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The Macroeconomic Effects of Fiscal Policy in Portugal: a Bayesian SVAR Analysis

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The Macroeconomic Effects of Fiscal Policy in Portugal: a Bayesian SVAR Analysis [*]

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Abstract

In the last twenty years Portugal struggled to keep public finances under control, notably in containing primary spending. We use a new quarterly dataset covering 1979:1-2007:4, and estimate a Bayesian Structural Autoregression model to analyze the macroeconomic effects of fiscal policy. The results show that positive government spending shocks, in general, have a negative effect on real GDP; lead to important "crowding-out" effects, by impacting negatively on private consumption and investment; and have a persistent and positive effect on the price level and the average cost of financing government debt. Positive government revenue shocks tend to have a negative impact on GDP; and lead to a fall in the price level. The evidence also shows the importance of explicitly considering the government debt dynamics in the model. Finally, a VAR counter-factual exercise confirms that unexpected positive government spending shocks lead to important "crowding-out" effects.

Keywords: B-SVAR, fiscal policy, debt dynamics, Portugal.
JEL classification: E37, E62, H62, G10.

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Non-technical summary

In the last twenty years, public spending control has been a major problem in Portugal. The gains from the drop in interest rates and, consequently, in the interest payments on the outstanding government debt were not accompanied by a sustained consolidation of public finances. Moreover, the episodes of fiscal improvement that occurred in the 1980s and in the 1990s have been short-termed and mostly not successful. Following the introduction of the Stability and Growth Pact (SGP), Portugal was the first country in the Economic and Monetary Union to breach the 3% of GDP reference value for the government deficit in 2001. Consequently, it became subject to the Excessive Deficit Procedure (EDP) in 2002, a situation that occurred again in 2005.

This paper evaluates the macroeconomic effects of fiscal policy in Portugal for the period 1979:1-2007:4, drawing on a new set of quarterly data built from the monthly Central Government's cash data.

We identify fiscal policy shocks using a recursive partial identification scheme and assess the posterior uncertainty of the impulse-response functions by estimating a Bayesian Structural Vector Autoregression (B-SVAR) model.

The empirical evidence shows that government spending shocks: (i) have, in general, a negative effect on GDP; (ii) lead to a fall of both private consumption and private investment; and (iv) impact persistently and positively on the price level and the average cost of refinancing the debt. In addition, government revenue shocks: (i) have a negative impact on GDP, on private consumption and on private investment, although the response emerges with a lag of about four quarters; and (ii) lead to a fall in the price level.

These results suggest that an expansion of government spending is associated to an episode of fiscal deterioration. Similarly, an increase in government revenue is followed by a somewhat less disciplined fiscal policy.

Finally, there is weak evidence of stabilizing effects of the debt level on the primary budget balance, and a VAR counterfactual exercise shows that unexpected variation in government spending leads to important "crowding-out" effects.

1. Introduction

In the last twenty years, public spending control has been a major problem in Portugal. The gains from the drop in interest rates and, consequently, in the interest payments on the outstanding government debt were not accompanied by a sustained consolidation of public finances. Moreover, the episodes of fiscal improvement that occurred in the 1980s and in the 1990s have been short-termed and mostly not successful.[1] Following the introduction of the Stability and Growth Pact (SGP), Portugal was the first country in the Economic and Monetary Union to breach the 3% of GDP reference value for the government deficit in 2001. Consequently, it became subject to the Excessive Deficit Procedure (EDP) in 2002, a situation that occurred again in 2005.

Therefore, given past performance and outcomes, it seems fair to say that after entering the European Union (EU) in 1986, joining the Exchange Rate Mechanism (ERM) of the European Monetary System (EMS) in 1992 and entering EMU in January 1999, Portugal's fiscal track record could have been better.

In this context, the evaluation of the effects of fiscal policy on economic activity in Portugal becomes relevant and is the major goal of this paper. Additionally, we look at its impact on the composition of GDP, therefore, identifying potential "crowding-out" effects on private consumption and private investment.

We identify fiscal policy shocks using a recursive partial identification scheme and assess the posterior uncertainty of the impulse-response functions by estimating a Bayesian Structural Vector Autoregression (B-SVAR) model. In addition, we consider the response of fiscal variables to the level of the government debt following Favero and Giavazzi (2007) and Afonso and Sousa (2009a).

Another important contribution of the paper is the use of a set of quarterly fiscal data for the period 1978:1-2007:4, which we build by drawing on the higher frequency (monthly) availability of fiscal cash data. This allows us to identify more precisely the effects of fiscal policy.

The findings of this paper can be summarized as follows.

In the one hand, government spending shocks: (i) have a negative effect on real GDP; (ii) generate substantial "crowding-out" effects and lead to a fall in both private

1 See Afonso (2008b).

consumption and private investment; and (iii) have a persistent and positive impact on the price level and the average cost of refinancing the debt.

On the other hand, government revenue shocks: (i) have a negative impact on GDP, (ii) crowding-out of private consumption and of private investment, although the response emerges with a lag of about four quarters; and (iii) lead to a fall in the price level. In addition, an increase in government revenue is normally followed by a somewhat less disciplined fiscal policy.

The consideration of the feedback from government debt makes the effects of fiscal policy on (long-term) interest rates and GDP more persistent and these variables are also more responsive to the shocks. Moreover, the results do not seem to support the existence of a significant stabilizing response of the budget balance to the debt level. In fact, there is only weak evidence suggesting that: (i) government spending falls when the debt-to-GDP ratio is above its mean (in particular, in the period 1979:1-1993:3, that is, the year after the Maastricht Treaty entered into force); and (ii) government revenue increases when the debt-to-GDP ratio is above its mean (namely, in the period 1993:4-2007:4, that is, after the Maastricht Treaty). Therefore, there was a possible Ricardian behaviour after the beginning of the 1990s.[2]

Finally, a VAR counterfactual exercise shows that unexpected increases in government spending lead to important "crowding-out" effects.

The rest of the paper is organized as follows. Section two reviews the related literature. Section three presents recent fiscal developments in Portugal. Section four explains the empirical strategy used to identify the effects of fiscal policy shocks and to take into account the uncertainty regarding the posterior impulse-response functions. Section five describes the data, provides the empirical analysis and discusses the results. Section six concludes with the main findings and policy implications.

2. Literature review

Despite the large literature on the impact of monetary policy on economic activity, the importance of fiscal policy for economic stabilization has received less attention. The 2008 financial turmoil has, however, contributed to revive the interest of academia, central bankers and governments in the role of fiscal policy.

[2] See Afonso (2008a) for results of Ricardian behaviour also in the EU.

This section provides a brief review of the existing evidence of the effects of fiscal policy on GDP, the aggregate price level and the composition of output, that is, private consumption and private investment.

For the U.S., different approaches have been used in the identification of the fiscal policy shock. The "narrative approach" developed by Ramey and Shapiro (1998) isolates political events and finds that, after a brief rise in government spending, nondurable consumption displays a small decline while durables consumption falls. Edelberg et al. (1999) follow the same approach and show that military build-ups have a significant and positive short-run effect on output and consumption. Fatás and Mihov (2001) use a Cholesky ordering and show that increases in government expenditures are expansionary, but lead to important changes in the composition of output in the form of an increase in private investment that more than compensates for the fall in private consumption.[3] Blanchard and Perotti (2002) identify the automatic response of fiscal policy by using information about the elasticity of fiscal variables, and find that fiscal shocks are expansionary, have a positive effect on private consumption, and a negative impact on private investment. More recently, Mountford and Uhlig (2005) relying on sign restrictions for the fiscal impulse-response functions find a negative effect in residential and non-residential investment for the U.S..

