose the residuals in such a way that they become orthogonal. One convenient, but also criticised way to do this is to apply the Choleski decomposition in the identification of the shocks.[3] The identifying assumption is that the variable that come earlier in the ordering affects the following variable contemporaneously, as well as with lags, while the variables that come later affect the previous variables only with lags. Despite its caveats, we believe that the Cholesky decomposition can to a certain extent be justified on economic grounds in our case, in other words, we believe that the structural relationships of the included endogenous variables are recursive, namely; first, a common way to separate a policy shock from non-policy shocks is to assume that policy shocks do not have contemporaneous effect on inflation and output (Favero, 2002). According to this assumption, output and inflation are ordered before the interest rate and the fiscal variables. Second, it is often assumed that monetary policy affects macroeconomic variables, including the fiscal variables, with a lag. This suggests that fiscal variables should come before the interest rate. Third, putting the debt to GDP ratio last is justified by the debt dynamics equation which specifies a contemporaneous effect of the other variables on the debt to GDP ratio. Thus, if this reasoning is relevant, the only ambiguous choice is what is the mutual ordering of output and inflation. However, as this choice only affects the relative importance of these two variables, we can try both orderings. Finally, especially the impulse responses

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[3] For example, Bernanke (1986) maintains that the Cholesky decomposition is equivalent to assuming that the structural model for the residuals is of a particular form, *i.e.* strictly recursive – which is usually not motivated by the relevant economic theory. For an assessment of different techniques used to tackle this problem, see, e.g., Christiano, Eichenbaum and Evans (1998).

functions of our basic VAR model seem to be almost invariant to different orderings. This downplays somewhat the importance of this matter.

Looking at the ordering of the variables in the studies we have mentioned, Favero (2002) and Favero and Marcellino (2005) use the ordering: inflation, output gap, short term interest rate and expenditure and revenue shares (and debt to GDP ratio in Favero, 2002). Favero (2006) has the ordering: total revenue, total expenses, output gap, inflation and interest rate. Friedman (2006) uses four and five variable VARs including GDP growth, inflation, public expenditure and revenue items or the actual deficit as share of the GDP, and the debt to GDP ratio, in this order (Friedman does not include the interest rate). Perotti's (2002) benchmark VAR includes expenditure and revenue shares, output growth, inflation and interest rate. Also Blanchard and Perotti (2002) put fiscal policy variables first when investigating specifically the effects of fiscal policy on output growth. Furthermore, many authors add structural inferences and identification schemes to overcome the ambiguities of the Cholesky ordering.

Our empirical results are based on a basic recursive, reduced-form VAR model of the form

$$A_0 X_t = \sum_{i=1}^{k} A_i X_{t-i} + \Phi D_t + \varepsilon_t \qquad (3)$$

where k denotes the lag-order of the model, D_t is a vector of deterministic terms and $\varepsilon_t \sim N_p(0,\Omega)$ is a vector of mutually uncorrelated innovations. The yearly VAR includes one lag while the quarterly VAR displayed in Appendix 1 includes four lags. In the first specification, X_t denotes a vector which contains the variables in the order $X_t = (y_t, \pi_t, pribal_t, i_{st}, b_t)$, comprising the GDP growth rate y_t, the change in the Consumer Price Index π_t, the general government primary balance as a share of GDP $pribal_t$, the three month money market interest rate i_{st} and the general government gross financial liabilities as a share of GDP b_t. In the second specification we replace the primary balance by its components, total public expenditure g_t, and total public revenue t_t, as shares of GDP so that in the second specification $X_t = (y_t, \pi_t, g_{t,} t_t, i_{st}, b_t)$.

The coefficients of the A_0 matrix reflect contemporaneous relationships among the variables X_t. We assume that A_0 is a lower triangular matrix which is equivalent to estimating a reduced form VAR model and computing the Cholesky factorization of the VAR covariance matrix (Stock and Watson, 2001, Corsetti and Muller, 2006). Once the VAR is estimated, we generate impulse response functions and variance decompositions of the reduced form.

3.2 The data

One complicating factor in the empirical analysis of fiscal policy is the small number of observations which is due to the low frequency of fiscal data. This is related to the fact that the budget is set for the fiscal year. While discretionary reactions to business cycle movements or other shocks could be taken within the year, the long implementation lags involved imply that the number and importance of such decisions is in most cases limited. The yearly frequency is particularly problematic for the recursiveness assumption discussed above since it is more difficult to justify the assumption that there would be no contemporaneous interaction between the relevant variables within the year than within a quarter. However, the low frequency may also bring some advantages; there is less need for the correction of seasonal effects or the impact of outliers. Moreover, the quality of quarterly fiscal data, which is available only for a limited number of OECD-countries, is not always clear (Beetsma, Giuliodori and Klaassen, 2006). We assess the importance of this problem in Annex 1 by comparing the results of our basic VAR achieved by both yearly and quarterly data for the US and Germany. The conclusion we draw from this comparison is that, in spite of the low frequency, the results obtained by the yearly data are quite similar with the results obtained by using quarterly data. Therefore we believe that the low frequency of our data will not pose a major problem for the analysis and, anyway, in the majority of cases, only yearly data is available.

The OECD economic outlook 2006 data base provides yearly fiscal data on pubic debt, revenue, expenditure and primary balance for 20 countries and quarterly data for 9 countries.[4] However, the length of both yearly and quarterly time series differs widely. We have restricted our analysis to those OECD economies for which the yearly data starts at latest in 1978. There are 13 such countries: Belgium, Denmark, Germany, Spain, Greece, France, Italy, Austria, Finland, the UK, the US, Japan and Canada. The data sources are the OECD, the European Commission, and the IMF. The quarterly federal funds rate is from the IMF data base and the debt to GDP ratio of the EU countries is from the European Commission. All other data are from the OECD. We use the European Commission definition of the general government debt to GDP ratio since this is the official yardstick used for measuring the compliance with the Stability and Growth Pact. As this measure is available only for the EU countries, we have used the OECD definition for the US, Japan and Canada.

Time series of our main variables and some related series are displayed in Figures 2 through 4 overleaf. We have aggregated the euro area 12 and compared it with the US time series to stress the striking similarities of public debt dynamics in both continents. Moreover, the time series illustrate well the overall

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4 Belgium, Germany, Spain, Greece, France, Italy, Austria, the Netherlands and Finland.

Figure 2

GDP Growth Rate and Inflation: the Euro Area and the US, 1960-2005

Output Growth

(percentage of change)

Inflation

(percent)

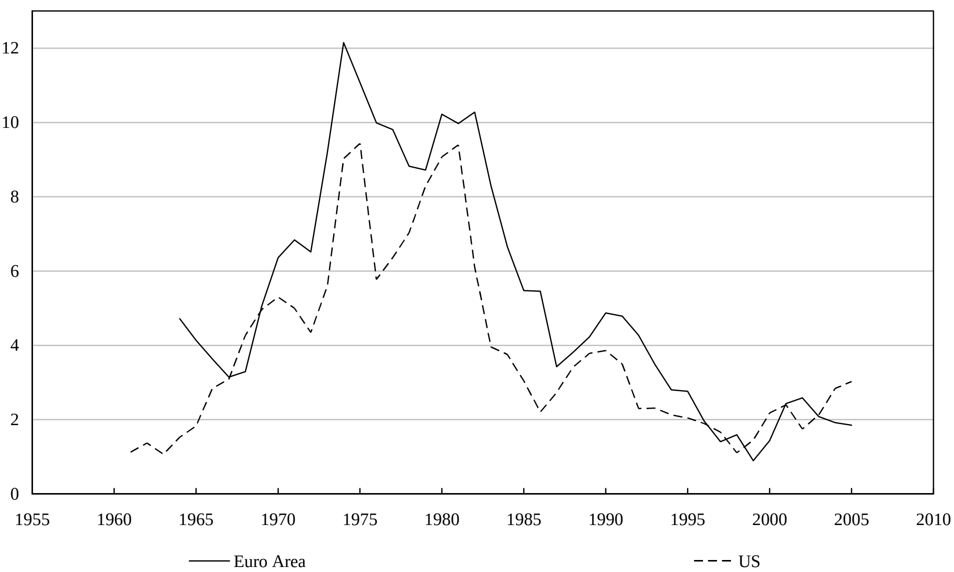
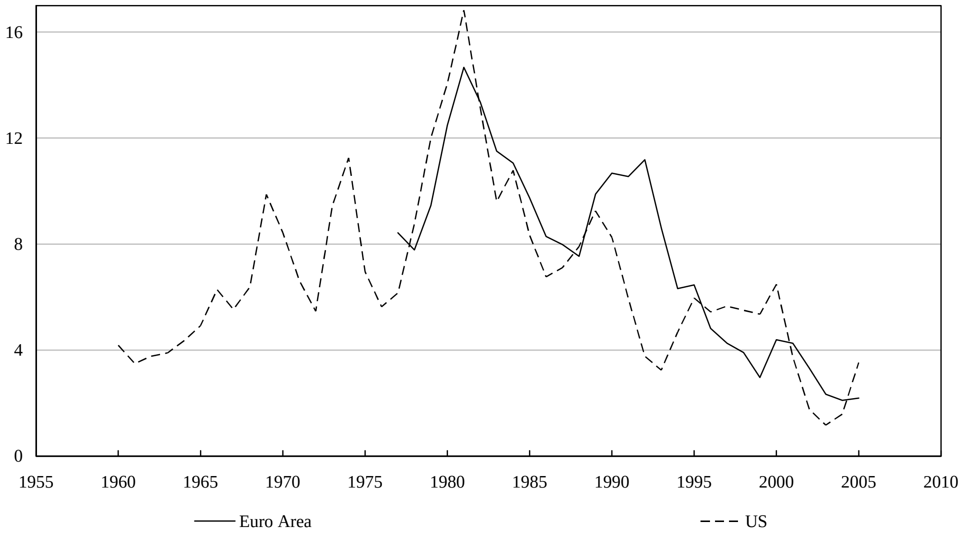


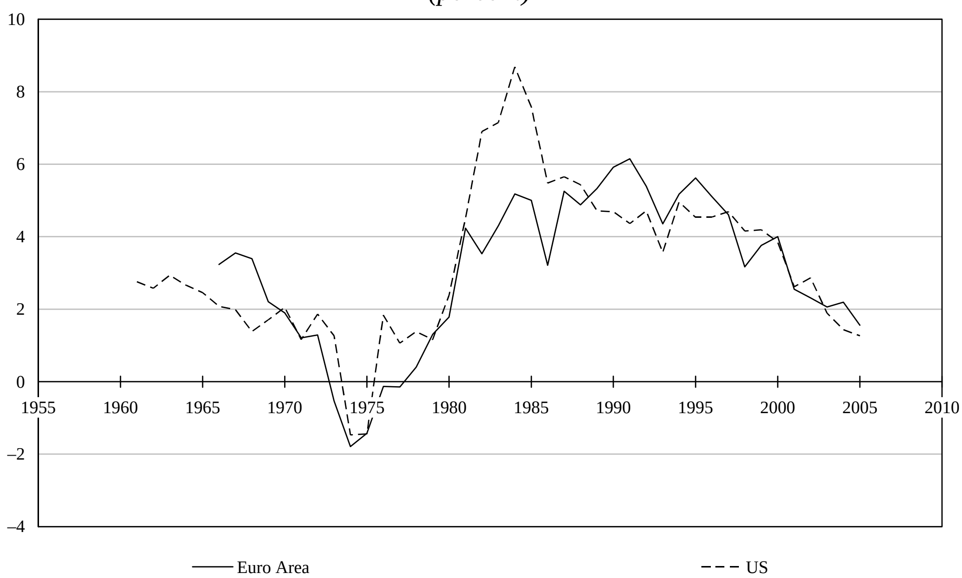
Figure 3

Three-month Nominal Money Market Interest Rate and the Long-term Real Interest Rate: the Euro Area and the US, 1960-2005

Three-month Nominal Money Market Interest Rate
(percent)



Long-term Real Interest Rate
(percent)



behaviour of monetary and fiscal variables in most OECD economies in 1960-2005.[5] As regards the statistical properties of the time series, according to Augmented Dickey-Fuller tests, the GDP growth rate is an I(0) process in all OECD-countries of our sample. The inflation rate and short term nominal money market interest rate are I(1) processes with only one borderline case.[6] The primary balance to GDP ratio is an I(1) process in the majority of the countries in our sample while it is an I(0) in the US, the UK, Germany, Denmark and Finland. Finally, the debt to GDP ratio is an I(1) process in eight of the sample economies, while it is an I(2) process in Belgium, Denmark, Spain, Japan and Canada. The inflation rate and the short term nominal money market interest rate show a "humped" shaped pattern with a peak at the end of the 1970s and at the beginning of the 1980s. The hump illustrates the consequences of escalating inflation rates since the late 1960s and the strong monetary policy reaction against this development in the beginning of the 1980s.

