BANCA D'ITALIA

Temi di discussione

del Servizio Studi

Assessing the effects of monetary and fiscal policy

by Stefano Neri

Number 425 - November 2001

ASSESSING THE EFFECTS OF MONETARY AND FISCAL POLICY

by Stefano Neri*

Abstract

This paper has two objectives: the first is to jointly analyse monetary and fiscal policy with a structural VAR model, evaluate the dynamic impact of policy shocks on U.S. output and prices and the contributions of these two sources to fluctuations in these variables. The second objective is to investigate if and how the effects of monetary policy are altered by the inclusion of fiscal policy variables in a benchmark monetary VAR. It is found that both monetary policy and fiscal policy have small effects on output and the price level and that neither of these shocks are important sources of fluctuations in either variable. The magnitude of the responses of output and prices to a monetary policy shock and the contribution of these shocks are reduced significantly once fiscal policy is introduced.

JEL classification: C32, E52, E63, H3.

Keywords: fiscal policy, monetary policy, impulse responses, omitted variables.

Contents

* Bank of Italy, Economic Research Department.

1. Introduction[1]

Analysing one policy at a time is like dancing a tango solo: it is a lot easier, but it is incomplete and ultimately unfulfilling. [2]

To date the empirical literature on structural VARs has focused almost exclusively on the analysis of the macroeconomic effects of monetary policy. Different aspects of the monetary policy transmission mechanism have been studied in the last twenty years both in the U.S. (Gordon and Leeper [1994], Christiano, Eichenbaum and Evans [1998], Galí [1992] and Bernanke and Blinder [1992] are some examples) and in the G-7 (Sims [1992], who does not however analyse all these countries, Canova and De Nicoló [2000] and Kim [1999]). Structural VARs have become popular for several reasons. They have the advantage of imposing a minimal set of economic restrictions and they also make it possible to simulate the dynamic responses to policy shocks and to evaluate the relative importance of the different shocks to the economy.

Only recently in the literature on structural VARs, some attention has been devoted to the analysis of fiscal policy. The main reason for this interest is the re-examination of fiscal policy as an effective tool for the stabilisation of business cycle fluctuations in European countries. The creation of the European Monetary Union with a single central bank has left participating countries with fiscal policy as the only tool for stabilisation. Thus any attempt to influence the economy has to rely on taxation and public expenditure, within the limits imposed by the Stability Pact. Another important reason for reconsidering the study of fiscal policy is the debate on balanced budget rules and the federal surplus in the U.S. This has reawakened an interest on the part of economists and policy-makers in the macroeconomic effects of fiscal policy. Empirical analysis of the effects of fiscal policy has generally been carried out with large-scale econometric models or with reduced-form models that looked at specific exogenous fiscal policy events, such as the 1975:2 tax rebate, in the U.S.[3] Other works such as Alesina and Perotti [1995] or Giavazzi and Pagano [1990] have focused on the macroeconomic effects of fiscal consolidation.

In the last two years a number of papers have used structural VARs to examine fiscal policy. Blanchard and Perotti [1999] look separately at the effects of shocks to government spending and taxes on output using U.S. data for the post-war period. The authors also analyse specific fiscal episodes, such as the 1975:2 tax rebate, using an event-study analysis. Edelberg, Eichenbaum and Fisher [1998] and Burnside, Eichenbaum and Fisher [1999] focus only on the effects of military spending. These two papers rely on Ramey-Shapiro [1998] fiscal dummies.

[1] I would like to thank Fabio Canova for his supervision and all the participants at the student seminar at Pompeu Fabra University and the Bank of Italy and two anonymous referees. I gratefully acknowledge financial support from the CESIFIN foundation (Centro per lo studio delle istituzioni finanziarie) of the Cassa di Risparmio of Florence for the period in which I was at Pompeu Fabra University. I am also grateful to Ilian Mihov for providing me with the data on fiscal variables. All remaining errors are mine. The opinions expressed in this paper do not reflect those of the Bank of Italy. E-mail: neri.stefano@insedia.interbusiness.it

[2] Leeper [1993]

[3] For an example, see Blinder [1981].

A dummy is created to capture the beginning of three military build-ups (the Korean war, the Vietnam War and the Carter-Reagan increase in military spending). A VAR is set up in order to trace the effects of these three fiscal episodes on the main macroeconomic variables and then theoretical models are developed to account for the main empirical findings. Fatás and Mihov [1998] follow a different methodology in constructing a measure of discretionary fiscal policy. They define a four-variable VAR using the ratio of primary deficit to GDP as the measure of fiscal policy. Structural fiscal shocks represent the discretionary component of fiscal policy.

One shortcoming of this measure is that it does not allow changes in taxation and expenditure to have different effects on the economy since the two components cannot be disentangled. Fatás and Mihov [1999] analyse the effects of different components of government spending on a set of macroeconomic variables. Their paper also develops a theoretical business cycle model that tries to match the empirical findings.

Blanchard and Watson [1986] have jointly analysed the effects of fiscal and monetary policy with a structural VAR. The authors build an index (derived from Blanchard [1985]) to measure the effects of fiscal policy and use M1 as indicator of monetary policy. However the VAR does not include any interest rate and for this reason the specification of monetary policy is not correct since it is widely recognised that the federal funds rate is the best measure of the stance of monetary policy in the U.S. According to Bernanke and Mihov [1998], the federal funds rate has performed well as an indicator of monetary policy since the mid-1960s with the sole exception of the Volcker period. The federal funds market dates back to the early 1950s. However, only after the end of 1964 did this market begin to perform as it does nowadays. The federal funds rate was never above the discount rate until October 1964 and was never considered a useful indicator of the monetary policy stance (Strongin [1995]). Blanchard and Watson [1986] provide evidence that aggregate demand, aggregate supply, fiscal and monetary shocks are important in explaining fluctuations in output and prices.

The objective of this paper is twofold. First we are interested in jointly analysing fiscal and monetary policy and measuring their importance as sources of output and price fluctuations. Second, we are interested in assessing whether standard conclusions about the effects of monetary policy are modified by the introduction of fiscal policy variables in VARs. The approach taken differs from the existing literature in several aspects. First, contrary to Blanchard and Watson [1986], it uses the federal funds rate and total reserves in order to specify and identify monetary policy disturbances as it is done in Gordon and Leeper [1994]. Second, contrary to Gordon and Leeper [1994] we use quarterly U.S. data and only a commodity price index to capture future movements in the price level. A model that includes the term structure of interest rates (the ten-year minus the three-month interest rate) to capture inflation expectations has also been tried without gaining anything in terms of results and dynamic simulations. Third, with respect to the choice of the fiscal policy indicator, we will start by following Fatás and Mihov [1998] and focus our attention on the ratio of the primary surplus to GDP and then move on to a specification of fiscal policy which explicitly uses revenue minus transfers and government expenditure[4], as in Blanchard and Perotti [1999].