At the international level, the evidence is scarce due to the limited availability of quarterly public finance data. Perotti (2004) analyzes the effects of fiscal policy in Australia, Canada, Germany and the U.K., and finds a relatively large positive effect on private consumption and no response of private investment. For France, Biau and Girard (2005) find a cumulative multiplier of government spending larger than one, and positive reactions of both private consumption and private investment. For Spain, De Castro and Hernández de Cos (2006) show that, despite the positive relationship between government spending and output in the short-term, expansionary spending shocks only lead to higher inflation and lower output in the medium and long-term. Heppke-Falk et al. (2006) and Giordano et al. (2007) find that government spending has expansionary effects on both output and private consumption for, respectively, Germany and Italy. Finally, Afonso and Sousa (2009a, 2009b) show that, for the U.S., the U.K., Germany and Italy, quarterly fiscal policy shocks have important macroeconomic effects while also impacting on housing and stock prices.

3 For a review of the debate between the predictions of the standard RBC model and the IS-LM Keynesian model, see Afonso and Sousa (2008).

3. Recent fiscal developments in Portugal

3.1. Excessive deficits

Portugal was the first country in the EU to breach the SGP deficit limit in 2001, becoming subject to the EDP in 2002 and again in 2005.

The first EDP for Portugal was launched in 2002, the year of the identification of the excessive deficit. On 5 November 2002, the Council decided that an excessive deficit existed in Portugal and issued a recommendation requesting Portugal to bring this situation to an end by 2003 at the latest. Portugal then opted to address the excessive deficit situation still in 2002 (one-off measures amounting to 1.4 per cent of GDP were used in that year), therefore avoiding further steps in the procedure. Subsequently the Council Decision of 11 May 2004 proposed the abrogation of the decision on the existence of an excessive deficit in Portugal in accordance with EU Treaty Article 104(12), stating that the correction of the excessive deficit was completed in 2003.

According to Afonso and Claeys (2008), the main reasons for the three initial breaches of the SGP in 2002 and 2003 seem to be expenditure rises in France and Portugal, while large revenue reductions unmatched by expenditure cuts in Germany pushed the deficit beyond 3 per cent of GDP. This evidence again seems to point, as already mentioned, to some difficulties related to expenditure control.

In 2003 and 2004, Portugal used sizable temporary measures, amounting respectively to 2.5 and 2.3 per cent of GDP, in order to keep the budget deficit below the 3 per cent limit. Overall, such temporary measures implemented in the 2002-2004 period, added up to 6.2 per cent of GDP.[4]

The adoption of such strategy, making use of temporary corrective measures, even if it prevented the budget deficit from going above the 3 per cent limit, did not address the structural factors behind the underlying Portuguese fiscal imbalances. Additionally, after the 2002 EDP, the consolidation strategy also included an increase in the standard VAT rate (from 17 to 19 per cent, which was again raised to 21 per cent in July 2005), while primary spending continued rising.[5]

4 For instance, pension funds transfers from public sector enterprises to the civil servants pension system in 2004; securitization in 2003 of tax credits; extraordinary settlement in 2002 of tax arrears (a tax amnesty). See Afonso (2007) for more details.

5 Guichard and Leibfritz (2006) also survey the reasons for the non-successful fiscal adjustment in the period 2002-2004.

The second EDP was initiated against Portugal in 2005 via a Council Decision of 20 September 2005, in line with Article 104(6). The deadline of 2008 was given for Portugal to correct the situation. Additionally, the Commission recommended to Portugal a reduction of the cyclically-adjusted deficit, excluding one-off and other temporary measures, by 1.5 per cent of GDP in 2006, and at least ¾ per cent of GDP in 2007 and in 2008. Under Article 104(7) a Council Recommendation was also adopted on 7 October 2005 asking Portugal to take effective action regarding the measures needed to address the excessive deficit situation.

Against this background, a word is in order regarding some limitations concerning the monitoring and collection of fiscal data. A specific commission led by the Banco de Portugal was created in 2002 to determine the value of the 2001 budget deficit. It was on the basis of that outcome, showing a much higher deficit than the one previously reported by the national authorities to Brussels that the first EDP for Portugal was triggered.

Yet again in 2005, another commission under the aegis of the Banco de Portugal concluded for the existence of still a higher number for the budget deficit in that year, more specifically of twice the 3 per cent limit. As already mentioned, Portugal then faced the second EDP in 2005. Therefore, it is somewhat worrying that in the past some limitations prevented the fiscal and statistical authorities of being able of accurately monitoring the outcomes of the several public finances related variables. Indeed, and even if this is not an easy task, one expects all steps of the budgetary process and the ensuing implementation and monitoring of fiscal policy to be tackled in a timely fashion by the fiscal authorities.

The second EDP was still underway at the end of 2008, and among the several measures proposed by the authorities to control primary spending, one can mention as some of the more structurally oriented ones, for instance, the revision of the civil servants' pension schemes, and the reform of the health care sector.[6]

Interestingly, both EDP episodes that occurred in Portugal were characterised by fiscal easing, but while the 2001 episode was coupled with more favourable monetary conditions, in the 2005 episode monetary conditions were more stringent (see Figure 1).

6 Since 2002, some public hospitals have been transformed into public corporations, in an attempt to increase efficiency and decrease costs in the National Health Service (NHS). Afonso and Fernandes (2008), carrying out an efficiency analysis of Portuguese public hospitals of the NHS, for the period 2000-2005, did not find significant differences in efficiency between hospitals with public corporations status and Administrative Public Sector hospitals.

[Figure 1]

After entering the EU in 1986 both inflation and interest rates in Portugal decreased steadily and converged towards the lower levels that were more common in other countries in Europe. This was an obvious benefit from entering the EU, with capital markets adjusting expectations vis-à-vis Portugal, which also allowed for better and more stable sovereign debt ratings attributed to the country.

Undeniably, Portugal was one of the countries that most had to gain from the decrease in interest rates, given the quite high inflation and interest rate levels that it incurred in the past. Indeed, between 1985 and 1993, the long-term interest rate decreased around 1650 basis points (bp), opening an extremely important window of opportunity to engage in fiscal consolidations. It then further declined by some 700 bp from 1993 to 2003.

3.2. Fiscal consolidations

Regarding the past experiences in terms of fiscal consolidations, fiscal episodes can be identified based on the change in the cyclically adjusted primary budget balance. For this purpose, Afonso (2008b) determined for the EU countries the periods when the change in the primary cyclically adjusted budget balance is at least 2 pp of GDP in one year or at least 1.5 pp points on average in the last two years. For the case of Portugal, two episodes of fiscal expansion (1980-1981, 2005) and three episodes of fiscal contraction can be reported (1982-83, 1986, and 1992).[7] Following such approach, we can also observe an additional fiscal contraction in 2006-2007.