Perhaps the most dramatic change occurs in real long-term interest rates in the beginning of the 1980s, particularly in the US. Real interest rates had been at historically low levels all over the world in the high inflation years of the 1970s. However, there was an abrupt shift in the monetary policy emphasis between 1979 and 1980 in most OECD economies.[7] The hikes in long real rates ranged from 11 per cent in the UK in 1981 and 1982 to about three to four per cent in Germany (which meant doubling of the real rates in Germany).

As regards the behaviour of the fiscal variables shown in the Figure 4, there are again striking similarities between development in the US and the euro area. The primary balances fluctuated around zero over the cycle until the severe recession of 1975 (not visible in the shorter euro area series). In that year the primary deficits hit a record of minus four per cent of GDP both in the US and the euro area as a whole. There was a pursuit for an immediate consolidation in 1976 to 1979, but the second oil shock in 1979, the sharp increase in monetary policy rates and the ensuing deep recession marked a new deterioration in fiscal balances (OECD EO, 1981). Primary deficits were brought close to balance in the majority of OECD countries in the latter half of the 1980s, but because of the impact of the high and persistent real interest rates on the interest burden of the debt, actual deficits did not turn into surplus until in the turn of the millennium.

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5 The public debt history of Finland, the UK and Japan differ from this general picture (see Figure 10 in Appendix 3). The UK has had a *declining* trend in its debt to GDP ratio until the beginning of the 1990s; in Finland severe public debt problems emerged only for a short period in the 1990s because of a deep recession, and in Japan the collapse of the "bubble economy" has aggravated greatly debt problems. The VAR results of these three countries, to which we refer to as countries with "peculiar debt histories" often differ from the others and sometimes distort the scale of comparisons.

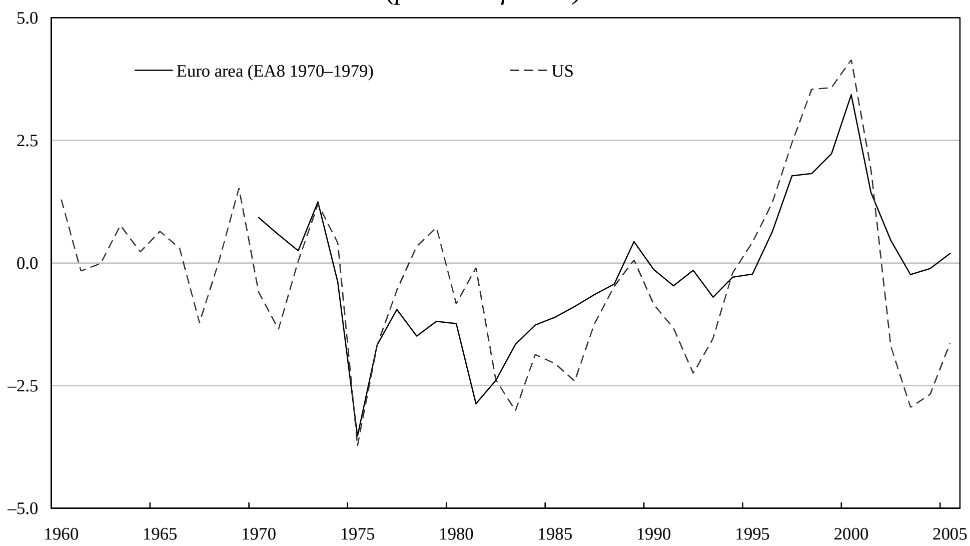
6 According to the ADF-test, the short term money market interest rate is *I*(0) in Germany with the 95 per cent significance level but *I*(1) according to the Phillips-Peron test. A critical discussion on the relevance of using unit root tests, see, for example, Maddala and King (1998).

7 According to Goodfriend (1995), in the US, "the announcement (by the new Fed Chairman Paul Volcker) on 6 October 1979 of the switch to non-borrowed reserve targeting officially opened the period of disinflation policy" (see also, for example, Huizinga and Mishkin, 1986, regarding the US, and Bagliano, Golinelli and Morana, 2002, regarding Europe).

Figure 4

General Primary Balance, Actual Balance, Revenue and Expenditure (excl. Interest Payments) and Debt: Euro Area and the US, 1960-2005

Primary Balance
(percent of GDP)



Actual Balance
(percent of GDP)

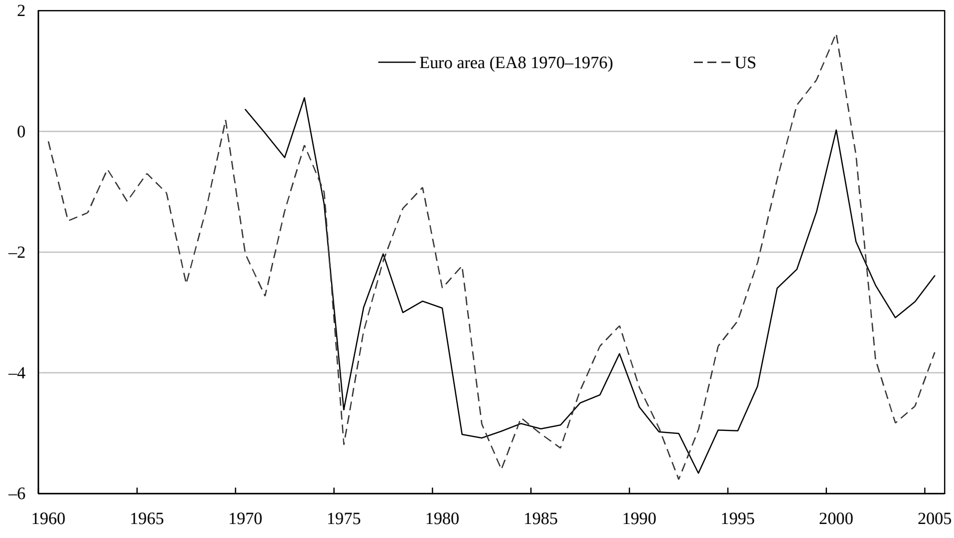
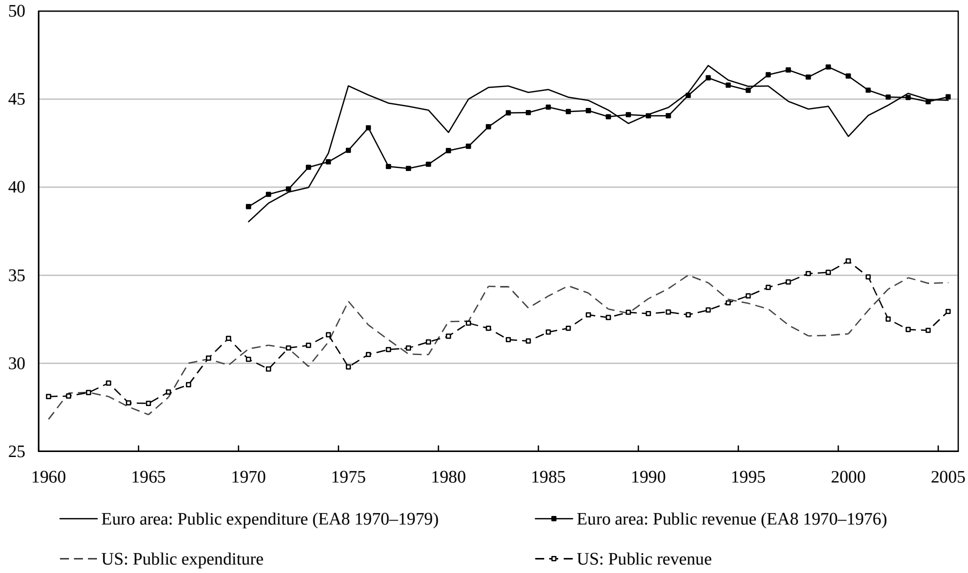


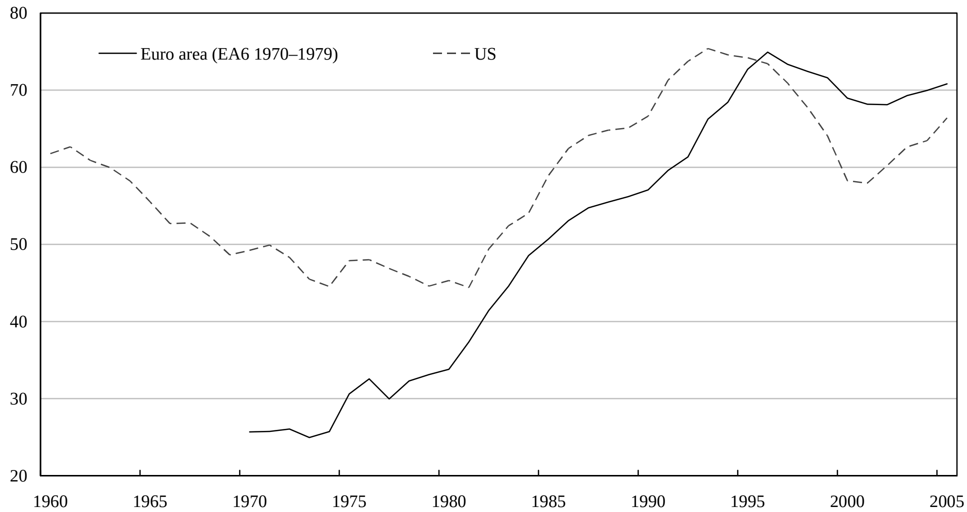
Figure 4 (continued)

General Primary Balance, Actual Balance, Revenue and Expenditure (excl. Interest Payments) and Debt: Euro Area and the US, 1960-2005

General Government Revenue and Expenditure
(percent of GDP)



General Government Debt
(percent of GDP)



Perhaps the only outstanding dissimilarity between the US and the euro area regarding fiscal variables is the large difference in the shares of public sector revenues and expenditure in GDP: in the euro area they are about 15 percentage points higher than in the US. Therefore, it is remarkable how similar the overall development of the fiscal variables is in both continents. In the US the significant increase in the debt to GDP ratios occurred in about ten years from 1982 to 1993 while in Europe the period was a few years longer. While many OECD countries, particularly the smaller ones, have got their debt to GDP ratios under control since the mid-1990s, the fiscal situation in the large euro area economies and the US is still worrying. The development of the debt to GDP ratio in the 13 OECD countries of our sample is presented in Appendix 3 together with dynamic forecasts estimated with the basic country VARs for the period 1998-2005.