Two conclusions can be drawn from the analysis. First, the responses of output and prices to fiscal policy shocks (measured either by an exogenous increase in revenue minus transfers or an increase in the primary surplus to GDP ratio) and monetary policy shocks are similar in pattern and are both statistically significant. The effects of monetary and fiscal policy (in particular when revenue minus transfers and government expenditure are considered) on real GDP and the GDP deflator are small. The contribution of fiscal and monetary policy shocks to fluctuations in output and prices is small, suggesting that none of these shocks is a driving source of fluctuations. Second, the omission of fiscal variables from a VAR that only analyses monetary policy affects the magnitude of the responses to monetary policy shocks. A statistical test of the differences in the mean of the responses shows that monetary policy has a smaller impact on real GDP once we control for fiscal policy. This result suggests that at least in the past fiscal and monetary policy were correlated.

The organization of the paper is the following. Section 2 briefly analyses fiscal and monetary policy in the U.S. Section 3 considers a small monetary VAR that is used as a benchmark. Section 4 introduces the ratio of primary deficit to real GDP as the indicator of fiscal policy. In Section 5 the primary deficit is disaggregated into revenue minus transfers and government expenditure. In Section 6 the significance of the differences in the responses of output and prices to a monetary shock and the contributions of these shocks to fluctuations is tested. Section 7 presents the final conclusions.

2. A brief history of monetary and fiscal policy in the U.S.

The information provided here on monetary policy can be found in more detail in Walsh [1998] and Strongin [1995]. The information on fiscal policy, the information comes from Poterba [1988, 1996] and Edelberg, Eichenbaum and Fisher [1998] and Blanchard and Perotti [1999]. The federal funds market began to function as the main source of liquidity for banks in the mid-1960s. Between 1972 and 1979 the Federal Reserve adopted a federal funds rate operating procedure under which it allowed nonborrowed reserves to stabilise the interest rate within a narrow band around the target rate. Shocks to the demand for total reserves were offset by open market operations and intended to keep the federal funds rate constant. In the period 1979-1982 there was a shift to a nonborrowed reserves operating procedure in order to reduce the inflation rate. This corresponds to the Volcker era which ran from 1979:10 to 1982:10. The shift to nonborrowed targeting was motivated by the need to exert greater control on monetary aggregates growth rates. Under this operating procedure, in response to an increase in expected inflation, the Fed would allow interest rates to rise, reducing money growth. The Volcker period represents the most important shift in the Federal Reserve's operating procedures given that all the other regimes can be seen as variants of federal funds rate or borrowed reserves targeting. Using a two-states Markov switching regime model, Bernanke and Mihov [1998] identify a structural change in Federal Reserve operating procedures in the Volcker period. Since 1982 the Fed has followed a borrowed reserves operating procedure whereby nonborrowed reserves are

[4] For details on the construction of fiscal variables see Appendix I.

adjusted in order to insulate borrowed reserves from non-policy shocks. Nowadays monetary policy is conducted by the Federal Open Market Committee (FOMC), which periodically fixes a target for the federal funds rate.

With respect to fiscal policy, two points deserve some attention. First, major fiscal shocks occurred in the 1950s and 1960s (for example, the Korean military build-up, two large tax increases in 1950:2 and 1950:3, the 1964 Kennedy-Johnson tax cut and the Vietnam war) and in the 1980s (Reagan's tax cuts in 1981 and 1986 and the increase in military spending). Second, the fiscal policies of the 1980s, especially during the Reagan administration, resulted in increased budget deficits and growing public debt. This in turn led to the approval of the Gramm-Rudman-Holling bill (1985) which had two objectives: first to accelerate budget discussions and to place deadlines earlier in the calendar year and, second, to introduce deficit targets together with a mechanism for ensuring that actual deficits did not exceed them. The Supreme Court ruled the law unconstitutional. Analysts predicted that this legislation would not help to control budget deficits since the President and Congress could always agree to modify the targets. The failure to achieve deficit targets led to the approval of the 1990 Budget Enforcement Act (BEA) which introduced annual caps on discretionary spending and required any proposal to increase spending on one program to be offset by cuts in other programs. The BEA was in force from 1990 to 1998 (including the extension of the Omnibus Budget Reconciliation Act of 1993). The main difference between the BEA and the Gramm-Rudman-Holling is that the former reformed the budget process while the latter was only a declaration of deficit targets. Under the BEA, policies could be expected not to increase deficits in any of the following five years (a period known as "the BEA window").

The most important fiscal event as far as magnitudes are concerned was the 1975:2 tax rebate (which included an increase in transfer payments). This involved a 10 per cent tax rebate of 1974 income taxes up to a maximum of 200 dollars and was designed to stimulate aggregate demand after the first oil shock. The intervention transferred 8.1 billion dollars from the Treasury to households between late April and mid-June. Measured in 1987 prices it represented an increase in disposable income of more than 100 billion dollars.[5] This tax rebate is examined in Blanchard and Perotti [1999] (and in Poterba [1988]) in an event study analysis where a dummy variable is defined for this event and the effects of the dummy on output are evaluated. Their work assumes that the event is exogenous. However, the tax rebate in question was designed to stimulate aggregate demand in response to the recession caused by the first oil shock and therefore does not exactly qualify as an exogenous fiscal policy shock.

[5]These figures come from Poterba [1988], who shows that the fiscal experiments of 1970s and 80s have a detectable effect on consumption, while the news effect is very slight. Either consumers are shortsighted or they face considerable liquidity constraints. The finding that the news effect of a fiscal intervention is small can be helpful in justifying the use of VARs in analysing of fiscal policy.

3. The benchmark VAR model: monetary policy

To evaluate if and how the above conclusions on the effects of monetary policy are modified by introducing fiscal variables, we set up a simple benchmark VAR (from now on we will refer to this model as M-VAR) making it possible to investigate the effects of monetary policy. Fiscal variables will be introduced later on to measure any possible change with respect to benchmark impulse responses and variance decompositions of output and prices. At the same time, the effects of fiscal policy on output and prices will be evaluated. Moreover, the ability of the models to capture the main fiscal and monetary policy events of the U.S. history will be assessed.

The benchmark model is based on Gordon and Leeper [1994]. In this model a demand for and a supply of total reserves are specified where the demand comes from commercial banks who need to satisfy reserve requirements and to hold excess reserves and the supply is assumed to be controlled by the Federal Reserve. The federal funds rate is the corresponding measure of monetary policy. Explicit modelling of the reserves market allows us to disentangle monetary policy shocks (i.e. shocks to the supply of total reserves) from reserve demand shocks. The use of total reserves as monetary aggregate implicitly assumes that demanders of reserves perceive borrowed and nonborrowed reserves as perfect substitutes. The variables in the model are divided into two vectors: the non-policy one, Y_t, that includes the log of a commodity price index, the log of real GDP and the log of the implicit GDP deflator, and the policy vector P_t comprising, initially, the federal funds rate (expressed on an annual basis) and the log of total reserves. Following Bernanke and Mihov [1998], we will specify the model by means of the following dynamic equations:

$$Y_t = \sum_{i=0}^{k} B_i Y_{t-i} + \sum_{i=0}^{k} C_i P_{t-i} + v_t^y \tag{1}$$

$$P_t = \sum_{i=0}^{k} D_i Y_{t-i} + \sum_{i=0}^{k} E_i P_{t-i} + v_t^p \tag{2}$$

The vector Y_t contains the macroeconomic variables which we are interested in studying. In order to identify the structural VAR we will assume that the vector of non-policy variables cannot respond simultaneously to monetary policy shocks.[6] In the literature on VARs, this assumption is commonly made although it could be argued that it is more applicable to monthly data than to quarterly data. We will define a monetary policy rule that specifies the supply of total reserves as a function of all the variables in the VAR. This is an information based assumption given that the Federal Reserve observes the commodity index, real GDP, the GDP deflator and the federal funds rate and reacts to changes in these variables by modifying the

[6] This assumption is made in Christiano, Eichenbaum and Evans [1996] and in many other works, both with monthly and quarterly data.

supply of total reserves. The commodity price index is introduced in order to eliminate the so-called ”price puzzle” i.e. the finding that after a contractionary monetary policy shock the price level initially increases (Sims [1992]). The commodity index is intended to capture the information the Federal Reserve has on future developments of the price level. In the reserves demand equation, total reserves are assumed to depend on the level of economic activity, on the price level and on the federal funds rate. The identification matrix of the M-VAR and the others that include fiscal policy variables are reported in Appendix II.