The abovementioned fiscal consolidation episodes were, on the one hand short-termed, and on the other hand mostly unsuccessful. During the 1982-83 consolidation both expenditures and revenues increased, as a share of GDP, while the debt-to-GDP ratio kept on increasing at the same time.[8]

Regarding the 1986 consolidation (the year of Portugal's entry in the EU), one observes in that period a certain stabilization of revenues as a share of GDP, a decrease

7 Blanchard (2007) argues that discretionary fiscal policy was expansionary in Portugal from 1995 to 2001.

8 It is also worthwhile mentioning that the Portuguese Escudo effective exchange rate faced a devaluation of 17 and 23 per cent respectively in 1982 and 1983, while Portugal undertook an IMF stabilisation programme.

in the expenditure-to-GDP ratio, and also a decrease in the debt ratio in the following three years. Additionally, the primary balance was also in surplus for the first time in thirteen years.[9]

Finally, the 1992 episode was very short-termed, taking place in a difficult environment, following revenue and expenditure increases with the debt ratio rising immediately afterwards.[10] Moreover, the 1993 economic downturn in Europe did not play in favour of prolonging the consolidation, with the primary spending-to-GDP ratio increasing more significantly in that year. Indeed, a known feature of fiscal policies in Portugal in the past has been the pro-cyclical behaviour of primary spending, which contributed to prevent the implementation of successful fiscal consolidations (see, for instance, Pina, 2004). Such pro-cyclical behaviour would again be present in 2001, with the budget deficit going once more above the 3 per cent limit.

4. Modelling strategy

We estimate the following Structural VAR (SVAR)

$$\underbrace{\Gamma(L)}_{n\times n}\underbrace{X_t}_{n\times 1} + \gamma_i d_{t-1} = \Gamma_0 X_t + \Gamma_1 X_{t-1} + ... + \gamma_i d_{t-1} = c + \varepsilon_t \qquad (1)$$

$$d_t = \frac{1+i_t}{(1+\pi_t)(1+\mu_t)} d_{t-1} + \frac{G_t - T_t}{P_t Y_t} \qquad (2)$$

$$v_t = \Gamma_0^{-1} \varepsilon_t \ , \qquad (3)$$

where $\varepsilon_t \mid X_s, s < t \sim \mathrm{N}(\underline{0}, \Lambda)$, *Γ(L)* is a matrix valued polynomial in positive powers of the lag operator *L*, *n* is the number of variables in the system, ε_t are the fundamental economic shocks that span the space of innovations to X_t, and v_t is the VAR innovation.

Equation (2) refers to the government's intertemporal budget constraint, and i_t, G_t, T_t, π_t, Y_t, P_t, μ_t and d_t represent, respectively, the interest rate (or the average cost of debt refinancing), government primary expenditures and government revenues, inflation, GDP, price level, real growth rate of GDP, and the debt-to-GDP ratio at the beginning of the period *t*.

9 In that year also occurred the effective introduction of VAT, and Portugal started receiving European funds.

10 Additionally, in 1992 and in 1993 privatisation revenues amounting respectively to 1.5 and 0.4 per cent of GDP were used for debt redemption. Coincidentally Portugal entered the ERM in April 1992, precisely the year were several currencies in the ERM system undergone speculative attacks, forcing both the Italian Lira and the British Pound out of the system after September 2002.

The specification follows Favero and Giavazzi (2007) in that we include the government debt dynamics, namely, by appending the non-linear budget identity to the VAR.[11] This assumption is important for a number of reasons: (i) a feedback from debt is expected when authorities have a Ricardian behaviour; (ii) the debt dynamics may influence interest rates; and (iii) government debt may have an impact on inflation and output (Barro, 1974; Kormendi, 1983; Canzoneri et al., 2001).[12]

We use a recursive identification scheme and characterize fiscal policy as follows:

$$G_t = f(\Omega_t) + \varepsilon_t^G \tag{4}$$

$$T_t = g(\Omega_t) + \varepsilon_t^T \tag{5}$$

where, G_t is the government spending, T_t is the government revenue, f and g are linear functions, Ω_t is the information set, and ε_t^G and ε_t^T are, respectively, the government spending shock and the government revenue shock. The shocks ε_t^G and ε_t^T are orthogonal to the elements in Ω_t.

We assume that the variables in X_t can be separated into 2 groups: (i) a subset of n_1 variables, X_{1t}, whose contemporaneous values appear in the policy function and do not respond contemporaneously to the fiscal policy shocks; and (ii) the policy variables in the form of government expenditure, G_t, and/or government revenue, T_t.

Therefore, the recursive assumptions can be summarized by $\boldsymbol{X_t} = [\boldsymbol{X}_{1t}, \boldsymbol{G_t}, \boldsymbol{T_t}]'$ and

$$\Gamma_0 = \begin{bmatrix} \underbrace{\gamma_{11}}_{n_1 \times n_1} & \underbrace{0}_{n_1 \times 2} & \underbrace{0}_{n_1 \times n_2} \\ \underbrace{\gamma_{21}}_{2 \times n_1} & \underbrace{\gamma_{22}}_{2 \times 2} & \underbrace{0}_{2 \times n_2} \\ \underbrace{\gamma_{31}}_{n_2 \times n_1} & \underbrace{\gamma_{32}}_{n_2 \times 2} & \underbrace{\gamma_{33}}_{n_2 \times n_2} \end{bmatrix}. \tag{6}$$

Finally, we assess the posterior uncertainty about the impulse-response functions by using a Monte Carlo Markov-Chain (MCMC) algorithm. Appendix A provides a detailed description of the computation of the error bands.

11 Chung and Leeper (2007) linearize the intertemporal budget constraint and impose it as a set of cross-equation restrictions on the estimated VAR coefficients.

12 Afonso (2008a) reports that it would be wise to reject the debt neutrality hypothesis for the EU and that higher government indebtedness can actually deter private consumption.

5. Empirical analysis

5.1 Data

This section provides a summary description of the data employed in the empirical analysis. A detailed description is provided in Appendix B. All variables are in natural logarithms unless stated otherwise and the data covers the period 1978:1-2007:4.

The variables in X_{1t} - the ones predetermined with respect to fiscal policy innovations - are GDP, private consumption, private investment, and GDP deflator. To these variables, we add the average cost of government debt financing (or the yield to maturity of long-term government bonds).[13] As measure of the fiscal policy instruments we use either the government expenditures (in which case, the government revenues are included in X_{1t}) or the government revenues (in which case, the government expenditures are included in X_{1t}). We include a constant (or quarterly seasonal dummies), and the government debt-to-GDP ratio in the set of exogenous variables.

Figure 2 plots the average debt cost servicing and the nominal (annualized) GDP growth. It shows that Portugal, in general, has moved from a situation where nominal GDP growth exceeded the cost of financing the debt to a situation where the converse has been true.

In addition, Figure 3 displays the observed debt-to-GDP ratio and the implicit debt-to-GDP ratio, that is, the one that emerges from the government debt's feedback. As can be seen, the implicit series for the debt-to-GDP ratio tracks pretty well the actual series.[14]

[Figure 2]

[Figure 3]

Finally, the quarterly series of government spending and revenues are computed using the monthly Central Government's cash data. Figure 4 provides a comparison of the annual values of such data with the annual national accounts data provided by the

13 The average government debt cost is obtained by dividing the net interest payments by the government debt at time t−1.

14 The small differences may be due to: (i) the consideration of the central government (instead of the general government) revenues and expenditures; (ii) the presence of seigniorage; (iii) the fact that GDP growth and inflation are computed as logarithmic differences; (iv) the stock-flow adjustments; and (v) the inclusion of seasonally adjusted measures.