4 The results of the recursive basic VAR model

4.1 The response of the debt to GDP ratio to innovations in the VAR variables

First of all, all country VARs are stable in the period under consideration.[8] In Figure 9 in Appendix 2 we display the impulse response functions based on yearly data of all countries of our sample.[9] The overall picture is that the sign and in most cases also the profile of the impulse responses are rather similar across countries while the magnitude of the responses differ from country to country. First, an unexpected positive shock to *output growth* initially decreases the debt to GDP ratio in all cases as one would expect and in the large majority this reaction is also statistically significant (the response of Belgium is clearly an anomaly). In Denmark, Spain, France, Finland and Japan the response is rather strong compared to others while it is weak in Germany, Greece, Italy and Austria. The UK, the US and Canada may be classified as intermediate cases. Second, as regards the influence of unexpected shocks to *inflation*, this is in most cases weak and almost in all cases statistically insignificant. In half of the cases (Denmark, Germany, Greece, Austria, the UK and the US) the accumulated impact is positive and in the other half negative (in Italy it is zero). The sum of the accumulated responses is close to zero. The negative responses are dominated by two high debt countries, Belgium and Japan. It is interesting to find out that in half of the cases an unexpected inflation shock increases the debt to GDP ratio. Namely, it is often thought that high inflation erodes the value of debt and is therefore often regarded as the ultimate contingency solution to debt crises. The likely reason for this result is that higher inflation leads to higher interest rates and, consequently, to larger interest payments on the debt.

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8 If we had chosen another period, say, from 1970s to the end of 1980s, several country VARs would have been unstable.

9 All shocks have been standardised by dividing them by the standard error of the equation of the variable. Accordingly, one standard deviation shock in the present context is always unity.

Concerning the impact of a positive innovation to the *primary balance*, in 12 cases the accumulated impact is negative while it is slightly positive only in Finland. The response is strongest in Japan and above average also in Belgium, Greece, France and Austria. The impact of unexpected fiscal policy shocks is weak in Denmark, Italy and the UK. Germany, the US and Canada are intermediate cases. An unexpected rise in the *short term interest rate* increases the debt ratio in 11 cases of 13 and in about half of the cases the response is statistically significant. The accumulated response is very large in Belgium and higher than average also in Denmark, Italy, Finland and Canada. The response is clearly weaker only in Greece and Austria. In the UK and Japan the accumulated response is negative but not statistically significant. In the case of Japan the "wrong" sign is probably due to the fact that there has at the same time been a strong trend decrease in the short term interest rates while the debt ratio has increased from 23 per cent to 134 per cent. Finally, the positive response of the debt ratio to a shock to itself is quite weak, though in most cases statistically significant.

All in all, shocks to output growth, the primary balance and the short term interest rate have the strongest and in accumulated terms almost equally strong influence on the debt to GDP ratio while shocks to inflation and the debt ratio itself have only a minor impact. In the great majority of cases the signs of the responses are as expected, but the responses of countries with peculiar debt histories often deviate from the common patterns. Regarding the persistence of the impact of the shocks to the debt to GDP ratio, in the large majority of cases the persistence is remarkably high. The responses are particularly large and persistent in the two high debt economies Belgium and Japan, while they are smaller but as persistent in Greece. Instead, in the fourth high debt country Italy the impulse responses are on average small and not particularly persistent compared to others. In Denmark, Spain, Finland and the UK the responses seem to die out sooner than average. On average, shocks to output growth and inflation are less persistent than the policy shocks.

4.2 The variance decompositions of the shocks

Table 1 displays the variance decompositions of the debt to GDP ratio for all countries of our sample. The table shows the decomposition in one and ten year horizons to highlight potential differences in the short and long run impact. Moreover, in the last two columns of the table we show the results of a variant of our basic VAR in which we have replaced the primary balance with its components, total public expenditure and revenue.

In general, the results of the variance decompositions are in accordance with what we have learned from the impulse response functions in that output growth, the primary balance and the short term interest rates are the most important factors affecting the debt to GDP ratio forecasting errors, particularly in the longer term. Shocks to output growth explain, on average, about 28 per cent, to inflation around 6.5 per cent, to the primary balance about 20 per cent, to the short term interest rate about 33 per cent and to the debt ratio itself about 13 per cent of the debt to GDP

Table 1

Variance Decomposition of the Debt-to-GDP Ratio in Selected OECD Countries, 1960-2005
(one and 10 year horizons, percentage points)

		S.E.	Y	INFL	PRIBAL	IS	B	EXPEN	REV
BE	1 year	1.5	7.9	31.7	10.2	2.3	48.0	4.5	8.1
	10 year	1.9	2.6	13.9	10.2	71.7	1.7	26.0	3.9
DK	1 year	1.1	51.8	11.3	2.6	9.9	24.4	0.1	1.4
	10 year	1.5	42.0	13.3	6.7	33.9	4.1	3.6	3.1
GE	1 year	1.6	48.3	2.4	14.0	0.3	35.0	5.1	9.7
	10 year	1.9	17.8	9.0	35.1	18.4	19.7	23.5	10.2
SP	1 year	1.0	34.0	5.4	17.5	12.1	31.1	16.6	7.0
	10 year	1.5	29.2	5.2	8.7	49.0	8.0	26.5	9.0
GR	1 year	2.2	5.7	1.2	17.6	0.0	75.6	9.3	0.6
	10 year	3.5	2.3	8.7	59.5	4.4	25.1	23.5	10.2
FR	1 year	1.1	23.6	0.1	37.9	4.7	32.6	27.1	18.9
	10 year	1.3	42.1	1.9	13.2	33.0	9.8	17.2	6.2
IT	1 year	1.7	26.4	5.6	1.2	2.5	64.3	0.0	2.2
	10 year	1.9	8.2	1.7	4.5	65.5	20.1	23.9	3.8
AT	1 year	2.1	32.8	6.7	9.3	0.3	51.0	23.6	8.9
	10 year	1.9	9.8	6.7	46.6	12.5	24.5	46.1	14.1
FI	1 year	2.1	32.8	6.7	9.3	0.3	51.0	0.9	13.8
	10 year	3.1	57.7	1.5	3.2	30.1	7.6	5.3	28.4
UK	1 year	1.6	2.9	0.2	0.0	11.7	85.2	17.8	20.7
	10 year	2.3	37.0	4.3	29.7	4.5	24.5	15.9	29.3
US	1 year	1.7	52.3	9.4	22.4	0.2	15.6	10.0	16.8
	10 year	2.2	39.9	6.4	21.2	26.6	5.9	13.8	5.7
JP	1 year	1.6	35.0	14.7	6.7	0.6	43.0	2.8	4.0
	10 year	1.8	62.0	12.4	11.2	12.2	2.1	1.2	12.2
CA	1 year	1.6	24.3	18.6	12.9	0.1	44.1	23.9	0.0
	10 year	2.3	7.6	3.0	6.6	69.7	13.2	15.8	25.0
Ave-rage	1 year	1.6	28.1	8.7	14.4	3.5	45.3	10.9	8.6
	10 year	2.1	27.6	6.4	20.1	33.3	12.7	18.6	12.4

ratio forecast error variation in the ten year horizon. However, especially the relative weights of shocks to output growth and the primary balance vary widely from country to country. Instead, monetary policy shocks explain consistently a large share in the forecast error variance in the large majority of the cases (the impact is weak in Greece and the UK).

The short and long term results deviate from each other mainly in that the short term interest rate exerts virtually no impact on the variance decomposition in the short run while shocks to the debt ratio itself explain about half of the forecasting error in one year horizon. However, the interest rate impact increases gradually by time and exerts the strongest effect among the VAR variables in the long run. The share of output growth is, on average, almost similar in both short and long term horizon. However, in most countries the impact of output is strong in the short run and then decreases gradually. This is clearly the case in Belgium, Germany, Italy, Austria and Canada. In contrast, in countries with peculiar debt histories and in France the impact of output growth increases over time. On average, the long term share of the primary balance in the variance decomposition is larger than in the short run but, again, the role of fiscal shocks differ widely from country to country.

As regards the large variance in the relative importance of output and primary balance shocks, one could perhaps conclude that in those countries where the output shocks explain a smaller than average share of the forecast error in the long run (Germany, Greece and Austria), the primary balance explains larger than average share and vice versa (Denmark, France, Finland and Japan). In addition, the share of output in the variance decomposition is small and the share of shocks to the short term interest rate very high in countries with high public debts (Belgium, Italy and Canada).

The fact that in Finland and Japan the share of shocks to output growth have a large share in the debt to GDP ratio variance decomposition is in accordance with the large drop in output in Finland in the beginning of 1990s and the sluggish growth performance of Japan also from the start of the 1990s, which explain the strong increase in the public debt to GDP ratio in these countries.

To attain information of the relative roles of public expenditure and revenue in public debt developments, we replaced the primary balance with total general government expenditure and revenue in our basic VAR model. The shares of these two components in the variance decomposition of the modified VAR are shown in the last two columns of Table 1. On average, the share of shocks to output, inflation and the debt ratio itself (not shown in Table 1) in the second VAR are close to those displayed in Table 1. However, the sum of the shares of shocks to expenditure and revenue in this second variance decomposition, about 30 per cent, is larger than the share of shocks to the primary balance of about 20 per cent in the basic VAR.

Shocks to expenditures have a larger influence in the variance decomposition than shocks to revenues which is in accordance with the common finding that fiscal consolidation measures that seek to restrain expenditure developments are more efficient than actions on the revenue side. This would also be visible in the impulse response functions (not shown) where a negative shock to expenditure has an unambiguous and often statistically significant decreasing effect on the debt to GDP ratio while a shock to public revenue has more often an ambiguous effect and is in most cases statistically insignificant. Shocks to public expenditure have the largest share in the variance decomposition in Germany, Greece and Austria. Finally, the share of revenue is larger than expenditure in the three countries with peculiar debt histories, Finland, UK and Japan and, furthermore, in Canada.

4.3 Further remarks on the role of monetary and fiscal policy in public debt developments

What has become obvious from the above is that unexpected shocks to monetary and fiscal policy have played an important role in public debt developments in our sample countries. Together they explain, on average, more than half of the forecast error variation in the debt to GDP ratio, and the response of the debt ratio to these policy shocks shows considerable persistence which lead to large accumulated effects. As regards the role of fiscal policy, it may be difficult to point out any specific unforeseen economic or policy shocks that would have triggered the overall deterioration in fiscal balances other than the deep recession in the mid-1970s after the first oil crises, and the accommodative stance of both fiscal and monetary policy during the recession. Many authors see the fiscal problems as a consequence of the building up of welfare states during the 1960s and 1970s. This strongly increased the share of public expenditures in GDP in several OECD economies (Rubini and Sachs, 1989, Masson and Mussa, 1989). However, the large increase in public indebtedness seems to be largely independent of the share of public sector in the economy. Nevertheless, the build up of welfare states do play a role in public debt developments as it has been difficult to adjust the existing welfare schemes to changing economic circumstances. Moreover, it took quite long before even professional economists realised that the high output growth rates which prevailed in OECD economies until the beginning of the 1970s did not re-emerge soon. Because of – by hindsight – unrealistically optimistic economic forecasts fiscal targets were constantly undershot in the late 1970s and early 1980s.

As regards the role of unexpected monetary policy shocks in public debt developments, it is easier to date the largely unexpected and in economic terms quite dramatic change in the monetary policy regime that happened in the beginning of the 1980s. In the US the quarterly nominal federal funds rate increased from 9.8 per cent in the third quarter to 15.9 per cent in the fourth quarter of 1980 while in many European countries the increase in nominal short term interest rates was even larger than in the US. From the second panel of Figure 3 we saw that this resulted in a sudden unexpected increase of several percentage points in the real long term interest rates in the US in the beginning of 1980. This implied that – just to keep the debt to GDP ratio constant – there should have been a marked increase in the primary balance to GDP ratio. However, at the same time as real interest rates reached high levels, the output growth rates declined. There had been a commitment to lower government deficits already before the second oil shock in 1979, but high interest rates, indexation commitments and unemployment related expenditures made it difficult to meet borrowing targets (OECD EO, Dec.1981). Mervin King described this dilemma vividly in the Federal Reserve Jackson Hole Conference in 1995 (King, 1995):

> "*One consequence of this change in monetary policy is that the attempt to bring inflation down – resulting in lower inflation than expected – led to a fiscal problem. A shift to a regime with a lower inflation rate but one in which the new policy does not have total credibility immediately raises the effective real interest rate on government debt. This creates a need for extra revenue to finance the higher debt-financing costs incurred in the transitional period during which credibility is being established …A successful policy of disinflation slows the growth of nominal GDP, but does not reduce the required interest payments on conventional debt until the new policy acquires credibility. Expected inflation will decline more slowly than inflation*" (King, 1995, pp. 176-77).