An important point in estimating structural VARs, as in all systems of equations, is the question of normalising coefficients whereby a value of 1 is given to the dependent variable in each equation of the system. Waggoner and Zha [1997] showed that normalisation can significatively affect the shape of the likelihood function and consequently the estimated coefficients, the shape of impulse responses and their probability distribution. They propose a solution to avoid distorting the shape of the likelihood function but we will not be applying it here. Instead, we will proceed in two steps. First we estimate the model leaving the main diagonal elements free, then we reestimate the model normalising these coefficients to 1. By comparing the resulting estimates we can evaluate whether the shape of the likelihood function is distorted. The reduced form of the VAR is given by:

$$X_t = \sum_{i=1}^{k} A_i X_{t-i} + U_t \tag{3}$$

and the structural form, obtained by premultiplying equation (3) by A_0, by

$$A_0 X_t = A_0 \sum_{i=1}^{k} A_i X_{t-i} + A_0 U_t \tag{4}$$

where A_0 is a square matrix containing the coefficients that simultaneously link the variables of the model, that is

$$A_0 = \begin{vmatrix} B_0 & C_0 \\ D_0 & E_0 \end{vmatrix}$$

and

$$U_t = A_0^{-1} V_t \tag{5}$$

is the system of equations linking structural shocks to reduced-form disturbances. Since the covariance matrix of the reduced-form VAR, Σ has $n(n+1)/2$ different moments, a maximum number of 15 coefficients of the A_0 matrix can be estimated in the M-VAR. In this case the elements of the main diagonal are not normalised to 1, and the covariance matrix of the structural shocks is assumed to be the identity matrix. The crucial element of the VAR is the identification matrix A_0. Different identifying assumptions would imply a different specification of this matrix and potentially different impulse responses and variance decompositions.

The reduced form VAR[7] is estimated consistently in levels with OLS. Then the concentrated log-likelihood is maximized (Full Information Maximum Likelihood) with respect to the free

[7]Data are quarterly and the sample period goes from 1965:1 to 1996:4. The selection of the lag number was

coefficients of the A_0 matrix.[8] Table 1 reports the estimated monetary policy rule of the M-VAR. All the coefficients of the monetary policy rule are significant at 5 per cent and have the expected signs, namely the Fed increases the federal funds rate whenever the commodity index increases, since this will produce an increase in the price level in the near future, and whenever real GDP and the GDP deflator increase. The coefficients of the total reserves demand equation, which are not reported, also have the expected signs: the demand for total reserves varies inversely with the federal funds rate and positively with the level of economic activity and the price level. However, this last coefficient is not significant.

3.1 Comments on impulse responses and variance decompositions

The monetary policy shocks we captured are associated with the following responses of the variables included in the M-VAR: (i) an increase in the federal funds rate, (ii) a decrease in total reserves, (iii) a sharp and fast decline in the commodity price index, and (iv) a decline in real GDP and a delayed reduction in the GDP deflator (figures 2 and 3 report the responses of output, prices, total reserves and the interest rate[9]). After a contractionary shock, real GDP responds by decreasing with the classical humped shape response with the maximum decrease of real GDP reached after 12 quarters. The real GDP goes back to its initial level after 18 quarters which suggests that monetary policy does not permanently affects output. An unexpected increase of 1.0 per cent in the federal funds rate produces a maximum decrease, after 10 quarters, of slightly more than 0.4 per cent in real GDP. This response is consistent with the interest rate channel of monetary policy transmission since the initial impulse to the federal funds rate is propagated to lending rates which affect firms' investment choices and households' consumption of durable goods. The GDP deflator response is permanent. It builds up slowly and is still significant after 32 quarters with a decrease of more than 1 per cent. From the analysis of these impulse responses we can conclude that monetary policy has permanent effects on the level of nominal variables. These results are robust to various identification schemes that have been proposed in the literature. The patterns of these responses are very similar, for example, to the ones in Bernanke and Mihov [1998], who use a different identification scheme to separate total reserves into nonborrowed and borrowed reserves. The authors find a significant price response only after 24 months and a transitory response of real GDP. In Christiano, Eichenbaum and Evans [1996] impulse responses to a monetary policy shock, identified alternatively by innovations in nonborrowed reserves and in the the federal funds rate, are also similar in shape and persistence to ours.

We now turn to examine the decomposition of the forecast error variance in order to evaluate

made using the Akaike and Schwarz criterion and looking at the autocorrelation function of the reduced form residuals, in order to get uncorrelated reduced-form disturbances. These two criteria led to the selection 6 lags for all the VARs considered in this paper.

[8] The results of the paper are robust to different identification schemes of the block of the Y_t variables.

[9] Error bands and variance decomposition intervals are computed by means of Monte Carlo integration following Sims and Zha [1999]. In this paper the authors show how to compute error bands for overidentified structural VARs. All impulse responses graphs display .68 and .95 flat-prior probability intervals. The authors also suggest presenting the principal components of the impulse responses since uncertainty about these is not serially independent across time. The graphs report the first and second components of the impulse responses.

the contributions of monetary policy shocks to fluctuations in real GDP and the GDP deflator. Tables 2 reports the median and .68 probability intervals of the k-step-ahead forecast error variance. Monetary shocks become important in generating output fluctuations after 2 years, accounting for a median value of 12 per cent. After 32 quarters these shocks account for 24 per cent of the variance of output, suggesting that monetary shocks are an important source of fluctuations. In Gordon and Leeper [1994] the percentage of forecast error variance in output and prices reaches respectively 33 and 22 per cent after 36 months. In Christiano, Eichenbaum and Evans [1996], monetary policy shocks identified by exogenous innovations in the federal funds rate account for 30 per cent of the 24 quarter-ahead forecast error variance of real GDP. At the same time non-borrowed reserves policy shocks account for 11 per cent. In Strongin [1995] innovations in nonborrowed reserves that are orthogonal to total reserves account 49 per cent of the variance in industrial production at the end of two years.

With respect to the price level, monetary policy shocks account for 25 per cent of the variability after 32 quarters, suggesting that these shocks, together with commodity prices shocks, are the most important source of price fluctuations (the figures on non-monetary shocks are not reported in this paper since the focus is exclusively on monetary and fiscal shocks). In Gordon and Leeper [1994] nearly 30 per cent of the variability of the price level is due to monetary policy shocks after 36 months. In the medium term at 8 and 16 quarters, commodity prices shocks are the most important source of fluctuations in prices. After 2 years, 60 per cent of the variability of the GDP deflator is due to shocks to these prices. Commodities are part of nearly all production processes and therefore their prices affect firms pricing decisions significantly. This result underlines the fact that commodity prices are an important informational variable for assessing future developments in the price level. These results, together with the impulse response analysis, show that monetary policy shocks have significant effects on output and prices.