European Commission (Ameco database). The patterns of both series are rather similar.[15]

[Figure 4]

5.2 Results

The starting point is the estimation of a B-SVAR model that does not include the feedback from government debt, that is, where equation (2) is not considered. Then, we compare the results with the ones that emerge from estimating specifications (1), (2), and (3).

Figure 5 shows the impulse-response functions to a fiscal policy shock. The solid line refers to the median response when the VAR is estimated without the government budget constraint, and the dashed lines are, respectively, the median response and the 68 percent posterior confidence intervals from the VAR estimated by imposing the government budget constraint. The confidence bands are constructed using a Monte Carlo Markov-Chain (MCMC) algorithm based on 1000 draws.

[Figure 5]

Figure 5a displays the impulse-response functions of all variables in X_t to a positive shock in government spending. In the case we do not include the debt feedback, it can be seen that government spending declines steadily following the shock, and the effect roughly vanishes after four quarters. The effects on GDP are negative and reveal that government spending has a strong "crowding-out" effect on the private sector. In fact, both private consumption and private investment fall after the shock. These results are in line with the works of Giavazzi and Pagano (1990) and Alesina and Ardagna (1998) who uncovered the presence of "non-Keynesian effects" (i.e., negative spending multipliers) during large fiscal consolidations.

In addition, there is a positive effect on the average cost of debt that reaches its peak after six quarters. The price level is also impacted persistently and positively by the shock in government spending. Finally, the results suggest that after a government spending shock, there is an increase in government revenue which is, however, small.

15 Pérez (2007) argues that intra-annual cash fiscal information can be used to improve the forecasting and monitoring of the annual General Government deficit in terms of ESA95. See also Onorante et al. (2008).

Therefore, this suggests that an expansion of government spending is associated with a episode of fiscal deterioration.

When we include the debt dynamics in the model, the effects of a government spending shock on the average cost of debt become somewhat larger while the impact on GDP is marginally smaller. Additionally, investment falls much more than before and the positive impact on the price level is attenuated by the feedback from government debt.

Figure 5b shows the impulse-response functions to a positive shock in government revenue. The results suggest that government revenue declines steadily following the shock which erodes after two quarters. The effects on GDP, private consumption and private investment are slightly positive over the four quarters following the shock, but they quickly mean revert and become negative.[16] In contrast, the price level falls for about four quarters, then recovers, and becomes positive. These results are closely related to the reaction of government spending, which increases after the shock. In fact, an increase in government revenue is followed by a somewhat less disciplined fiscal policy and, as a result, there is a deterioration of the fiscal balance. This also seems to be the reason for the positive impact on the average cost of debt.

Figure 6 shows the forecast-error variance decompositions to a fiscal policy shock when we include the feedback from government debt. The solid line corresponds to the median estimate, and the dashed lines indicate the 68 percent posterior confidence intervals estimated by using a MCMC algorithm based on 1000 draws.

[Figure 6]

Figure 6a plots the forecast error-variance decomposition of all variables in X_t to a shock in government spending. It shows that government spending shocks explain a large percentage (around 80%) of their own forecast-error variance decomposition. It also accounts for between 6% and 8% of the forecast-error variance decomposition of private consumption and the price level, and a small share of the remaining variables.

16 Giavazzi et al. (2000) find that an increase in taxes can raise private consumption in the case of fiscal consolidations if it moves the economy from an unsustainable fiscal path to a sustainable one. Romer and Romer (2007) also find that the effect of a U.S. tax shock on output depends on whether it is motivated by the government's desire to stabilize the debt, or is unrelated to the stance of fiscal policy.

Figure 6b summarizes the forecast error-variance decomposition of the variables in the system to a shock in government revenue. Similarly to the case of government spending, government revenue shocks account for a large fraction of their own forecast-error variance decomposition. On the other hand, government revenue shocks play a negligible role for all the remaining variables.

5.3 Fiscal shocks and government debt feedback

In this sub-section, we consider the potential debt feedback and estimate the following structural VAR:

$$\Gamma_0 X_t + \Gamma_1 X_{t-1} + ... + \gamma_i (d_{t-1} - d^*) = c + \varepsilon_t \text{,} \tag{7}$$

$$d_t = \frac{1+i_t}{(1+\pi_t)(1+\mu_t)} d_{t-1} + \frac{G_t - T_t}{P_t Y_t} \text{.} \tag{8}$$

Specification (7) is suggested by Bohn (1998) who estimates a fiscal reaction function in which d^* is the unconditional mean of the debt ratio. Therefore, we model the target level of the debt as a constant on the basis of the evidence of stationarity of d.

Table 1 reports the estimated coefficients on (d_{t-1} − d^*) in the structural equations of the SVAR (government spending and government revenue). We report the coefficients (and the standard errors in brackets) taken from the estimation for the full sample and for sub-samples. We consider two sub-samples: 1979:1 – 1993:3, corresponding to the period before the Maastricht Treaty entered into force; and 1993:4 – 2007:4, thereafter.

Table 1 – The effect of (d_{t-1}-d^*) in a VAR.

		T_t	G_t
	1979:1 - 2007:4	-0.001	0.000
	(N=116)	(0.001)	(0.002)
	1979:1 - 1993:3	-0.008***	-0.005*
(d_{t-1}-d*)	(N=59)	(0.002)	(0.003)
	1993:4 - 2007:4	0.006*	0.002
	(N=57)	(0.03)	(0.004)

Note: standard errors in brackets.
*, **, *** - statistically significant respectively at the 10%, 5%, and 1% levels.

In general, the results do not show a significant response of revenue and primary spending to deviations of the debt-to-GDP ratio from its sample average for the full sample. In the first sub-sample (1979:1 – 1993:3), there is some evidence suggesting a

weak stabilizing effect that works mainly through government spending: when the debt-to-GDP ratio is above its historical mean, government primary spending decreases (the coefficient associated to ($d_{t-1} - d^*$) is negative (-0.005). In the second sub-sample (1993:4 – 2007:4), the empirical findings show that government revenue plays some stabilizing effect: when the debt-to-GDP ratio is above its historical mean, government revenue increases as the coefficient associated to ($d_{t-1} - d^*$) is positive (0.006).

5.4 A VAR counter-factual exercise

We now conduct a VAR counter-factual exercise aimed at describing the effects of shutting down the shocks in government spending or government revenue. In practice, after estimating the VAR summarized by (1), (2) and (3), we construct the counter-factual (*CFT*) series as follows:

$$\underbrace{\Gamma(L)}_{n\times n}\underbrace{X_t^{CFT}}_{n\times 1} + \gamma_i d_{t-1} = \Gamma_0 X_t^{CFT} + \Gamma_1 X_{t-1}^{CFT} + ... + \gamma_i d_{t-1} = c + \varepsilon_t^{CFT} \quad (9)$$

$$d_t = \frac{1+i_t}{(1+\pi_t)(1+\mu_t)} d_{t-1} + \frac{G_t - T_t}{P_t Y_t} \quad (10)$$

$$v_t^{CFT} = \Gamma_0^{-1} \varepsilon_t^{CFT} \quad . \quad (11)$$

This is equivalent to consider the following vector of structural shocks

$$\varepsilon_t^{CFT} = \left[0, \varepsilon_t^T, \varepsilon_t^Y, \varepsilon_t^P, \varepsilon_t^i, \varepsilon_t^I, \varepsilon_t^C\right]' \quad (12)$$

$$\varepsilon_t^{CFT} = \left[\varepsilon_t^G, 0, \varepsilon_t^Y, \varepsilon_t^P, \varepsilon_t^i, \varepsilon_t^I, \varepsilon_t^C\right]' \quad (13),$$

where we shut down, respectively in (12) and in (13), the government spending and the government revenue unexpected variation and then use the counter-factual structural shocks to build the counter-factual series for all endogenous variables of the system.