Consequently, the credibility of the new monetary policy regime posed a new problem both to monetary and fiscal authorities. King coined this dilemma "Some unpleasant fiscal arithmetic" in corollary to the famous Sargent-Wallace's argument on "Some unpleasant monetarist arithmetic" (Sargent and Wallace, 1981).

Did fiscal policy – in terms of an increase in the primary balance – react according to this "arithmetic" in the 1980s? As Figure 5 of selected OECD countries show, there has been a significant increase in the share of interest payments in GDP which started in the mid-1970s and got a strong boost in the beginning of the 1980s. According to Figure 5, there has been a gradual correction in the primary balance in Belgium, Germany and Italy but the reaction was delayed and, as the different scales of the left and right axes of the Figure 5 reveal, the increase in interest payments evidently surpassed the increase in the primary balance. This delayed reaction explains a major part of the rise in the debt to GDP ratio particularly in the high debt countries. Figure 5 also shows the importance of the marked decrease in interest rates after the mid-1990s for the decline of the interest burden on public debts.

To find more evidence of the response of fiscal policy to a deterioration of the debt ratio, we display in Figure 6 the response of the primary balance to a positive innovation in the debt to GDP ratio in our sample economies. In eight cases, out of 13, there is an immediate, albeit small, positive response of the primary balance. In five of these the reaction is also statistically significant. In all cases the accumulated response is positive.[10] In Belgium, Denmark, Spain, Greece, Italy and Canada, of which most still are or have been high debt economies, the positive response is somewhat larger than average while it is close to zero in Germany, France and

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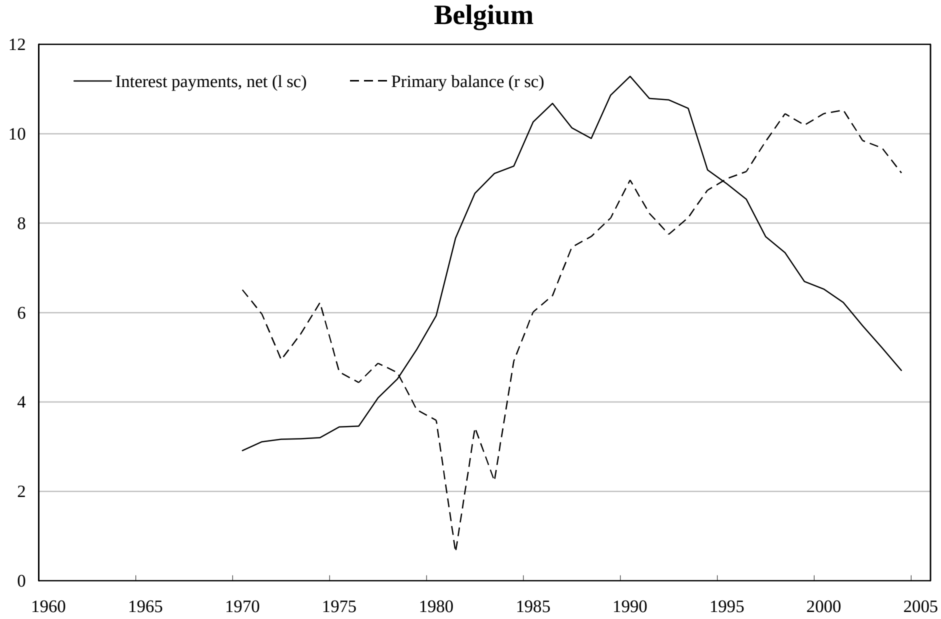
[10] Bohn (1998) argues that a strictly positive and at least linear response of the primary balance to changes in the debt to GDP ratio is a sufficient condition for debt sustainability, regardless of how interest rates and growth rates compare (p. 960–961). Since his analytical framework is different from ours, we are not sure if his reasoning applies here.

Figure 5

Share of Net Interest Payments (left scale)
and Primary Balance (right scale), 1960-2004
(percent of GDP)



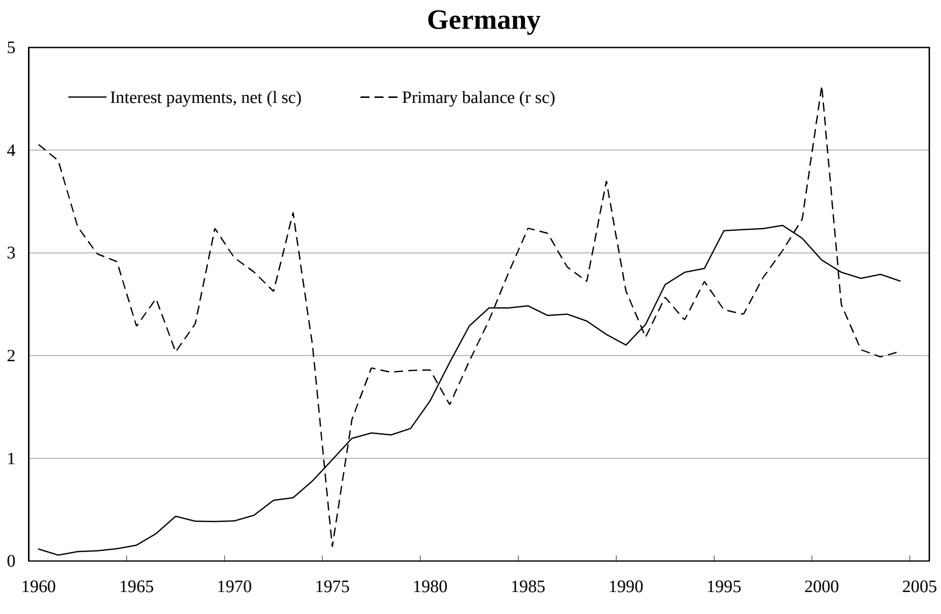
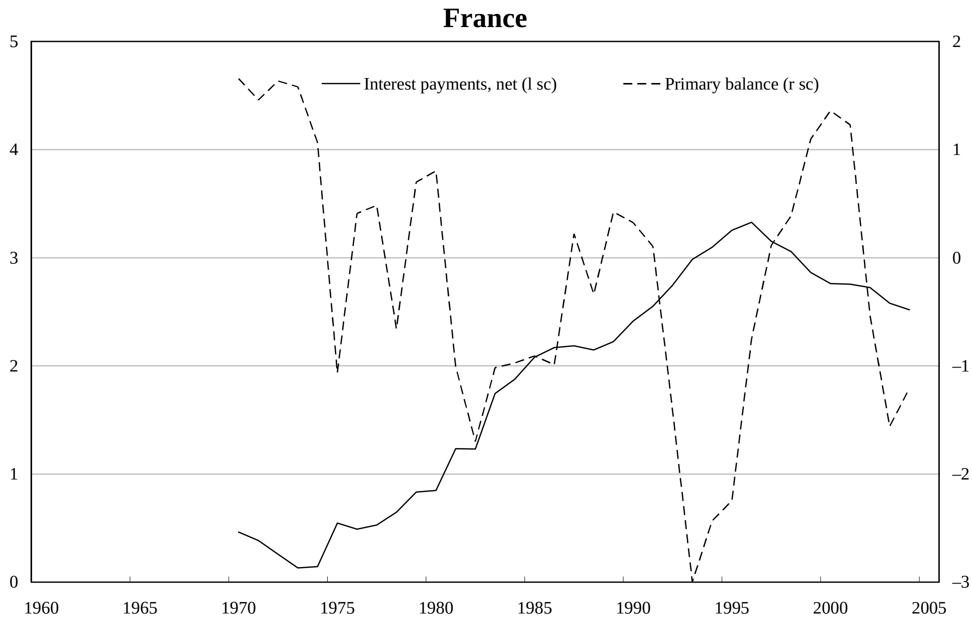
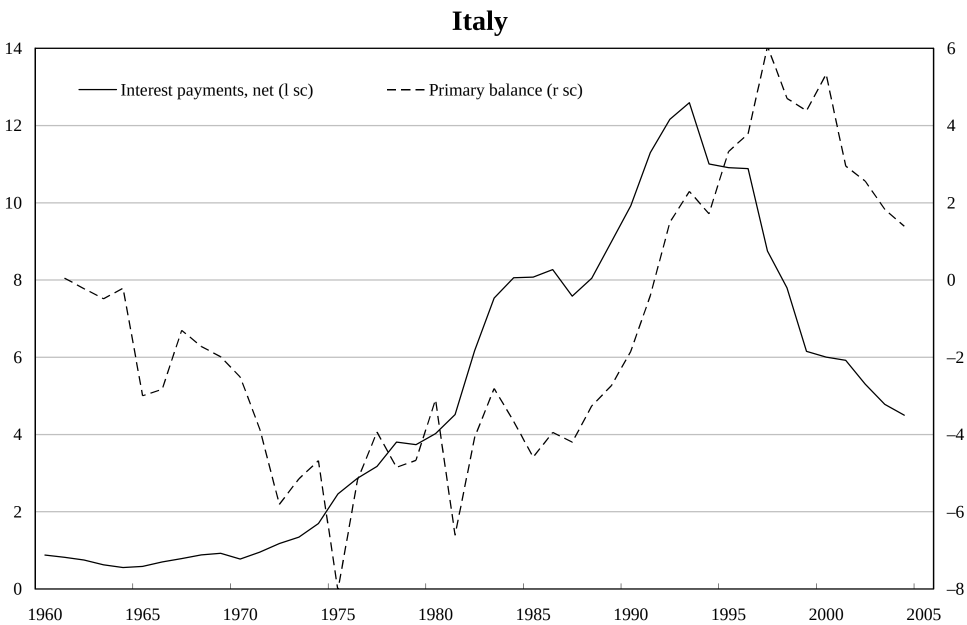


Figure 5 (continued)

Share of Net Interest Payments (left scale) and Primary Balance (right scale), 1960-2004
(percent of GDP)





Austria, of which the first two have had difficulties in stabilising their debt to GDP ratios. The positive reaction is also small in Japan while the US is an intermediate case. In Finland and the UK – both countries with peculiar public debt histories – the profile of the reaction is different from the rest and the accumulated response is close to zero.

There has been a lively debate of the potential non-Keynesian effects of fiscal policy among academic economists in recent years. In our basic VAR this would mean that a positive shock to the primary balance would have a positive effect on output. Figure 7 shows the reaction of output growth to an unexpected increase in the primary balance in our sample economies. While in nine cases the accumulated effect is negative, *i.e.* "Keynesian", all in all, the responses are small and rarely statistically significant. In four cases the accumulated impact is positive (Germany, Greece, Austria and Japan) but in all these cases the reaction is not statistically significant. If we compare our results with those obtained from a "pure" fiscal VAR including only output growth and the primary balance, the accumulated response of output growth to a fiscal policy shock is in most cases stronger than in our basic VAR.

So far we have only paid attention to the reaction of the primary balance to an unexpected shock to the debt to GDP ratio. Concerning the response of the other VAR variables to an unforeseen positive shock to the debt to GDP ratio, they are also are very small, although more consistent in that in the large majority of cases an unexpected shock to the debt to GDP ratio has a small negative impact on GDP growth, inflation and the short term interest rate. In less than half of the cases the response is statistically significant.