The figures of the variance decomposition of real GDP and the GDP deflator will be used in the comparison of the forecast error variance decomposition obtained in the VARs where fiscal variables are introduced.

4. Introducing fiscal policy: the primary deficit

Different methods have been proposed in the literature for constructing indicators of fiscal stance. They all aim at capturing discretionary changes in the budget i.e changes due not to the endogenous response of budget components to the state of the economy but to exogenous fiscal policy actions. They all follow Blanchard's advice that the indicator should be simple even at the cost of ignoring relatively important considerations. Blanchard [1990] builds an indicator of the stance of fiscal policy by estimating what government revenue and expenditure would be if the unemployment rate were at the level of the previous period. The difference between the actual deficit and the estimated deficit is the indicator of fiscal policy. The simplest measure of fiscal impulse available is the change in the primary deficit from the previous year. In this measure the benchmark value is assumed to be the level of the previous year. Other methods are used by the IMF and the OECD. These measures try to estimate what is called the structural budget balance, an indicator providing information on medium-term fiscal policy. The construction of the structural budget balance involves three steps: (i) estimating potential output and the corresponding output gap; (ii) computing the cyclical component of expenditure and revenue; and (iii) calculating the structural budget balance by subtracting the ciclycal components from observed levels of revenue and expenditure. According to the IMF's methodology, structural revenue is computed by adjusting observed revenue by an amount that reflects both the size of the output gap and the cyclical sensitivity of revenue. Structural expenditure are obtained by adjusting observed expenditure in proportion to the gap between actual and natural (NAIRU) rates of unemployment. A similar methodology is used by the OECD. In this section we will use the ratio of primary deficit to GDP as the indicator of fiscal policy as in Fatás and Mihov [1998]. The primary deficit equation of the VAR (we will refer to this model as PD-VAR) is used to eliminate any fluctuation in the primary deficit that is due to business cycles. The difference between actual deficit and its endogenous component is used to derive the fiscal shocks.

One shortcoming of choosing the primary deficit as an indicator of fiscal policy is that the effects of government expenditure and revenue cannot be separated. This amounts to assuming that changes in taxation and in expenditure have the same dynamic effects on the economy. We will use fiscal data for the federal government since the federal government is responsible for fiscal policy in the US. Moreover, the inclusion of state and local data may, a priori, affect the results because of idiosyncratic changes in state and local government budgets. However using the primary deficit definition for general government leads to the same qualitative results. Contrary to Fatás and Mihov [1998] we will use total GDP instead of private sector GDP (GDP net of government spending), since this is a more conventional measure of economic activity and has been used in most empirical monetary policy exercises. Restrictions must be imposed in order to identify fiscal shocks. We will assume that real GDP and the GDP deflator cannot respond to the fiscal indicator.[10] Contrary to Blanchard and Watson [1986] we will estimate the fiscal rule instead of imposing it using outside estimates of the relative elasticities. It is assumed that the primary deficit/GDP ratio depends simultaneously on real GDP and on the GDP deflator; while expenditure may be acyclical, revenue and transfers depend on the level of economic activity and also on the overall price level since these aggregates are expressed in nominal terms. Fiscal and monetary policy are assumed to be set independently. This restriction denies any simultaneous response of one policy variable to the other.[11] The estimated policy rules are reported in Table 1: all coefficients are significative at 95 per cent. These coefficients are those of the fourth and fifth rows of the second A_0 matrix in Appendix II. These policy rules must be interpreted as capturing the endogenous response of the fiscal and monetary indicator to the state of the economy. The reported coefficients refer to the elements of the primary deficit and interest rate equations reported in the second A_0 matrix in Appendix II.

The coefficients in the fiscal policy rule have the expected signs, that is the primary surplus

[10] Allowing output and prices to respond simultaneously to a fiscal shock does not alter the impulse responses in any way.

[11] This means the reduced form residuals of the primary deficit do not enter in the residuals of the federal funds rate equation and viceversa. However, the conclusions of this paper are not affected by assuming dependence between the two policies.

increases if the level of economic activity rises and if the price level increases. This happens because there are budget components, such as revenue and transfers, that depend on the level of economic activity and are expressed in nominal terms. The coefficients in the monetary policy rule also have the expected signs and show little change compared with those reported for the M-VAR.

4.1 Criticisms of the use of structural VARs in analysing fiscal policy

The use of VARs for fiscal policy analysis is subject to a simple criticism, namely, the long lag between the announcementof a fiscal intervention (say, a tax cut) and the time the measure is actually enacted by congress and affects taxpayers. However, the presence of shortsighted consumers and liquidity constraints can significantly reduce the announcement effect on consumption. Moreover, the announcement of a tax cut might raise expectations of future tax increases, in which case under Ricardian equivalence, there would be no effect on consumption. Poterba [1988] studied the effect on consumption of the fiscal experiments of the 1970s and 80s. He found a significant effect on consumption following the implementation of policies but a very slight announcement effect. On the other hand, a policy of subsidies for the scrapping of old cars (applied in Italy, France and other countries) might have an important news effect on new car purcjases by inducing consumers to postpone their purchases until the implementation of the subsidy. This would result in a reduction of the number of cars bought and probabily a decrease in current production, or more likely an increase in inventories. As will be shown below, the structural VAR is capable of capturing a number of fiscal interventions, thus justifying its use for fiscal policy analysis.

4.2 Comments on impulse responses and variance decompositions

An increase of 1.0 per cent in the primary surplus to GDP ratio produces a maximum decline in output of more than 0.6 per cent after 16 quarters. The response of real GDP is not permanent since output goes back to its initial level after 20 quarters (see Figures 6 and 7). The price level decreases persistently after a contractionary fiscal policy shock. The response of prices to fiscal policy is similar to the response to a monetary policy shock in that it becomes significant after 6 quarters. The response of prices is very slow which indicates that prices may be sticky. After 32 quarters prices are 1.6 per cent below their initial level. The response of the interest rate is not statistically significant for the first 20 quarters (see Figure 6). An increase in the surplus, due to an increase in taxation, for example, reduces disposable income and determines a decrease in consumption. This decrease in aggregate demand causes the price level and output to decrease. The responses of output and prices to a contractionary fiscal policy shock have the same patterns as the responses to a contractionary monetary policy shock since both produce a decline in real GDP and in the GDP deflator. Fiscal policy seems to be as effective as monetary policy.

We now examine the response of real GDP and the GDP deflator to an identified monetary policy shock. Following a contractionary monetary policy shock, output decreases with the classical humped shape response where the maximum response is reached after 12 quarters. The response of output is not permanent since it goes back to the initial level after 24 quarters.