Figure 7a plots the actual and the counter-factual series for GDP, private consumption, private investment, and government spending in the case of a shock to government spending. Figure 7b displays the actual and the counter-factual series for GDP, private consumption, private investment, and government revenue in the case of a shock to government revenue.

[Figure 7]

The results show that fiscal policy shocks play a minor role as the difference between the actual and the counterfactual series are relatively small. Nevertheless, one

can see that in the absence of government spending shocks, private consumption and private investment would have been higher, for instance, in the period 1983-1988 and, more recently, since 2003. Therefore, such evidence suggests and confirms that unexpected increases in government spending generate relevant "crowding-out" effects.

In the case of government revenue, the difference between the actual and the counterfactual series are negligible, a feature that may be related with the relative size of the government revenue shocks. In fact, while unexpected variation in government spending seems to be large – as one can see by looking at the larger differences between the actual government spending and the counter-factual government spending -, government revenue shocks are generally small.

6. Conclusion

This paper evaluates the macroeconomic effects of fiscal policy in Portugal for the period 1979:1-2007:4, drawing on a new set of quarterly data built from the monthly Central Government's cash data.

We identify fiscal policy shocks using a recursive partial scheme, and estimate a Bayesian Structural Vector Autoregression, therefore, accounting for the posterior uncertainty of the impulse-response functions.

The empirical evidence suggests that government spending shocks: (i) have, in general, a negative effect on GDP; (ii) lead to a fall of both private consumption and private investment; and (iv) impact persistently and positively on the price level and the average cost of refinancing the debt. In addition, government revenue shocks: (i) have a negative impact on GDP, on private consumption and on private investment, although the response emerges with a lag of about four quarters; and (ii) lead to a fall in the price level.

These results suggest that an expansion of government spending is associated to an episode of fiscal deterioration. Similarly, an increase in government revenue is followed by a somewhat less disciplined fiscal policy.

When we explicitly consider the feedback from government debt, (long-term) interest rates and GDP become more responsive and the effects of fiscal policy on these variables also become more persistent. In addition, the results provide weak evidence of stabilizing effects of the debt level on the primary budget balance.

Finally, a VAR counter-factual exercise shows that unexpected spending shocks are responsible for important "crowding-out" effect.

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Appendix A. Confidence bands of the impulse-response functions

Under the normalization of $\Lambda = \boldsymbol{I}$, the impulse-response function to a one standard-deviation shock is given by:

$$B(L)^{-1}\Gamma_0^{-1}. \qquad \text{(A.1)}$$

We assess uncertainty regarding the impulse-response functions by following Sims and Zha (1999). Therefore, we construct confidence bands by drawing from the Normal-Inverse-Wishart posterior distribution of *B(L)* and *Σ*

$$\beta|_{\Sigma} \sim \mathrm{N}(\hat{\beta}, \Sigma \otimes (X'X)^{-1}) \qquad \text{(A.2)}$$

$$\Sigma^{-1} \sim \mathrm{Wishart}((T\hat{\Sigma})^{-1}, T-m) \qquad \text{(A.3)}$$

where β is the vector of regression coefficients in the VAR system, Σ is the covariance matrix of the residuals, the variables with a hat denote the corresponding maximum-likelihood estimates, X is the matrix of regressors, T is the sample size and m is the number of estimated parameters per equation (see Zellner, 1971; Schervish, 1995; and Bauwens et al., 1999).

Appendix B. Data description and sources

GDP
Data for GDP are quarterly, seasonally adjusted, and comprise the period 1978:1-2007:4. The source is the Bank of Portugal.

Private Consumption
The source is the Bank of Portugal. Consumption is defined as the household consumption expenditure including non-profitable institutions serving households. Data are quarterly, seasonally adjusted, and comprise the period 1978:1-2007:4.

Price Deflator
All variables were deflated by the GDP deflator (2000=100). Data are quarterly, seasonally adjusted, and comprise the period 1978:1-2007:4. The source is the Bank of Portugal.

Private Investment
The source is the Bank of Portugal. Private Investment is defined as total gross fixed capital formation. Data are quarterly, seasonally adjusted, and comprise the period 1978:1-2007:4.

Government Spending
The source is the Bank of Portugal, collected from the Monthly Bulletin of the Directorate-General of Public Accounting. Government Spending is defined as Central Government primary spending (on a cash basis), that is, the difference between

authorized expenditure and debt interest payments. We seasonally adjust quarterly data using Census X12 ARIMA, and the series comprise the period 1978:1-2007:4.

Interest Payments
The source is the Bank of Portugal, collected from the Monthly Bulletin of the Directorate-General of Public Accounting. Interest Payments is defined as Central Government debt interest payments (on a cash basis). We seasonally adjust quarterly data using Census X12 ARIMA, and the series comprise the period 1978:1-2007:4.

Government Revenue
The source is the Bank of Portugal, collected from the Monthly Bulletin of the Directorate-General of Public Accounting. Government Revenue is defined as Central Government total revenue (on a cash basis). We seasonally adjust quarterly data using Census X12 ARIMA, and the series comprise the period 1978:1-2007:4.

Government Debt
The source is the Bank of Portugal, the Directorate-General of Treasury, and the Directorate-General of Public Credit. Government Debt is defined as the stock of Direct State Debt.
The original series are available as follows:

1.
   a) Total Internal Debt, for the period 1997:12-1994:6, on a quarterly basis;
   b) Internal Direct Debt, for the period 1997:12-1994:6, on a quarterly basis;
   c) Total External Debt, for the period 1997:12-1994:6, on a quarterly basis;
   d) Direct External Debt, for the period 1997:12-1994:6, on a quarterly basis;
   e) Total Public Debt, for the period 1997:12-1994:6, on a quarterly basis;
   f) Effective Public Debt, for the period 1997:12-1994:6, on a quarterly basis;

2.
   a) Internal Effective Direct Debt, for the periods 1991:12, 1992:12, and 1993:6-1995:11, on a monthly basis;
   b) Total Effective Direct Debt, for the periods 1991:12, 1992:12, and 1993:6-1995:11, on a monthly basis

3.
   a) Internal Direct Debt, for the period 1995:7-1998:12, on a monthly basis;
   b) Total Direct Debt, for the period 1995:7-1998:12, on a monthly basis

4.
   a) Direct State Debt, for the period 1998:12-2007:4, on a monthly basis.