Finally, the impulse response functions of our two reduced form VARs confirm some stylized facts which are typical for many VAR studies including either monetary or fiscal variables or both: first, in the vast majority of cases, a positive expenditure shock boosts output growth and a positive revenue shock discourages growth in the short run. While in most cases inflation declines after a positive shock to the interest rate, in some countries there is a notable "prize puzzle", *i.e.* inflation initially increases after a hike in the short term interest rate before it starts to decline. In contrast, output responds negatively to a positive interest rate shock as one would expect. The short term interest rate responds positively to positive output and inflation shocks as the Taylor rule suggests and inflation reacts positively to a positive output shock as the Phillips curve would imply.

5 Discussion

In Chapter 3 we discussed the justification of the assumption that the structural relationships of the VAR variables are to a certain extent recursive. In the following we look briefly into the sensitivity of our results to the chosen ordering of the variables. As regards the *impulse response functions* of the base model, they are highly resistant to various different orderings, illustrating the same patterns in

Figure 6

Response of the Primary Balance to a Positive Shock in the Debt-to-GDP Ratio
(yearly data)

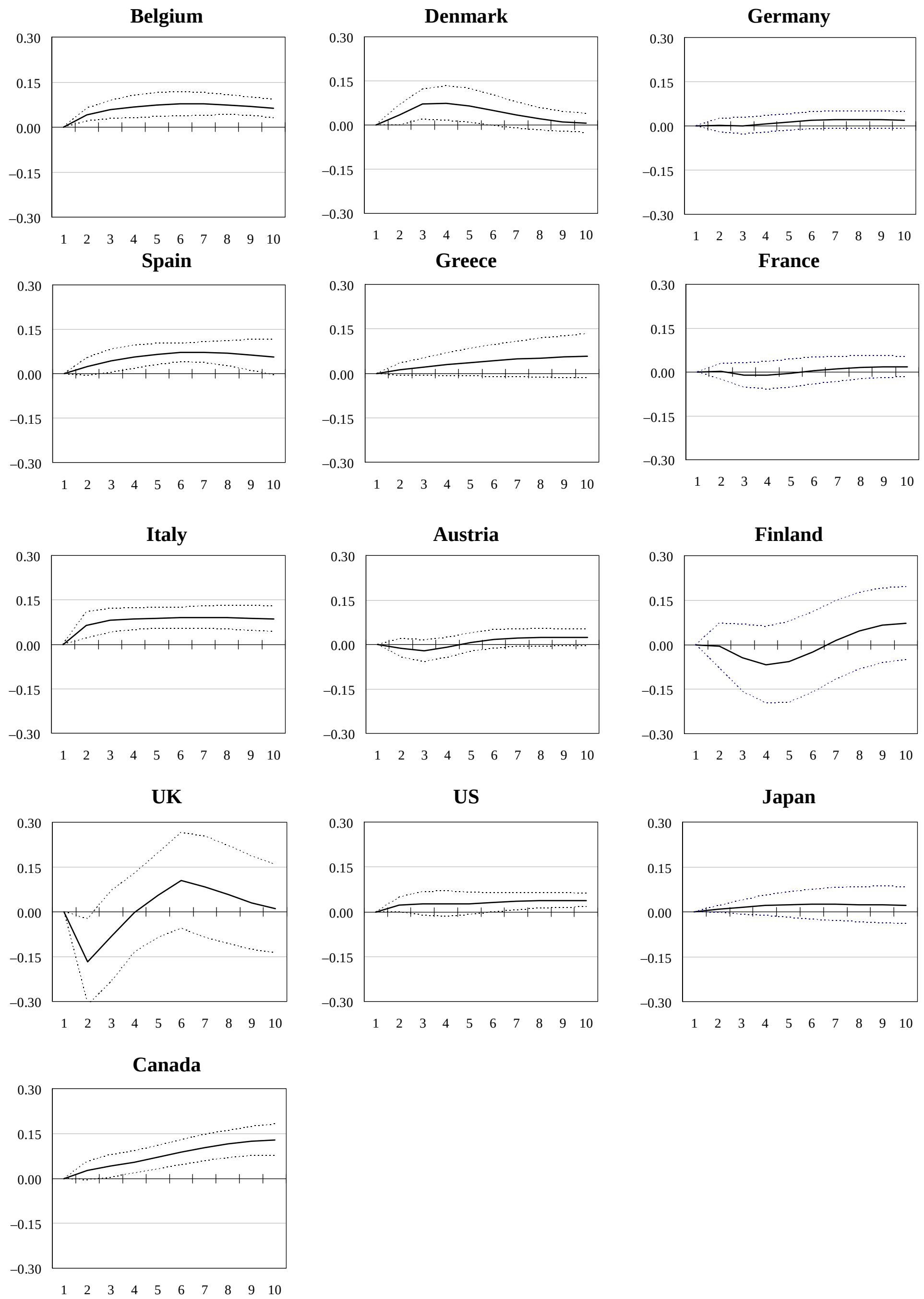
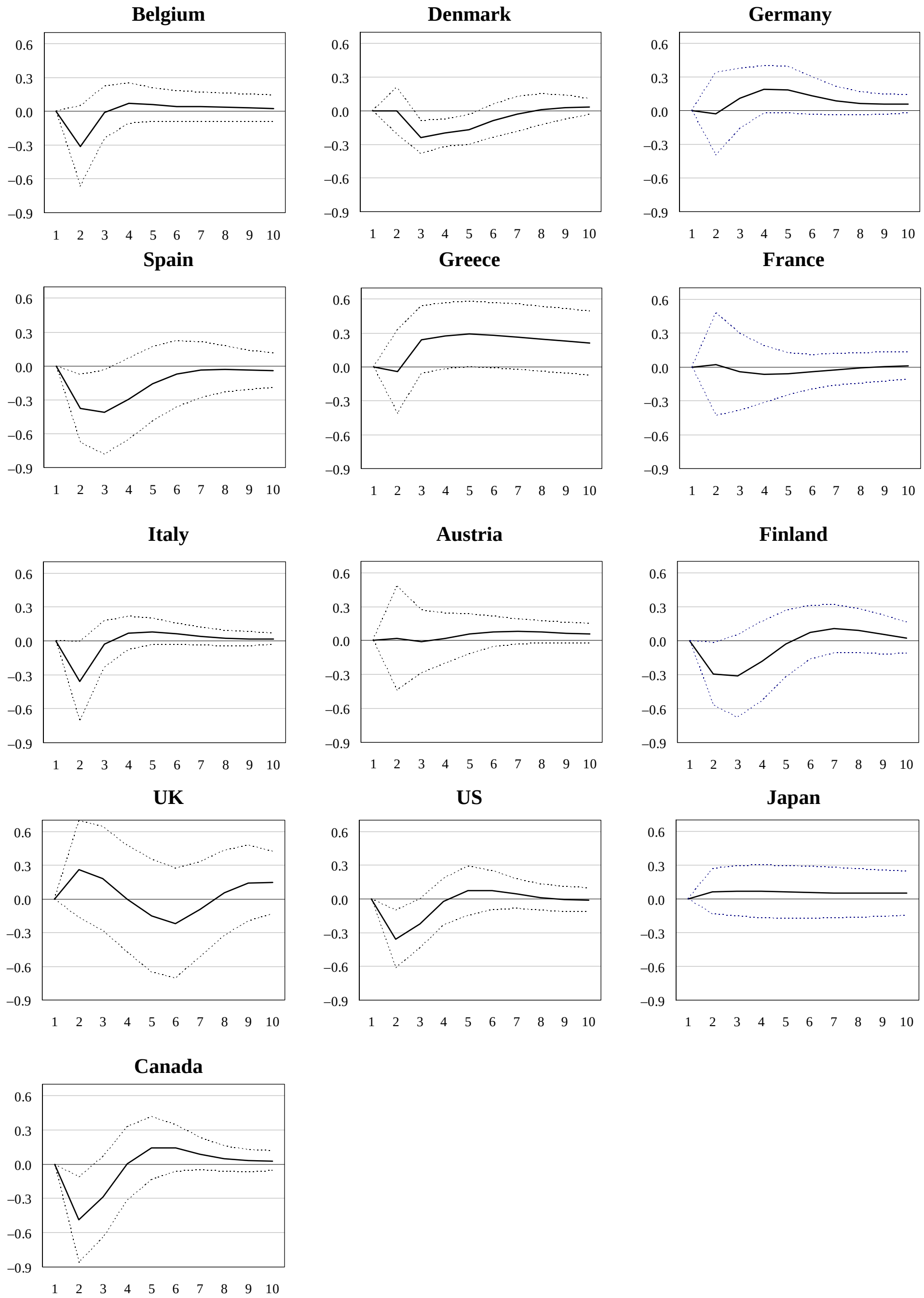


Figure 7

Response of Output Growth to a Positive Innovation in the Primary Balance
(yearly data)



almost all cases. When the unit responses are compared to non-Cholesky ordered unit responses, even their magnitudes are in many cases close to each other. However, the results of the *variance decompositions* are normally more sensitive to the ordering. Therefore, we discuss below some alternative orderings: As said, it is arguable whether one should order output before inflation, which is our choice, or the other way round. Nevertheless, as this has only minor effects on the relative importance of output and inflation, both orderings could be applied in our case.[11] A more intricate question is whether it is justified to have the short term interest rate after the fiscal variables; namely, if the short term interest rate is ordered before the primary balance, the long term impact of the short term interest rate in the variance decomposition declines significantly in some cases. The impact of fiscal policy would also become more prominent. However, the logic of the model would change too, since in that case the impact of automatic stabilisers would be felt in the residual, making the policy response unambiguous. Finally, if the short term interest rate would be ordered last, its significance would increase further and at the same time the share of shocks to the debt ratio itself would become very small. This last ordering could be justified if the effective interest rate on public debt reacts with a lag to a change in the monetary policy rate. The small average share of 3.5 per cent of the short term interest rate in the first year variance decomposition could be an indication of such delay (see also Figure 1).

In the following we present a simplified, small "semi-structural"[12] model in the spirit of Favero (2002) and Favero and Marcellino (2005) of the potential structural relationships of the five endogenous variables of our basic VAR. The system includes the following five equations:

$$y_t = \beta_1 y_{t-1} + \beta_2 (i_{s\,t-1} - \pi_{t-1}) + \beta_3\, pribal_{t-1} + \varepsilon_{1t} \qquad \text{IS-curve} \qquad (4)$$

$$\pi_t = \beta_4 \pi_{t-1} + \beta_5 y_{t-1} + \varepsilon_{2t} \qquad \text{Phillips curve} \qquad (5)$$

$$pribal_t = \beta_6\, pribal_{t-1} + \beta_7 y_{t-1} + \beta_8 b_{t-1} + \varepsilon_{3t} \qquad \text{Fiscal rule} \qquad (6)$$

$$i_{st} = \beta_9 i_{s(t-1)} + \beta_{10} \pi_{t-1} + \beta_{11} y_{t-1} + \varepsilon_{4t} \qquad \text{Taylor rule} \qquad (7)$$

$$b_t = \beta_{12} b_{t-1} + \beta_{13} y_{t-1} + \beta_{14} \pi_{t-1} + \beta_{15}\, pribal_{t-1} + \beta_{16} i_{st-1} + \varepsilon_{5t} \qquad \text{Debt equation} \qquad (8)$$

The first equation is a sort of IS-curve including the real interest rate (implying that the Fisher-effect holds in the long run) and the primary balance while the second equation is a Phillips curve in which output growth is used as an indicator for the overall level of activity instead of the more common unemployment or output gap. Equation 6 describes the automatic response of the primary balance to output shocks and a potential systematic reaction of fiscal policy to an increase in the public debt burden. Equation 7 is a sort of backward looking Taylor rule, where

11 The share of inflation shocks would increase slightly if inflation is ordered first.

12 Favero and Marcellino use the term semi-structural to indicate that there are no forward looking variables.

the central bank reacts systematically to innovations in inflation and output. Finally, equation 8 is the debt equation of our basic VAR model. While it resembles the debt dynamics identity 2, it is important to note that it ignores the non-linear interaction terms between the level of the debt on the one hand, and the real interest rate and GDP growth rate on the other hand in the identity. There is no straightforward way to overcome this problem in a linear VAR setting.[13] Moreover, there are other reasons why equation 8 should *not* match the actual debt evolution *exactly*: First, our choice to use the monetary policy rate as a proxy for the interest rate on general government debt causes some discrepancy (see Figure 1). Second, we have omitted seigniorage income from the debt identity because its role has decreased significantly, but it may have exerted some influence particularly in the 1970s in countries with high inflation. Finally, the debt identity ignores the role of the so called stock flow adjustment which in some countries causes a marked discrepancy between the public debt figures achieved by the debt identity and actual statistical data on public debt.