The response of real GDP is significantly different from zero for 14 quarters. An increase of 1.0 per cent in the federal funds rate produces a maximum decline in real GDP of 0.2 per cent, which is smaller than the decrease of 0.4 per cent found in the M-VAR (Figure 4). Monetary policy has real effects even if these are small. With respect to prices, the response becomes significant after 5 quarters and remains so for more than 32 quarters (at .68 confidence level). After 32 quarters prices are 0.6 per cent below the initial level. In the benchmark model the decrease of the price level after 32 quarters is more than 1.0 per cent. By comparing the responses of output and prices in the two VARs analysed, we can see that the magnitudes of the responses to monetary policy shock change when the primary deficit is introduced in the M-VAR. The shapes, however, are very similar. The significance of the differences in the magnitudes will be tested in Section 6 with an appropriate test.

Table 3 shows the forecast error variance decomposition for real GDP. For comparison we also report in parentheses the figures obtained in the M-VAR. The contribution of monetary shocks to output fluctuations is substantially smaller than in the benchmark model. In this VAR, monetary policy shocks accounted for 24 per cent of output variability while in the model analysed in this section they account for no more than 9 per cent at 40 quarters. The significance of this difference and that of the price level will be tested in Section 6. At the same time fiscal shocks account for 12 per cent of the fluctuations in real GDP after 40 quarters. These figures on the importance of monetary policy shocks are close to those obtained by Uhlig [1999] who uses an identification procedure that relies on restrictions on the signs of impulse responses.[12] The author finds that monetary policy shocks may easily account for less than 3 per cent of the variability of real GDP. Our results also suggest that monetary policy shocks may have very small real effects. However, it is important to underline that this result only applies to the exogenous component of monetary policy. The endogenous component is likely to have important real effects. Fiscal policy shocks are an important source of fluctuations in real GDP in the medium and long-term as are monetary policy shocks . It is also important to note the reduction in the percentage of variance of the GDP deflator explained by monetary policy shocks: from 25 per cent of the benchmark model to 9 per cent of the fiscal VAR at 40 quarters. At the same time, fiscal policy shocks seem to be a more important source of variability in prices accounting for 22 per cent at 40 quarters. This result may seem puzzling. However, it only means that the unexpected component of fiscal policy is more important than the corresponding component of monetary policy, which is perhaps more predictable.

How can the simple introduction of a fiscal policy variable have such significant effects on the contribution of monetary policy shocks to fluctuations in output and the magnitudes of the impulse responses? One possibility is that because fiscal shocks play an important role in determining output and price fluctuations, a VAR that does not include a fiscal policy indicator is likely to give a distorted view of the relative importance of monetary versus fiscal policy shocks as sources of fluctuations of real GDP and the GDP deflator. From an econometric point of view, it is essentially a problem of omitted variables and misspecification of the reduced-form of the VAR, which leads to inconsistent estimates of the coefficients. Since impulse responses

[12] The paper analyses only monetary policy.

and variance decompositions are non-linear functions of the reduced-form coefficients, they are also inconsistently estimated. The federal funds rate captures the effects of the fiscal policy indicator, the omitted variable, on output and prices and these two measures actually tend to raise during expansions and decrease in slowdowns and recessions (see Figure 1). The consequences of misspecifying vector autoregressions are analysed in detail in Braun and Mittinik [1993], who show that the omission of relevant variables, the incorrect specification of lag lengths or the incorrect orthogonalization of innovations produce inconsistent impulse responses and variance decompositions. In particular, with respect to point estimates, the misspecification effects can be dramatic. However, the importance of inconsistencies is reduced once uncertainty on the parameter estimates is considered. Variance decompositions are more sensitive than impulse responses to misspecifications, since they are essentially ratios of potentially inconsistent quantities. This is exactly what we obtain by misspecifying the M-VAR: the point estimates of the contributions of monetary shocks to fluctuations in output and prices are significantly affected by the omission of fiscal policy variables. In order to test the robustness of this result in the next section we modify the M-VAR by including separately the components of the federal government budget, revenue minus transfers and expenditure.

4.3 Structural fiscal and monetary shocks

In this section we evaluate whether the structural fiscal and monetary policy shocks we have observed capture the main fiscal and monetary events of the last 40 years. Structural shocks can be computed from

$$V_t = A_0^{-1} U_t \tag{6}$$

where U_t represents the vector of reduced form residuals. Structural fiscal shocks provide a measure of discretionary fiscal policy. Figure 8 reports the structural monetary and fiscal policy shocks. Turning to the analysis of fiscal shocks, several fiscal events can be identified: the strong adjustment of 1969 (the surtax approved in 1968:2, a temporary increase in taxation); the expansion of 1967 (this event is highlighted in Blanchard and Perotti [1999] as an expenditure shock); the tax rebate of the second quarter of 1975; the Reagan tax cut of 1981 (Economic Recovery Tax Cut) which was approved in August 1982, and the increase in military spending in 1980 . Therefore it seems that the VAR is performing quite well in capturing the most important fiscal events in the post-war U.S. data. We consider this an important criterion in the overall evaluation of the VAR model. It is important to underline that policy shocks are observed at the time of implementation because it is at this time that the budget is affected.

With respect to monetary policy shocks Figure 8 clearly highlights the Volcker era in which the volatility of the federal funds rate increased because of nonborrowed targeting. The interest rate had to adjust in order to equate supply and demand for total reserves. The anti-inflationary shock of 1979:2 is clearly detectable (Romer and Romer [1989]). The expansionary policy of 1983 and 1992 are also detectable (these events are the ones highlighted in Bernanke and Mihov [1998] who compare their indicator with the Romers' dates and the Boschen-Mills index.

5. Disaggregating the federal budget into revenue and expenditure

In this section we disaggregate the federal primary deficit into revenue minus transfers and expenditure, following Blanchard and Perotti [1999]. The authors specify a three variable VAR to analyse the effects of fiscal policy alone on real GDP. This is because the use of the primary deficit implicitly assumes that shocks to revenue or expenditure have the same impact on output and prices. With this new specification of fiscal policy (we will refer to the VAR analysed in this section as RE-VAR) we will be able to differentiate between the effects of tax and expenditure shocks and we will test the robustness of the results on the effects of monetary policy obtained with the PD-VAR . We are interested in assessing the relative importance of shocks to revenue and to expenditure and in evaluating the dynamic responses of output and prices to each of these two shocks separately. We also want to evaluate the changes in the impulse responses and in the variance decomposition in relation to the two VAR analysed above. The result on the relative importance of fiscal and monetary shocks obtained with the primary deficit may be due to the specific measure of fiscal policy that we have used. With respect to the restrictions, the same identification scheme of the previous VAR holds i.e. fiscal variables depends simultaneously on real GDP and on the GDP deflator for the same reason as the primary deficit does. However, with respect to the PD-VAR, we now allow real GDP and the GDP deflator to respond to fiscal variables because government expenditure is likely to have a contemporaneous effect on output. Our result on the consequences of omitting fiscal variables for monetary policy still holds if we assume that output and prices cannot respond within a quarter to fiscal policy shocks. In addition we assume that taxation decisions are taken once expenditure has been decided. This assumption is also present in Blanchard and Perotti [1999], although they find that the same conclusion is obtained no matter which decision is taken first. We have also tested the two specifications without obtaining any substantial changes in the results. The estimated policy rules are reported in Table 1. All the estimated parameters in the monetary policy rule are significant at 95 per cent and the same is true for the two fiscal policy equations with the only exception of the price level in the expenditure equation. All the coefficients have the expected signs. These coefficients are those of the fourth, fifth and sixth row in the third A_0 matrix in Appendix II. The coefficients of the monetary policy rule are similar to those of the benchmark monetary policy rule. The coefficients of the tax policy rule have the correct signs: revenue increases when the tax base, related to GDP, increases and when the price level increases (since revenue is in nominal terms). The expenditure policy rule suggests that government expenditure increases when output decreases.