We build the series for the Direct State Debt as follows:

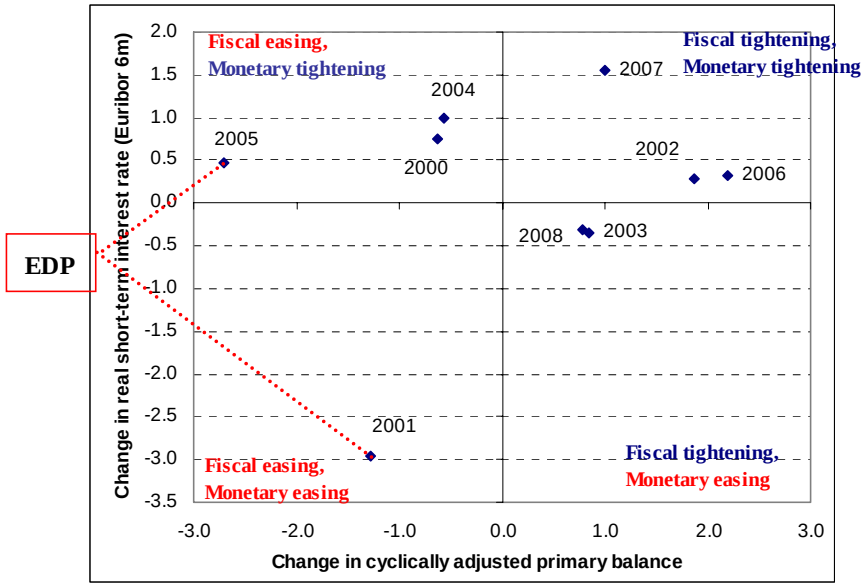
1) For the period 1998:12-2008:4, as the series of Direct State Debt itself;
2) For the period 1995:7-1997:12, we use the ratio of Direct State Debt to Total State Debt in 1998:12 (that is, a scale factor of 0.994679113), to back-out the series of Direct State Debt;
3) For the period 1993:6-1995:6, we use the ratio of Total Effective Direct State Debt to Total Direct State Debt in the period 1995:7-1995:11 (that is, a scale factor of 1.002277388), to back-out the series of Total Direct Debt;
4) For the period 1977:12-1993:3, we use the ratio of (Effective Public Debt minus Non-Direct Debt) to Total Effective Direct Debt in the period 1993:6-1994:6 (that is, a scale factor of 1.03997385), to back-out the series of Total Effective Direct Debt.

Given that the scale factors are very close to one, the time series of the Direct State Debt is smooth over time and we guarantee that there are not structural breaks.
We build the quarterly series using monthly data (where available) and seasonally adjust it using Census X12 ARIMA. The constructed series comprise the period 1977:4-2007:4.

Average Cost of Financing Debt
The average cost of financing debt is obtained by dividing interest payments by debt at time *t-1*.

Long-Term Interest Rate
Long-Term Interest Rate corresponds to the yield to maturity of 10-year government securities. Data are quarterly, and comprise the period 1957:1-2007:4. Data for the period 1974:2-1975:4 is not available. Therefore, we linearly interpolate the data for that period using the observations at 1974:1 and 1976:1. The source is the IMF, International Financial Statistics (series " IFS.Q.182.6.61.$$$.Z.F.$$$").

Figure 1 – Monetary conditions and fiscal balances in Portugal (2000-2008).



Source: EC, Eurostat, Banco de Portugal, and own calculations.
Notes: HICP, September 2008, Euribor, October 2008, and EC Autumn 2008 forecasts for CAPB in 2008. EDP – Excessive Deficit Procedure.

Figure 2 - Average cost of servicing debt and (annualized) nominal GDP growth.

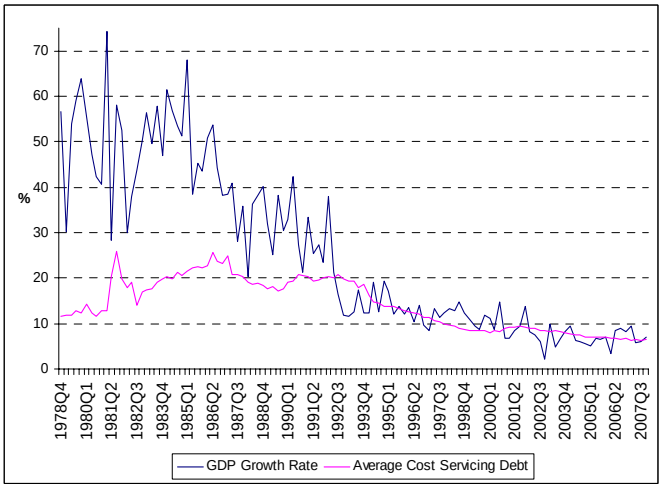
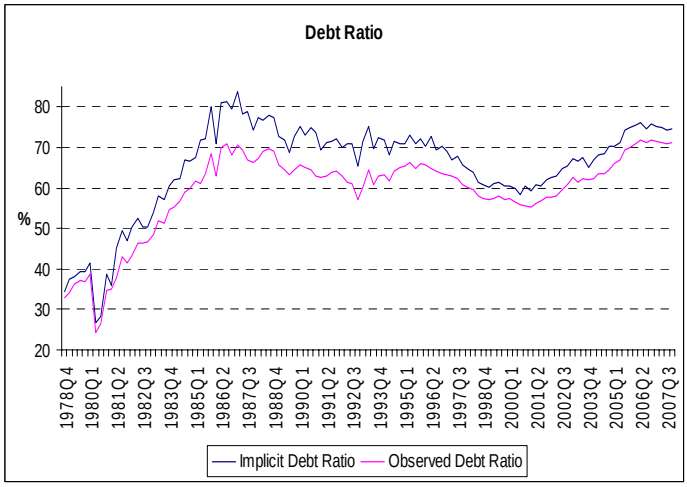


Figure 3 - Implicit debt ratio and observed debt ratio, percentage of GDP.



Note: Implicit debt ratio computed via equation (14).

Figure 4 – Quarterly *versus* annual fiscal data.