By exploring the coefficients of the A_i matrix of equation 3 of the individual country VARs we find that in ten cases out of 13 there exists a statistically significant positive relationship between output and inflation as the Phillips curve suggests. Also in ten cases out of 13 there exists a significant positive relationship between output and the short term interest rate as suggested by the Taylor rule, while only in four countries (Greece, Italy, the UK and the US) there was in addition a significant positive relationship between inflation and the short term interest rate, as also suggested by the Taylor rule (moreover, in six cases there was a positive but not statistically significant reaction). As regards the IS-curve and the "fiscal rule", there is more variation. In six cases there was a statistically significant negative correlation of around –0.4 between the primary balance and output. These were Belgium, Spain, Italy, Finland, the US and Canada. Moreover, in six cases there was a significant negative correlation between the nominal short term interest rate and output of the order –0.2 to –0.5. As regards the existence of a "fiscal rule", in ten cases out of 13 there was a systematic positive response of the primary balance to an increase in the debt to GDP ratio but only in four cases (Belgium, Denmark, Italy and the US) the coefficient was statistically significant.

As regards the debt equation, in 12 cases the coefficient of GDP growth was negative and in ten cases the coefficient was statistically significant. In four cases there was a statistically significant negative coefficient for inflation. The coefficient of the primary balance was negative in all cases but significant only in six cases. Finally, the coefficient of the short term interest rate was in all cases positive and statistically significant in seven cases. As a conclusion, our basic VAR captures quite well some basic macroeconomic relationships typical for small macro economic models, although the coefficients – perhaps partly because of the limited number of observations – were not always statistically significant.

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[13] Giannitsarou and Scott (2006) give several references where this problem is discussed. See also Appendix 3.

If the error terms of our basic VAR model would be uncorrelated – as they more or less were in the case of the quarterly data – their economic interpretation as policy shocks would become more straightforward. However, because the error terms show larger correlation in the yearly data, we are more dependent on the relevance of the Cholesky decomposition, and therefore the interpretation of the error terms remain somewhat ambiguous without more specific structural identification schemes for the shocks. Therefore, an obvious extension of this study would be to aim at more structural identification of the monetary and fiscal policy shocks. Another natural extension would be to identify the cointegration relationships suggested by statistical tests and give them an economic interpretation. Hasko (2006) and Reade and Scott (2006) have followed (independently) this path and specified the cointegration relationships in the case of the US using quarterly data for the period 1960-2005. Both studies found two stable long-run relationships among the VAR variables which they interpreted as a sort of Taylor rule and a fiscal policy rule and which explained the sustainability of the public debt developments in the US. Similar experiments could be done for other OECD countries.

6 Conclusions

One of the main conclusions of our study on public debt dynamics is that shocks to monetary and fiscal policy have played a major role in public debt developments since the mid-1970s. Together these shocks explained, on average, about half of the forecast error variation in the debt to GDP ratio in the ten year horizon while the share of the shocks to GDP growth was close to 30 per cent. Instead, shocks to inflation and the debt ratio itself played in most cases a minor role. However, the inflation shocks were vital in initiating the public debt problems as the increase in actual inflation and particularly the persistence of high inflation expectations in the 1980s led to a prolonged period of high real interest rates. This raised significantly the interest burden of public debts. Thus, the new monetary regimes of the early 1980s gave rise to "some unpleasant fiscal arithmetic" which aggravated and prolonged debt problems. Nevertheless, monetary authorities had no choice but to attain control over the rapid inflation. An additional factor that contributed to the initial increase in public indebtedness – though not studied here – was that both economists and politicians of the time were overly optimistic of the resurgence of the economic growth rates of the preceding decades which delayed the necessary adjustment to the slower growth phase.

The reaction of the debt ratio to both monetary and fiscal policy shocks has shown considerable persistence which partly explains the current high debt levels. Nevertheless, it seems that, according to the impulse response functions and the basic VAR equations, in most countries of our study fiscal policy has aimed at correcting the deteriorating fiscal balances by improving the primary balance, but the progress has in most cases been slow and delayed. It is difficult to say whether this could partly explain the fact that all the country VARs are stable in the period under consideration.

While the large role of monetary policy shocks in debt developments has been quite uniform across the OECD economies, the longer term role of fiscal policy shocks and shocks to GDP growth differ among countries. However, it is difficult to distinguish any particular country profiles which could explain the differences. It is quite obvious that the debt development of countries with very high debt ratios like Italy and Belgium is very sensitive to interest rate shocks and at the same time, other shocks play a minor role.

Looking our results from a different perspective, we could also conclude that shocks to output growth, inflation and monetary policy explain together about two thirds of the forecast error variance in the public debt ratio while fiscal policy shocks explain only about 20 per cent of it in the longer term horizon. Could this be seen as an indication of the limited power of fiscal policy in affecting public debt evolution? So far we have not discussed the consequences of our results for the fiscal framework of the EMU. The remarkable similarity of the overall evolution of public debts and deficits in both the US and the euro area, shown in Figure 4, may be the result of the large shocks to economic growth and monetary policy which have been more uniform across the OECD countries than shocks to fiscal policy. If this was the case, we should probably give more weight to the assessment of these "exogenous" factors in the judgment of fiscal policy outcomes in the context of the Stability and Growth Pact. On the other hand, taking into account the success of the new monetary policy regimes in controlling price developments, it may be less likely that today's economies would confront real interest rate shocks of the magnitude seen in the 1970s and 1980s. Therefore, it is possible that monetary policy shocks play a smaller role in fiscal developments in the future. That said it should be clear that even lesser shocks than those seen in the mid seventies and early eighties could have detrimental effects on the public finances of most OECD economies, taken into account the current high public debt levels. Therefore, policy makers should continue to do their best to keep inflation in control and to consolidate fiscal balances, particularly amid the favourable economic circumstances of the day.

APPENDIX 1

COMPARISON OF THE RESULTS FROM QUARTERLY AND YEARLY DATA: THE US AND GERMANY

In this Appendix we compare the results of our basic VAR obtained by quarterly and yearly data in the case of the US and Germany. For the US the range of both yearly and quarterly data is 1960-2005. For Germany it is 1970-2005 because of the shorter range of the quarterly data. Figure 8 displays the response of the debt to GDP ratio in the US and Germany to a positive one unit shock[14] in the variables of the basic VAR. The quarterly impulse response functions are displayed on the first row and the yearly responses on the second row for each country.

In qualitative terms, the responses are rather similar in both quarterly and yearly data in both countries. In quantitative terms, the reaction of the debt to GDP ratio to shocks to output, inflation and the debt to GDP ratio itself in both countries, and to a shock in the primary balance in the US, are also quite similar. As regards an unexpected shock to the primary balance in Germany, and to the short term interest rate in both countries, the response is clearly larger in the quarterly data compared to that in the yearly data although the overall profile of the reaction is again rather similar. Furthermore, in the quarterly data the responses are in general somewhat less persistent than in the yearly data. Still, in most cases the difference is not that large: for example, as regards shocks to output growth, in the US the maximum response of –1.1 is achieved after 10 quarters in the quarterly data and of –1.3 in the third year in the yearly data. For Germany the corresponding figures are –0.8 after six quarters in the quarterly data and also –0.8 after two years in the yearly data.

As regards the comparison of the results from the variance decompositions, in general there are more differences. For example, as regards the US, the weights of shocks to output and the short term interest rates are higher in the yearly data than in the quarterly data. Finally, concerning the correlation of the error terms of the equations, in the quarterly data the correlations are clearly smaller than in the yearly data. In the German case the quarterly cross-correlations are mainly of the order of 0.05 to 0.2 while in the US they are somewhat larger. All in all, the results of the two data sets with different frequencies seem to be quite consistent in the case of both the US and Germany.

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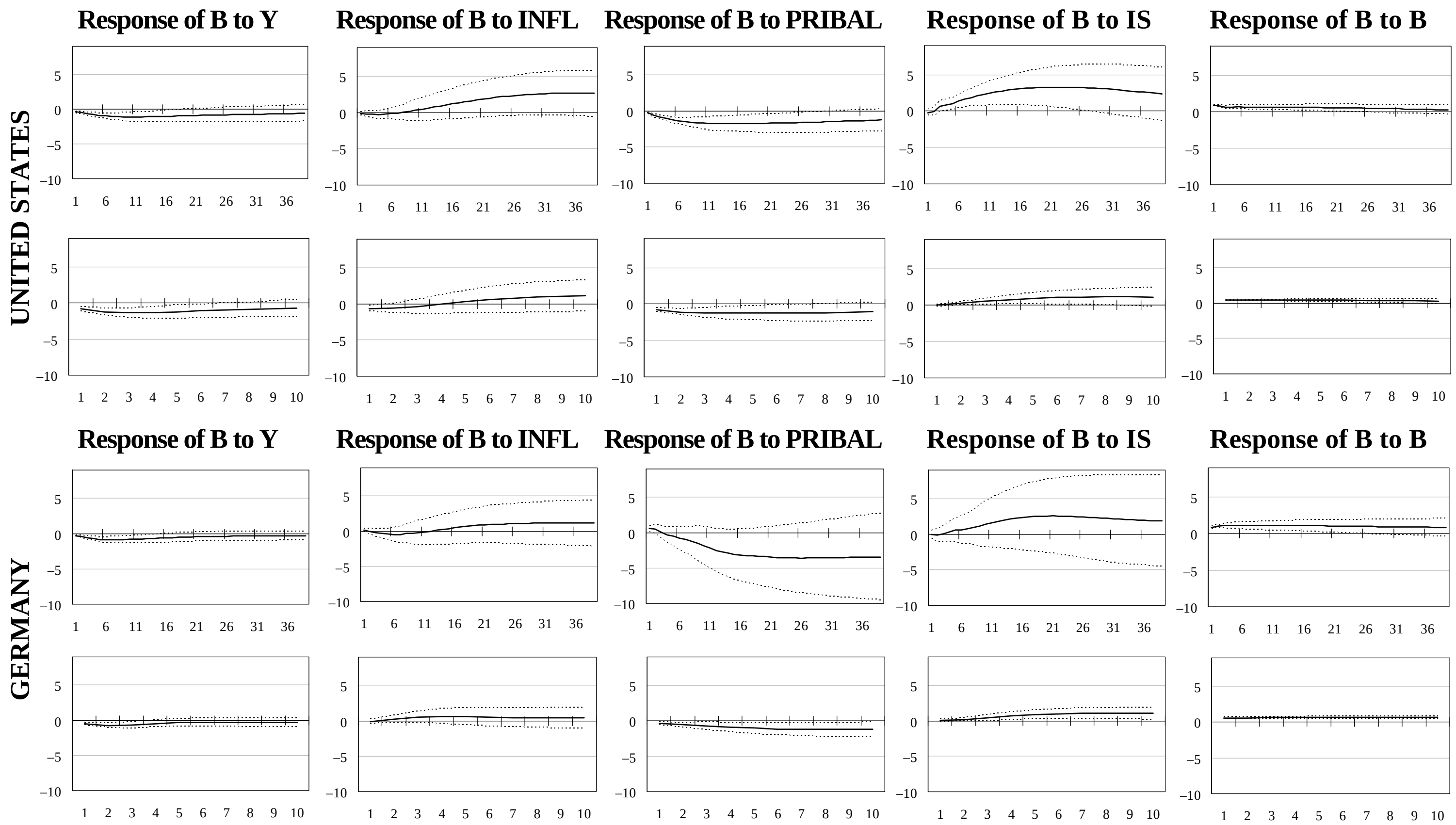
[14] All shocks have been standardised by dividing them by the standard error of the equation of the variable. Accordingly, one standard deviation shock in the present context is always unity.