5.1 Comments on impulse responses and variance decompositions

We now comment on impulse responses to monetary and fiscal policy shocks. Fiscal shocks now have two components: revenue shocks and expenditure shocks. With respect to a contractionary monetary policy shock, the pattern previously obtained is repeated, with real GDP declining with the classical humped shape and the GDP deflator slowly declining. An increase of 1.0 per cent in the federal funds rate produces a maximum decrease of real GDP of 0.26 per cent which is lower than the 0.4 of the benchmark case.

Figure 16 presents a comparison of the mean impulse responses to a monetary policy shock in the three VAR specifications. Error bands are not presented to make the comparison easier. The responses of real GDP are different in terms of magnitude and persistence although the shapes are very similar. Output responds with the classical humped shape in all three specifications. For the GDP deflator, the M-VAR implies a greater response to a monetary policy shock. These differences (which will be tested in Section 6) in the impulse responses are also reflected in the differences in the contributions of monetary policy shocks to fluctuations in output and prices. The omission of fiscal policy increases the effects of monetary policy on the economy. Again, the explanation for this result is that the federal funds rate in the benchmark captures the effects of the fiscal variables when these are omitted. This result is robust to the specification of fiscal policy variables since it has been obtained either by using the primary deficit or by disaggregating the budget into revenue minus transfers and expenditure. For comparison purposes we report the impulse responses to an exogenous increase in the federal funds rate, obtained by means of the Christiano, Eichenbaum and Evans [1996] VAR modified to include the ratio of the primary deficit to GDP as the indicator of fiscal policy.[13] Figure 17 reports the impulse responses of real GDP and the GDP deflator to a contractionary monetary policy shock with and without fiscal variables. The result we have previously obtained with our VAR models is clearly confirmed, namely the omission of a fiscal policy indicator modifies the conclusion about the quantitative effects of monetary policy. The maximum contraction of output is halved in the VAR that includes the fiscal variable. The response of the GDP deflator also changes significantly. With respect to the variance decomposition, the contribution of monetary policy shocks is reduced when fiscal policy is introduced in the Christiano, Eichenbaum and Evans [1996] VAR since the percentage of the variability of output and prices is reduced by 50 per cent. The results are confirmed if revenue minus transfers and expenditure are used in place of the primary deficit. Overall, these results suggest that the explanation we proposed above on the misspecification of monetary VARs is correct and may be robust to different identification schemes.

Turning to the analysis of fiscal shocks, it can be seen that a contractionary fiscal shock measured by an exogenous increase in revenue induces a significant decrease in real GDP which is significatively different from zero. An increase of 1.0 per cent in revenue produces a decline in output of 0.08 per cent after 13 quarters. The price level permanently decreases after the fiscal policy shock and after 32 quarters prices are 0.24 per cent below their baseline value. An increase in distorsionary taxation produces a decline in disposable income which in turns reduces consumption. The decrease in aggregate demand determines a contraction of the price level. An expansionary fiscal policy measured by an exogenous increase in government expenditure immediately produces a small increase in output that lasts for two years. The response of output compared with the initial increase in expenditure suggests that the response of private-sector real GDP might be negative. This may be due to the rise in the interest rate (see Figure 13 and 14) and revenue (which is not shown). In fact, an expansionary fiscal policy causes the interest rate and revenue to increase which in turn lowers investment and consumption thus smoothing the impact on output. This suggets the existence of a crowding-out effect of government expen-

[13] The results are robust to the ordering between monetary and fiscal policy variables.

diture shocks. The response of the price level is not significant. The responses of output are in line with those obtained by Blanchard and Perotti [1999] from a qualitative point of view. However, our model suggests a smaller response of output which dies out more quickly. The reason for this difference may be that Blanchard and Perotti (1999) omit a short-term interest rate and so they are not able to capture the crowding-out that is present in our VAR.

The next step is to compute the variance decomposition of the forecast error of output and prices and to compare these results with those of the M-VAR. Table 5 shows that the contribution of monetary policy to output fluctuations falls to 8 per cent (9 per cent in the PD-VAR) at 40 quarters compared with the 24 per cent of the benchmark case. These figures confirm that monetary policy shocks contribute little to macroeconomic fluctuations. It must be noted that there are differences in the contributions of all the different shocks. However the most significant change is precisely the one regarding monetary policy shocks. This result is robust to the use of different indicators of fiscal policy as shown by the two VARs with fiscal variables. Therefore it is confirmed that by ignoring fiscal policy we are likely to overestimate the importance of monetary policy shocks in determining output fluctuations. The changes with respect to the benchmark model will be tested in Section 6. Expenditure shocks contribute very little to fluctuations in real GDP in the long-run accounting for no more than 5 per cent. Revenue shocks account for a greater percentage, reaching 9 per cent after 40 quarters. With respect to the variance decomposition of the GDP deflator, the contribution of monetary shocks decreases to 9 per cent from a benchmark value of 25 per cent. Monetary policy, together with commodity shocks, is still the most important source of fluctuations in prices in the long run. Revenue shocks contribute significantly to the variability of prices (15 per cent at 40 quarters). Expenditure shocks account for 3 per cent of the forecast error variance of prices, the lowest contribution among policy shocks.

The result is thus confirmed that monetary policy is close to being neutral when the primary deficit is disaggregated into revenues minus transfers and consumption expenditure. The explanation is the same as the one we have given for the results obtained with the PD-VAR i.e. the omission of relevant variables produces inconsistent impulse responses and variance decompositions. The same misspecification result is obtained if monetary policy variables are dropped from the RE-VAR. In this case revenue shocks become the most important source of fluctuations in real GDP and in the GDP deflator (accounting for nearly 35 per cent and 27 per cent respectively of the forecast error variance). Impulse responses (see Figures 18 and 19) show that a positive revenue shock has a severely negative impact on output and prices. These responses are very similar in sign and shape to the responses to a contractionary monetary policy shock obtained in the M-VAR. An expansionary expenditure shock produces an increase in the price level and a very small increase in output (see Figures 20 and 21 for the so-called F-VAR, the VAR with only fiscal policy). The positive response of prices is not present in the VAR that includes monetary variables because the increase in the interest rate offsets the initial expansionary shock. This result confirms that in order to correctly evaluate the effects of fiscal and monetary policy shocks, both policies should be considered in the same VAR.

5.2 Structural fiscal and monetary shocks

Figure 15 presents the structural fiscal and monetary policy shocks captured in the RE-VAR. With respect to tax shocks, the 1975:2 tax rebate is clearly detectable and represents the most important event in the post-war history of fiscal policies in the U.S. in terms of magnitude. The 1981 Reagan's tax reduction plan is also detectable together with the 1968 surtax (a temporary increase in taxation). Expenditure shocks highlight the Vietnam war and an important increase in government expenditure in 1972 and a significative decrease in 1983. Large expenditure shocks also occurred before 1973. With respect to monetary policy, the anti-inflationary period under Volcker chairmanship, is clearly detectable. The expansionary episodes in 1974 and 1992 when the Federal Reserve cut interest rates to help the economy recover are also captured by the VAR.