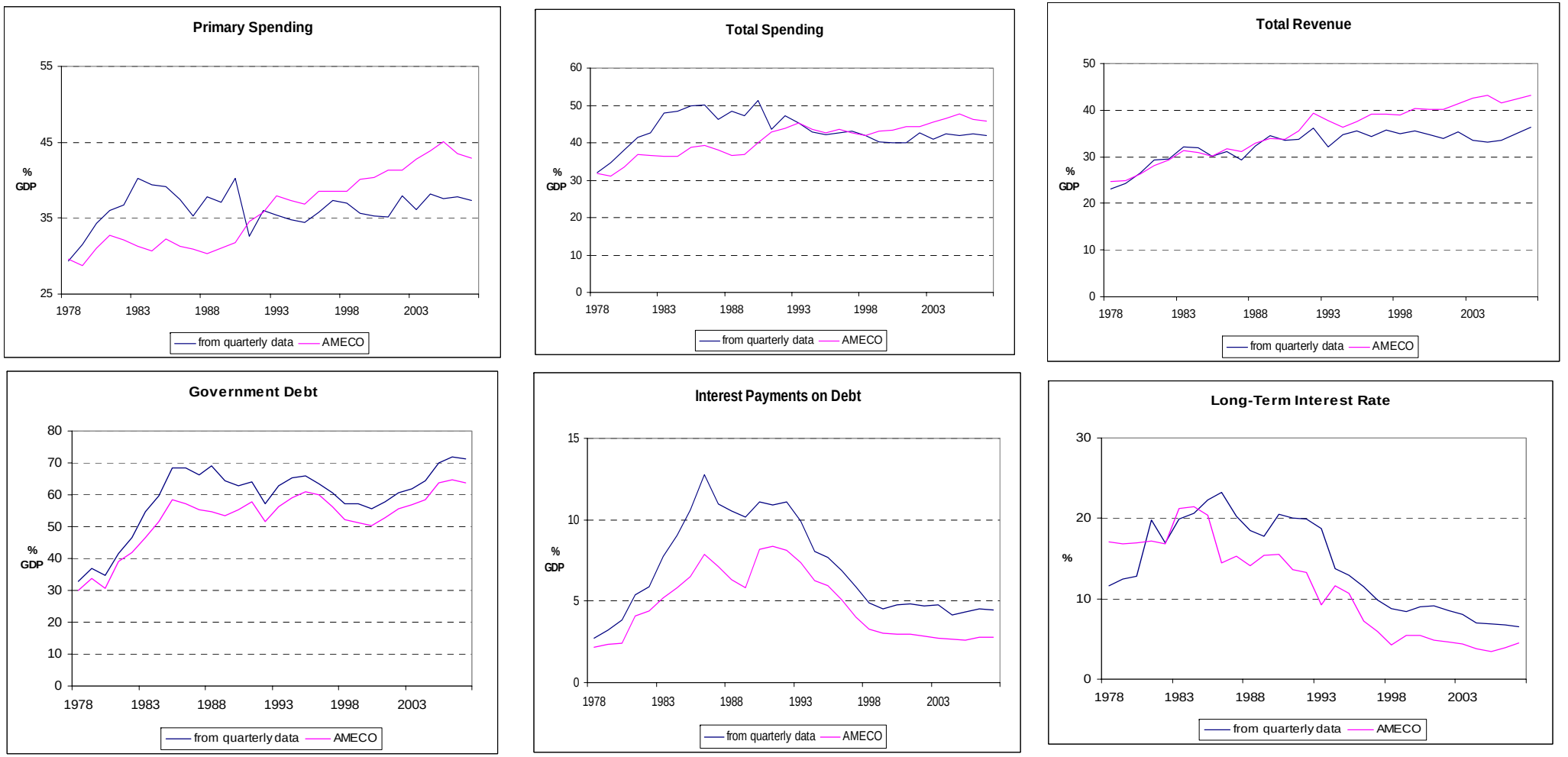
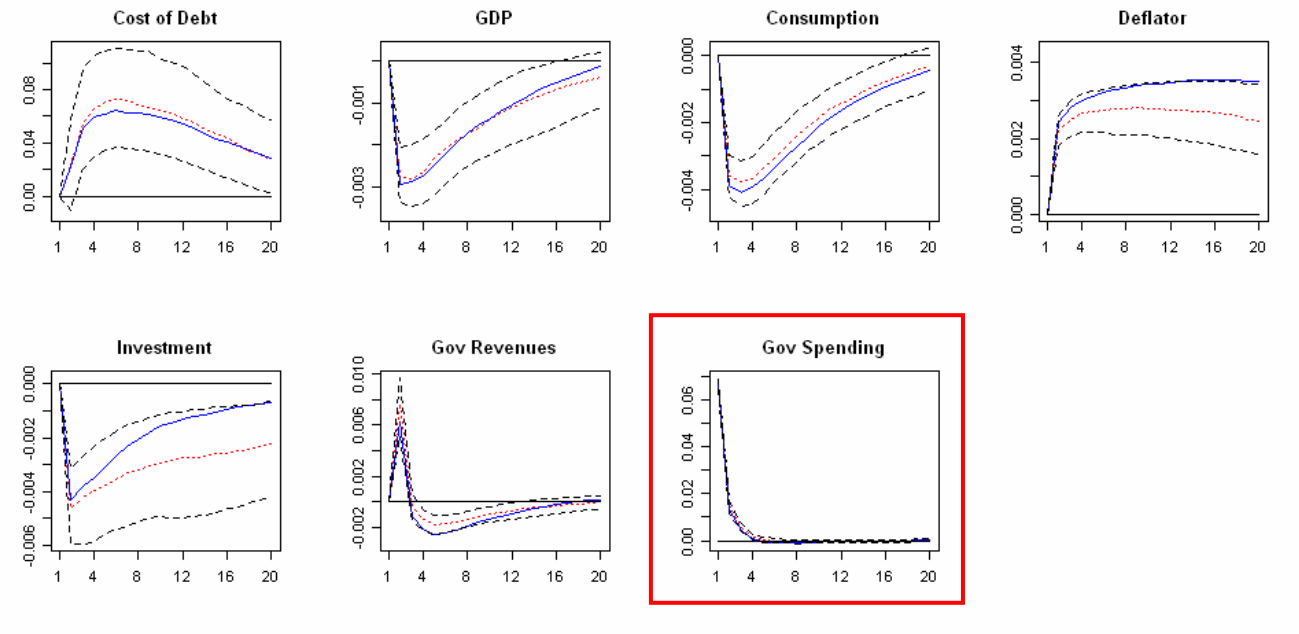


Figure 5 – Impulse-response functions.