Figure 8

Response of the Debt-to-GDP Ratio to Innovations to the VAR Variables in the US and Germany; Comparison of Results of Quarterly Data (First Row) with Yearly Data (Second Row)



APPENDIX 2

Figure 9

Response of the Debt-to-GDP Ratio to a One Unit Innovation in the VAR Variables – Yearly Data

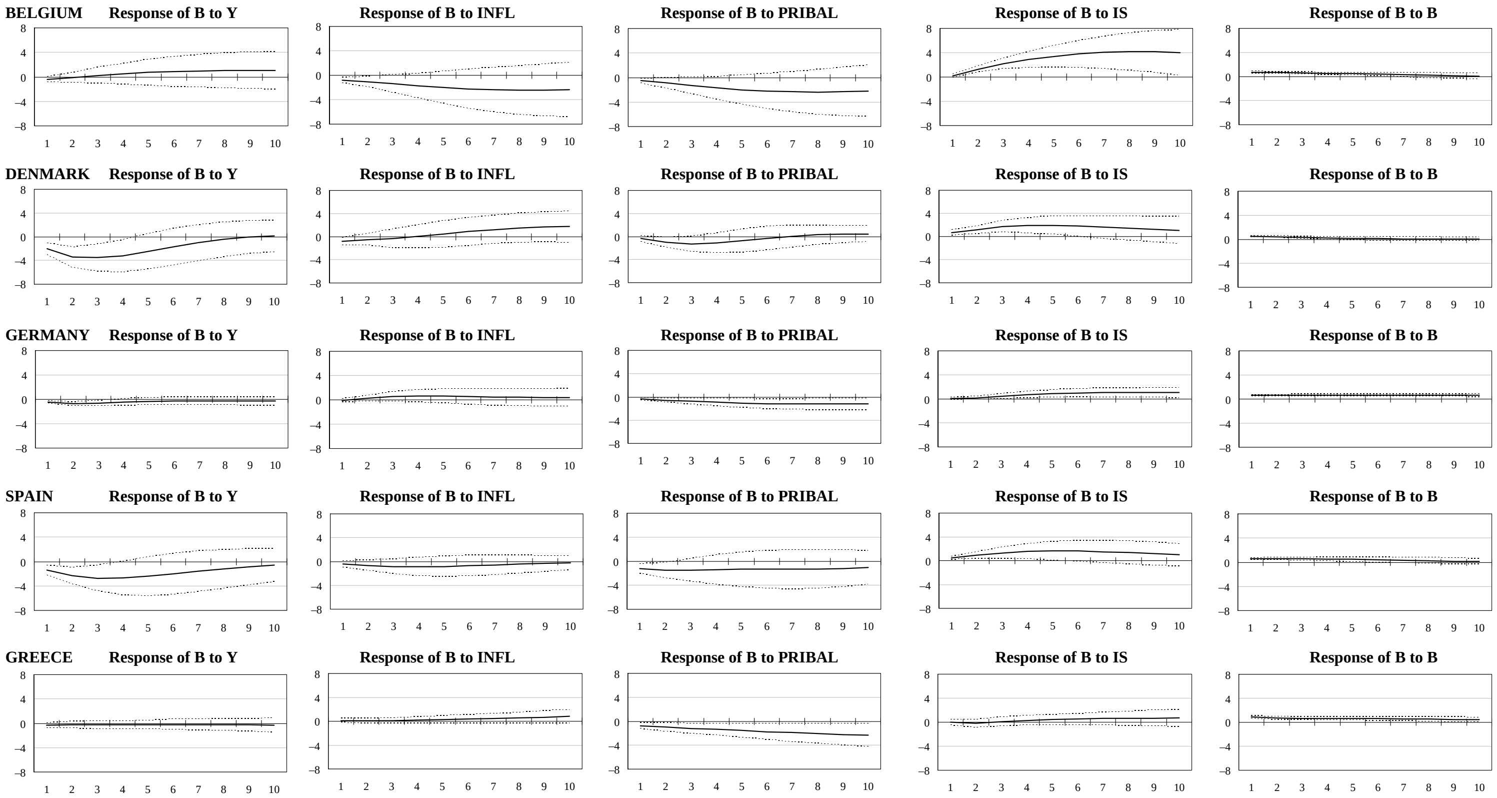


Figure 9 (continued)

Response of the Debt-to-GDP Ratio to a One Unit Innovation in the VAR Variables – Yearly Data

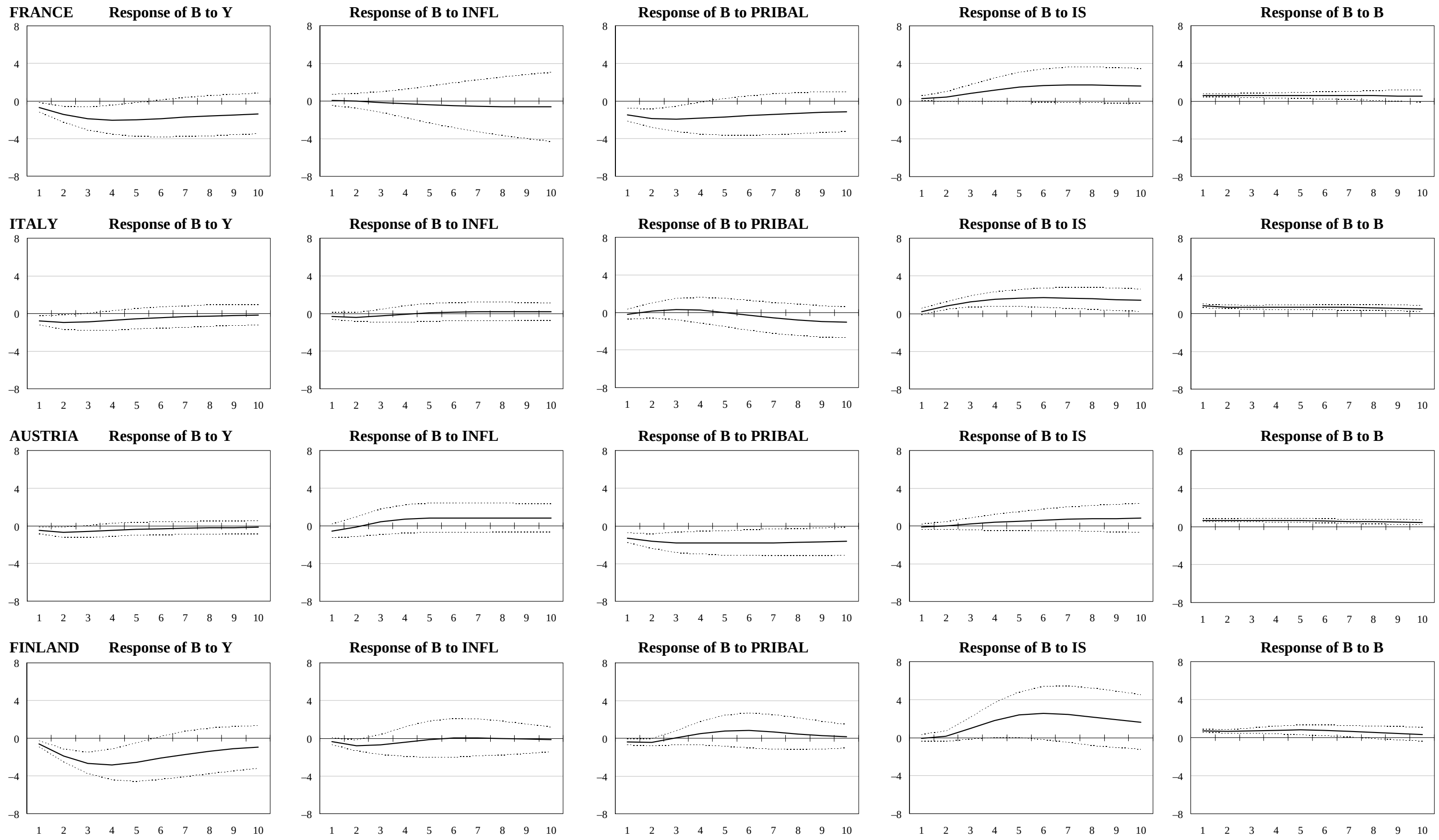
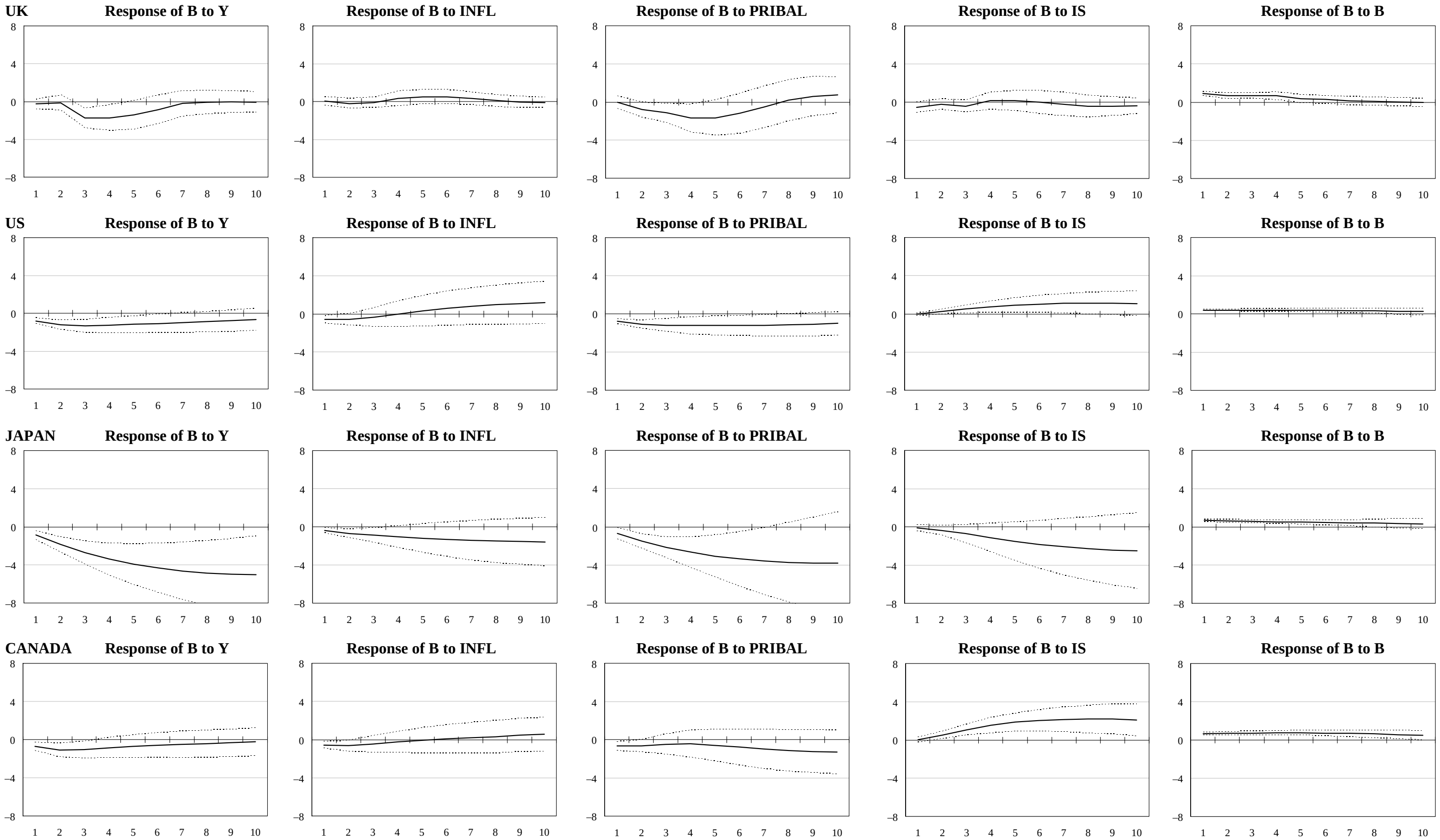