6. Do we really need to model both fiscal and monetary policy?

The introduction of fiscal policy variables in the M-VAR affects the magnitude of the responses of output and prices to a monetary policy shock without making any alterations to the shapes. Up to now this conclusion has only been based on a qualitative analysis. In this section we will test the significance of the differences in the magnitudes of the responses of output and prices to a monetary policy shock in the three models we have analysed. The test will be based on the first and second principal components. For each quarter of the impulse response function, the following statistic (which is distributed asymptotically as a χ^2 with one degree of freedom) is computed:

$$\chi_i^2(k) = \frac{(\bar{c}_i^b(k) - \bar{c}_i^f(k))^2}{\sigma^2(\bar{c}_i^b(k)) + \sigma^2(\bar{c}_i^f(k))} \tag{7}$$

where $k = 1, .., K$ is the step at which the impulse responses are evaluated, $\bar{c}_i$ gives the average responses of real GDP and the GDP deflator (b stands for benchmark and f for the two fiscal models, while i stands for real GDP and the GDP deflator) and $\sigma^2(\bar{c}_i(k))$ is their variance.[14] The responses are normalised so that in all the VARs a monetary shock is equal to a one per cent increase in the federal funds rate. According to Sims and Zha [1999] the impulse responses can be represented in terms of the principal components of their estimated covariance matrix Ω

$$c_{ij}(t) = \hat{c}_{ij}(t) + \sum_{k=1}^{K} \gamma_k W_{\cdot k}(t) \tag{8}$$

where c_{ij} is the response of variable i to shock j, $\hat{c}_{ij}$ is the estimated mean response of variable i to shock j, γ_k is a random variable with mean zero and variance equal to the k^{th} eigenvalue of Ω,

[14] The variance of the k^{th} principal component of $c_{ij}(t)$ at step t is equal to $\lambda_k W_{\cdot k}(t)^2$ where λ_k is k^{th} eigenvalue of the estimated variance covariance matrix of impulse responses.

and $W_{\cdot k}$ the corresponding eigenvector. The results from the tests based on the first component[15] (see Table 7) are the following: the response of real GDP in the M-VAR is significantly greater than in the two other VARs (for the first 11 quarters in both fiscal VARs) while the differences in the response of the GDP deflator are significantly different from zero only for the first 4 quarters in the RE-VAR.

The results for the second and third component are reported respectively in Tables 8 and 9. An overall evaluation of the significance of these differences can be obtained by summing χ^2 statistics over the number of steps in the response horizon: this sum is distributed as a χ^2 with as many degrees of freedom as the number of steps, K. Overall, the results for both comparisons (Table 10) are that there is a significant difference, using alternatively the first, the second or the third component, in the responses of both real GDP and the GDP deflator to a monetary policy shock.

The χ^2 statistic in (7) is then used to test the differences in the contributions of monetary shocks to output and price fluctuations.[16] The result for real GDP is that there is a significant difference only between 1 and 6 quarters (PD-VAR) and between 3 and 5 quarters (RE-VAR) when the first component of the variance decompositions is used. With respect to the price level, no difference is found to be significant.[17] When the second component is used in the test, the differences, in both fiscal VARS, with respect to real GDP are significant after 13 quarters (PD-VAR and RE-VAR) and 19 quarters as far as the price level is concerned. When the sum of the chisquare statistics is computed using the first principal component of variance decompositions, the differences in the contributions of monetary shocks are significant only for output. When the second component is used the differences are significant for both output and prices. The results hold for both the PD-VAR and the RE-VAR.

Overall, these tests have shown that the bias, due to the omission of fiscal variables from the M-VAR, is greater for the response of real GDP to a monetary policy shock. Similar results are obtained for the decomposition of the variances of the forecast error.

7. Conclusions

This paper has shown that fiscal and monetary policy have both small effects on output and the price level. Neither fiscal nor monetary policy shocks are important source of fluctuations of real GDP and the GDP deflator. A contractionary monetary policy shock decreases output and prices as well as does a contractionary fiscal policy shock, measured alternatively by an exogenous increase in revenue or in the primary surplus to GDP ratio. Expenditure shocks have

[15] The first component accounts on average for 50 per cent of the variance of the responses of real GDP and nearly 90 per cent with respect to the GDP deflator. The second component explains about 25 per cent of the variance of the response of real GDP and 9 per cent for the price level while the third component accounts for, respectively, 15 and 3 per cent.

[16] In order to save space the tables are not presented. They are available upon request.

[17] The first components account for more than 80 per cent of the variance of the contributions of monetary shocks, the second component for 10 per cent on average and the third one for less than 3 per cent in the three models.

very small and short-lived effects on output and no effect on prices.

This paper also provides another, perhaps more interesting, result. Using the structural VAR methodology, we have shown that the introduction of fiscal variables has important consequences on the magnitudes of the response of real GDP and the GDP deflator to a monetary policy shock. A statistical test on the significance of the differences between the mean responses has shown that the impact on real GDP is significantly smaller in the VARs that include fiscal policy variables. The contribution of monetary shocks to fluctuations in output and prices is also affected by the introduction of fiscal variables. This result is obtained either by using the ratio of the primary deficit to GDP or by disaggregating the budget into expenditure and revenue minus transfers. If one is concerned with evaluating qualitatively the dynamic responses of output and prices to a monetary policy shock, fiscal variables may be omitted. On the other hand, if the focus is on the quantitative effects of monetary policy (especially on output), on its contribution to output and price fluctuations, and on the relative importance of fiscal and monetary policy shocks, then it would be desirable to specify a structural VAR that jointly analyses the two policies.

This result is in line with the suggestions of Leeper, Sims and Zha [1997] who underline the importance of correctly identifying structural shocks by setting up larger models that can trace the effects of policy shocks across a wider variety of variables. The authors identify serious problems in models that imply significant real effects of monetary policy and argue that correcting these problems lowers the implied size of these effects.

We think that including fiscal variables in a basic monetary policy VAR is a correct thing to do in order to understand the true contribution of monetary policy shocks to fluctuations in output and prices and the dynamic impact of these shocks.

Appendix I. Data sources and construction of fiscal variables

All quarterly data come from NIPA (National Income and Product Account) and the FRED database of the Federal Reserve of Saint Louis.