5a – spending shock



5b – revenue shock

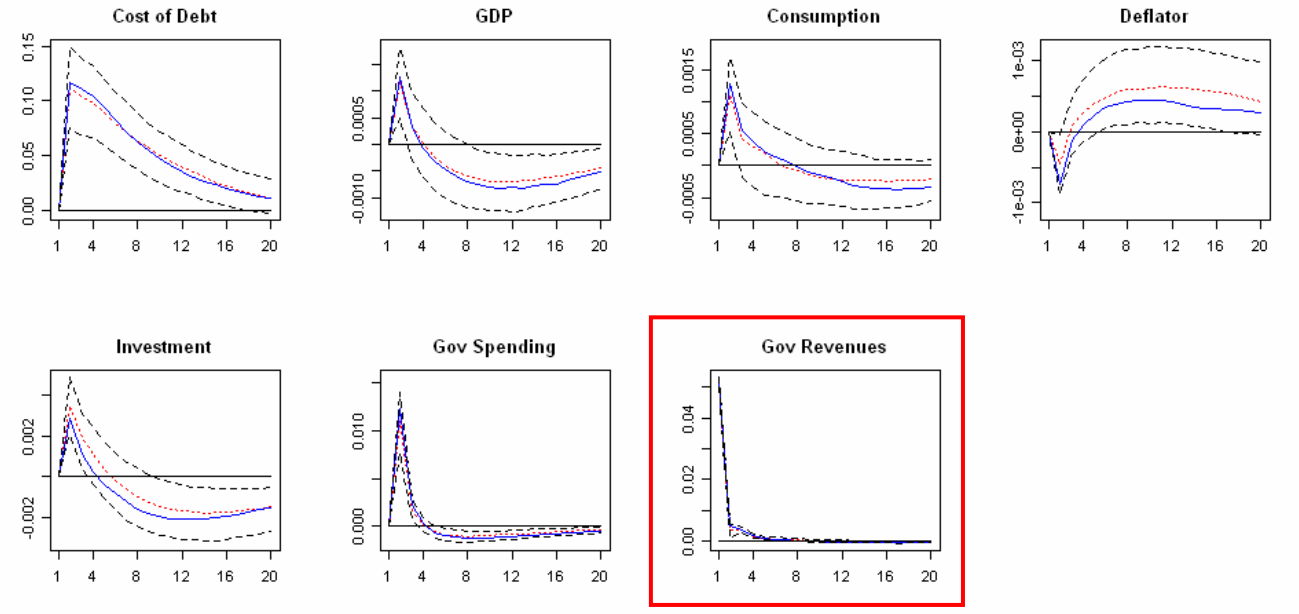
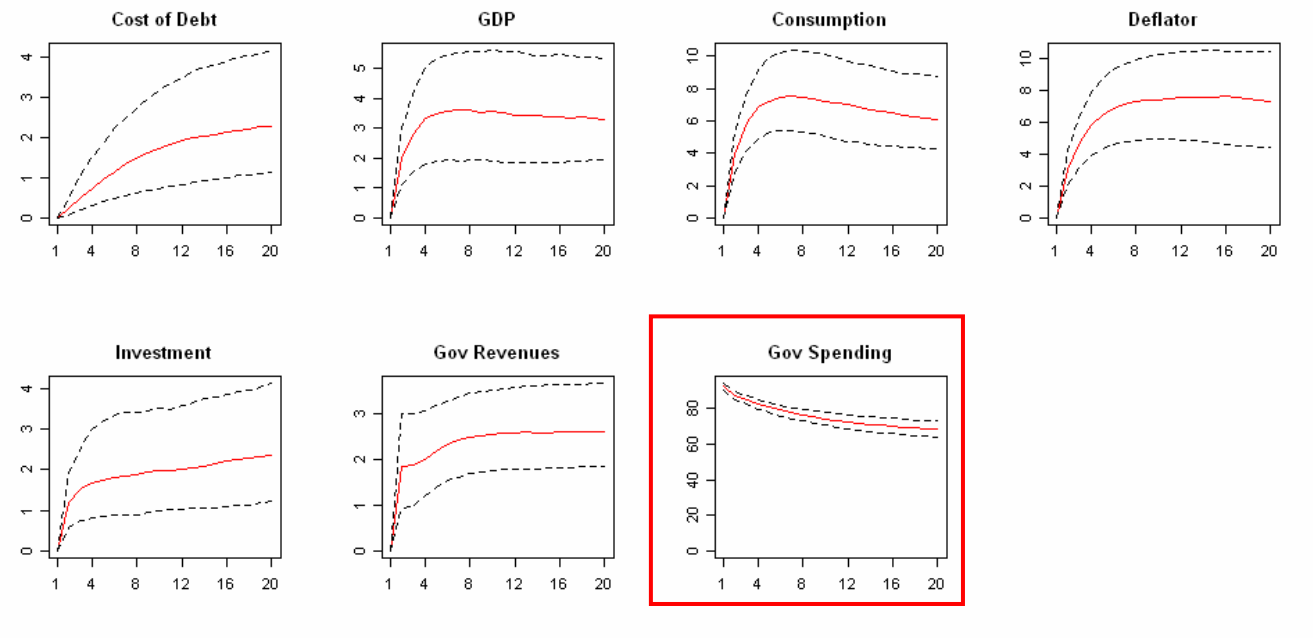


Figure 6 – Forecast-error variance decomposition.
6a – spending shock



6b – revenue shock

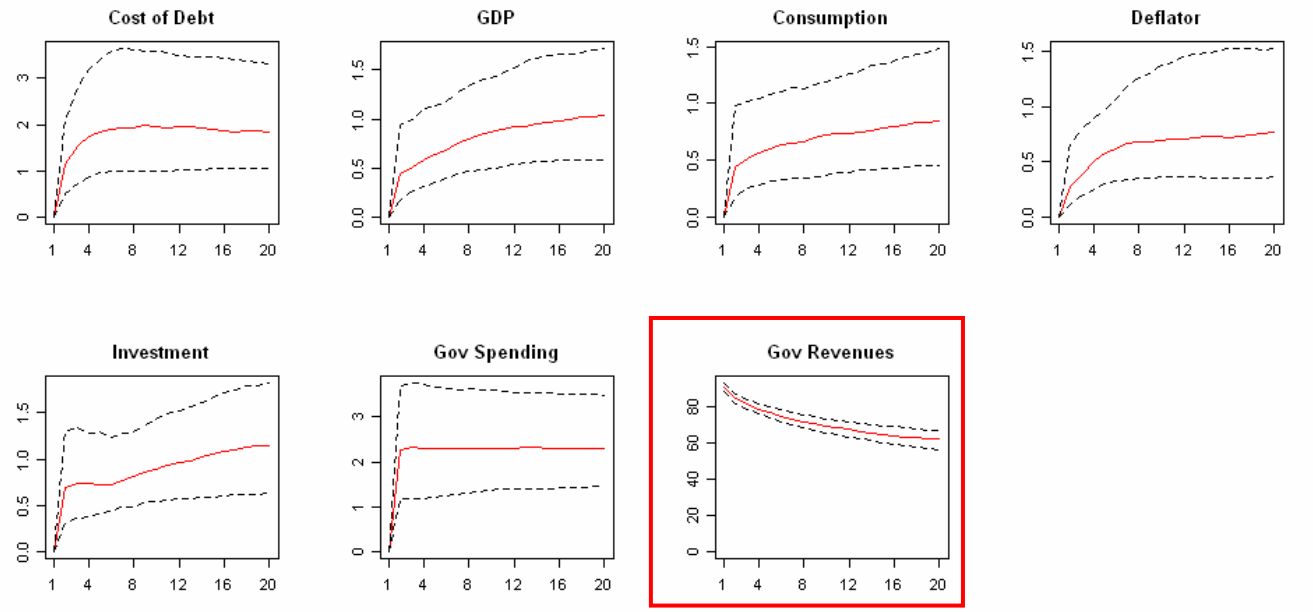
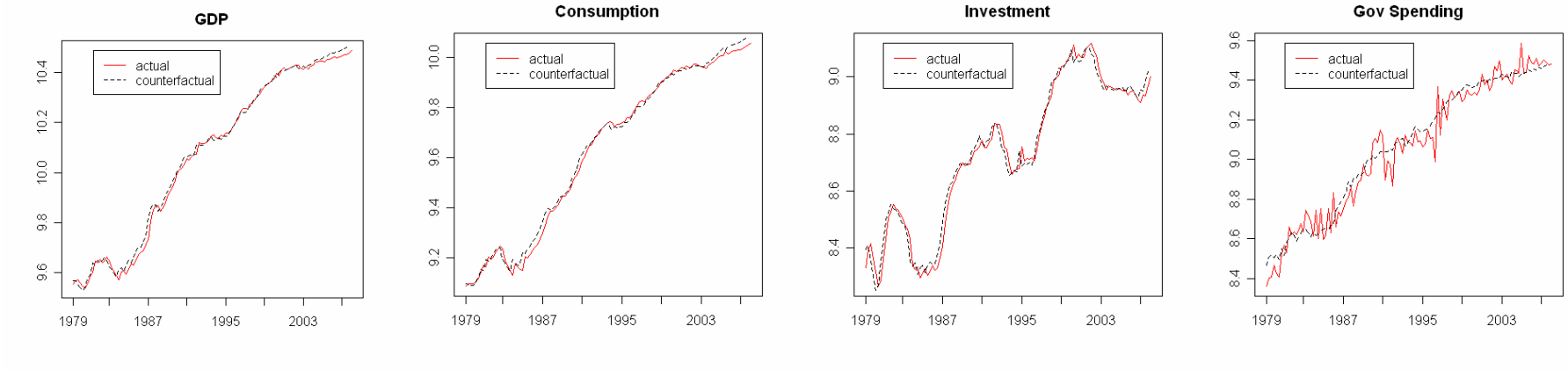


Figure 7 – VAR counterfactual.

7a – spending shock



7a – spending shock