Figure 9 (continued)

Response of the Debt-to-GDP Ratio to a One Unit Innovation in the VAR Variables – Yearly Data



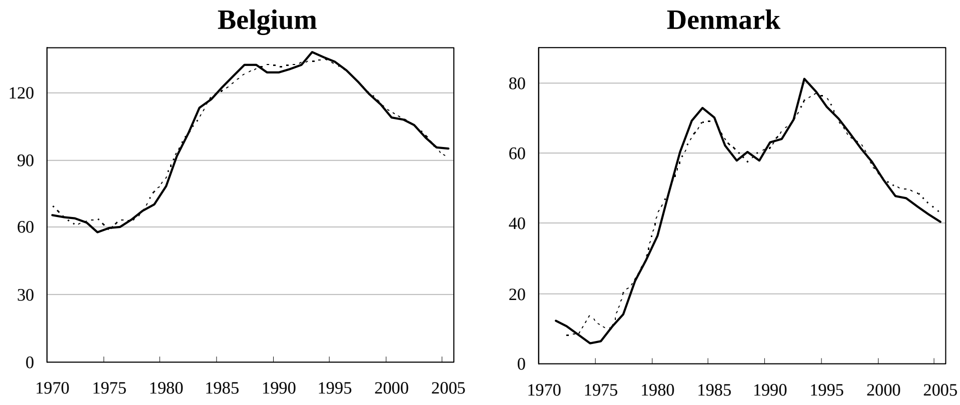
APPENDIX 3
DYNAMIC FORECASTS OF THE DEBT TO GDP RATIO

Figure 10 shows the dynamic forecasts of the debt to GDP ratio for the period 1998 – 2005 for the 13 OECD countries estimated by the individual country VARs.[15] The reason for making these forecasts was to find out whether the results would hint to any such non-linearity in the public debt dynamics which would clearly question the use of a linear approximation of the debt identity, *i.e.* the equation 8, in the basic VAR.

The forecasts seem to capture the actual debt developments with different degrees of precision. For some countries like Greece, Austria, the US and Japan the forecasts overestimate the degree of consolidation achieved for the forecast period while it underestimates it for Spain. For Japan this may be due to the special circumstances after the collapse of the "bubble economy", and as regards the US, it may be due to the radical loosening of fiscal policy in the beginning of the 2000s. However, for the majority of countries the forecast mimics quite well actual developments in 1998-2005.[16] Our conclusion from this is that, indeed, equation 8 seems to be a feasible approximation of the debt dynamics equation.

Figure 10

Dynamic Forecasts for the Debt-to-GDP Ratio for the Period 1998-2005
(actual: dark line, forecast: light line)



[15] The country VARs have been estimated from the first year there is data available for all variables until 1997. Using the estimated coefficients, dynamic forecasts have then been computed for the period 1998-2005.

[16] For some countries the debt dynamics "stabilise" rather early, so that, for example, for Italy the VAR forecast for period 1987-2005 and for the US for 1989-2005 are quite good.

Figure 10 (continued)

Dynamic Forecasts for the Debt-to-GDP Ratio for the Period 1998-2005
(actual: dark line, forecast: light line)

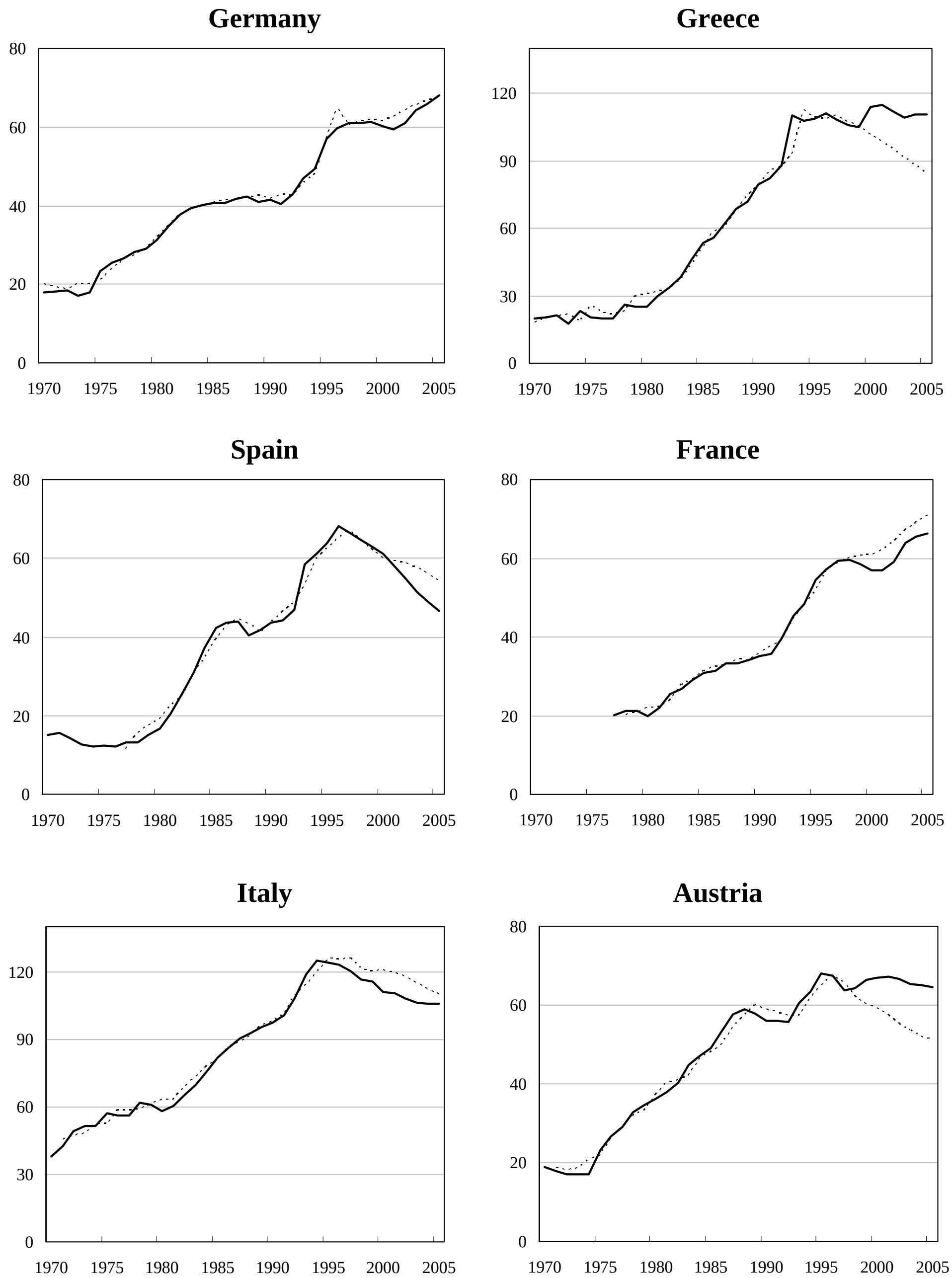
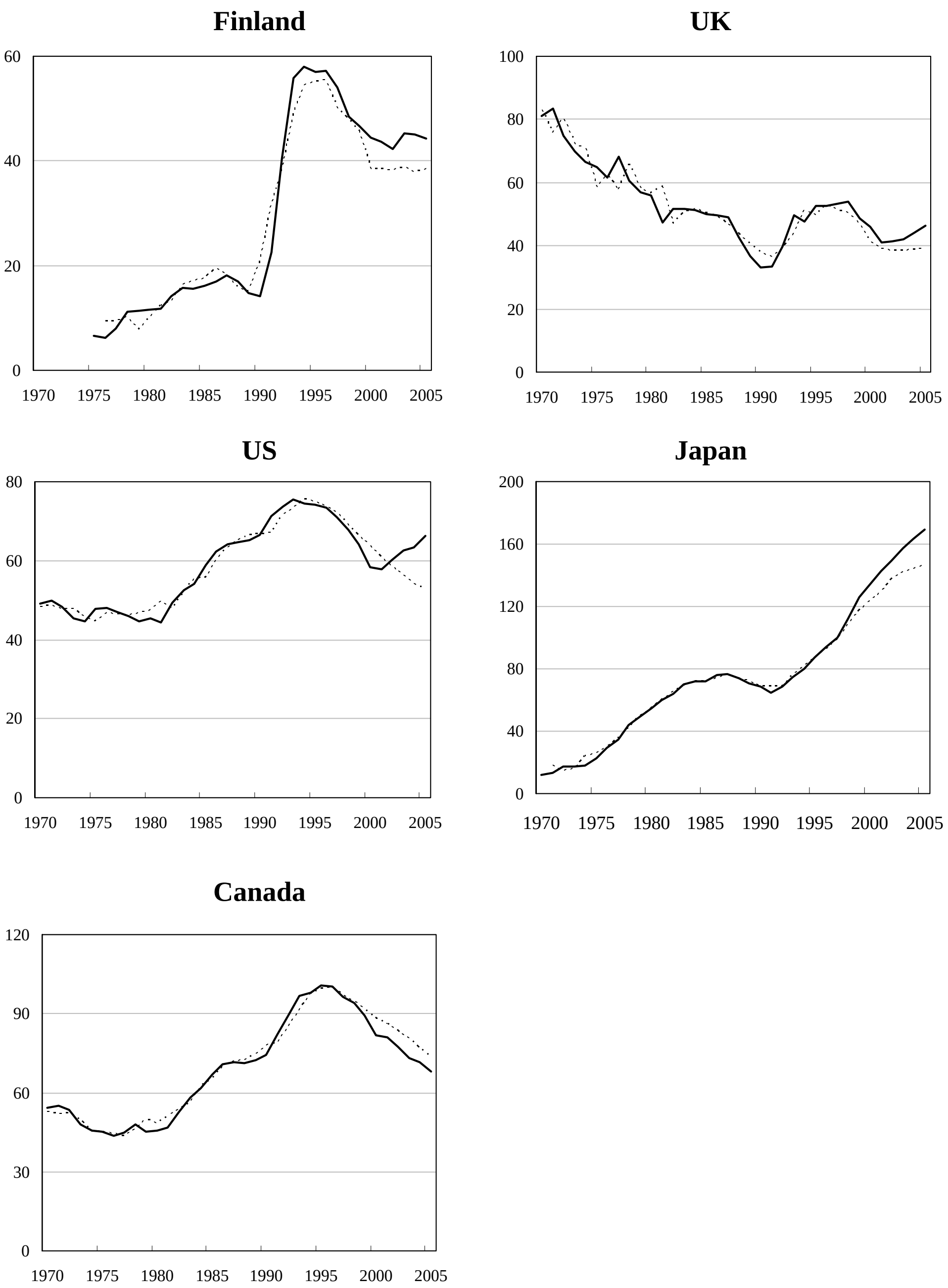


Figure 10 (continued)

Dynamic Forecasts for the Debt-to-GDP Ratio for the Period 1998-2005
(actual: dark line, forecast: light line)



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