”Y”: gross domestic product seasonally adjusted billions 1992 $

”P”: gross domestic product implict price deflator 1992=100, seasonally adjusted

”PC”: Dow Jones index of spot commodity prices, average of daily figures

”R”: federal funds rate average of daily figures in percentage annual terms

”TR”: total reserves adjusted for changes in reserve requirements billions $

”PD”: federal government primary surplus(+) or deficit(-)

”T”: federal revenue minus transfers billions $ seasonally adjusted

”G”: federal government current expenditure billions $ seasonally adjusted

Transfers = social security benefits + social assistance grants + unfunded employee pension + transfers to the rest of the world + net casualty premium + other transfers

Revenue = direct taxes on households + direct taxes on business + indirect taxes + social security contributions received

Expenditure = consumption expenditure + grants to state and local governments + subsidies

Federal primary surplus = revenue - expenditure - transfers - consumption of fixed capital - net capital transfers received + property income - interest paid + interest received

Appendix II. Identification matrices

Identification matrix of the M-VAR.

$$A_0 = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & a_{23} & 0 & 0 \\ 0 & a_{32} & a_{33} & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} \\ 0 & a_{52} & a_{53} & a_{54} & a_{55} \end{bmatrix} \begin{matrix} PC \\ P \\ Y \\ R \\ TR \end{matrix}$$

Identification matrix of the PD-VAR.

$$A_0 = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & a_{23} & 0 & 0 & 0 \\ 0 & a_{32} & a_{33} & 0 & 0 & 0 \\ 0 & a_{42} & a_{43} & a_{44} & 0 & 0 \\ a_{51} & a_{52} & a_{53} & 0 & a_{55} & a_{56} \\ 0 & a_{62} & a_{63} & 0 & a_{65} & a_{66} \end{bmatrix} \begin{matrix} PC \\ P \\ Y \\ PD/Y \\ R \\ TR \end{matrix}$$

Identification matrix of the RE-VAR.

$$A_0 = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} & 0 & 0 \\ 0 & a_{32} & a_{33} & 0 & 0 & 0 & 0 \\ 0 & a_{42} & a_{43} & a_{44} & 0 & 0 & 0 \\ 0 & a_{52} & a_{53} & a_{54} & a_{55} & 0 & 0 \\ a_{61} & a_{62} & a_{63} & 0 & 0 & a_{66} & a_{67} \\ 0 & a_{72} & a_{73} & 0 & 0 & a_{76} & a_{77} \end{bmatrix} \begin{matrix} PC \\ P \\ Y \\ G \\ T \\ R \\ TR \end{matrix}$$

Identification matrix of the F-VAR.

$$A_0 = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} \\ 0 & a_{32} & a_{33} & 0 & 0 \\ 0 & a_{42} & a_{43} & a_{44} & 0 \\ 0 & a_{52} & a_{53} & a_{54} & a_{55} \end{bmatrix} \begin{matrix} PC \\ P \\ Y \\ G \\ T \end{matrix}$$

Tables and figures

Table 1

Estimated policy rules[a]

M-VAR

Monetary policy rule

$R = 0.045 \cdot PC + 0.49 \cdot Y + 0.799 \cdot P + 0.378 \cdot TR + v_M$
(0.027) (0.02) (0.045) (0.047)

PD-VAR

Monetary policy rule

$R = 0.063 \cdot PC + 0.555 \cdot Y + 0.739 \cdot P + 0.354 \cdot TR + v_M$
(0.026) (0.019) (0.041) (0.031)

Fiscal policy rule

$PD/Y = 0.224 \cdot Y + 0.518 \cdot P + v_F$
(0.005) (0.016)

RE-VAR

Monetary policy rule

$R = 0.047 \cdot PC + 0.551 \cdot Y + 0.88 \cdot P + 0.362 \cdot TR + v_M$
(0.002) (0.02) (0.05) (0.044)

Fiscal policy rule: taxes

$T = 1.853 \cdot Y + 6.384 \cdot P + 0.092 \cdot G + v_T$
(0.11) (0.234) (0.018)

Fiscal policy rule: expenditure

$G = -0.122 \cdot Y - 0.062 \cdot P + v_G$
(0.053) (0.118)

[a]The estimates refer to the policy equations coefficients of the corresponding A_0 matrices.
[b]Standard errors are reported in parentheses.

Table 2

Variance decomposition: M-VAR

quarters	real GDP	GDP deflator
2	0 0 0	0 0 0
8	6 12 20	1 4 8
16	10 20 32	4 11 22
40	14 24 38	11 25 42

Table 3

Variance decomposition real GDP: PD-VAR

quarters	fiscal	monetary	
2	0 0 1	0 0 1	(0 0 0)
8	2 5 10	1 4 10	(6 12 20)
16	5 10 18	3 8 15	(10 20 32)
40	6 12 19	4 9 16	(14 24 38)

Figures in parentheses refer to the M-VAR.

Table 4

Variance decomposition GDP deflator: PD-VAR

quarters	fiscal	monetary	
2	0 0 1	0 0 0	(0 0 0)
8	0 2 5	0 2 5	(1 4 8)
16	1 5 12	1 5 12	(4 11 22)
40	10 22 36	2 9 21	(11 25 42)

Figures in parentheses refer to the M-VAR.

All tables above report .68 flat-prior probability intervals and median contributions.

Table 5

Variance decomposition real GDP: RE-VAR

quarters	expend.	revenue	monetary	
2	1 2 4	0 1 2	0 0 1	(0 0 0)
8	1 3 6	1 3 8	1 4 9	(6 12 20)
16	2 4 9	3 8 17	3 8 14	(10 20 32)
40	2 5 10	4 9 18	4 8 14	(14 24 38)

Figures in parentheses refer to the M-VAR.

Table 6

Variance decomposition GDP deflator: RE-VAR

quarters	expend.	revenue	monetary	
2	0 1 1	0 0 1	0 0 1	(0 0 0)
8	0 1 2	0 2 5	1 3 7	(1 4 8)
16	0 1 4	1 6 13	2 6 13	(4 11 22)
40	1 3 8	5 15 30	2 9 20	(11 25 42)

Figures in parentheses refer to the M-VAR.

All tables above report .68 flat-prior probability intervals and median contributions.

Table 7

Distance[a] test on first component of impulse responses

quarters	distance Y		p-value		distance P		p-value	
1[b]	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
2	0.048	(0.016)	0.000	(0.001)	0.003	(0.013)	0.445	(0.000)
3	0.106	(0.060)	0.000	(0.000)	0.003	(0.012)	0.639	(0.010)
4	0.178	(0.118)	0.000	(0.000)	0.001	(0.021)	0.875	(0.005)
5	0.183	(0.124)	0.000	(0.000)	0.006	(0.017)	0.718	(0.161)
6	0.163	(0.105)	0.000	(0.000)	0.023	(0.003)	0.364	(0.886)
7	0.178	(0.150)	0.000	(0.000)	0.042	(0.019)	0.280	(0.575)
8	0.185	(0.147)	0.000	(0.000)	0.052	(0.032)	0.356	(0.504)
9	0.185	(0.159)	0.000	(0.000)	0.065	(0.047)	0.399	(0.486)
10	0.181	(0.148)	0.001	(0.009)	0.087	(0.064)	0.390	(0.472)
11	0.181	(0.147)	0.019	(0.049)	0.113	(0.083)	0.377	(0.463)
12	0.180	(0.131)	0.075	(0.168)	0.134	(0.099)	0.394	(0.473)
13	0.183	(0.130)	0.142	(0.259)	0.154	(0.116)	0.413	(0.487)
14	0.167	(0.121)	0.261	(0.376)	0.177	(0.131)	0.422	(0.506)
15	0.158	(0.121)	0.364	(0.445)	0.205	(0.148)	0.416	(0.517)
16	0.151	(0.121)	0.443	(0.501)	0.231	(0.161)	0.418	(0.537)
17	0.150	(0.125)	0.491	(0.527)	0.253	(0.173)	0.426	(0.556)
18	0.138	(0.131)	0.555	(0.542)	0.278	(0.187)	0.429	(0.568)
19	0.133	(0.139)	0.589	(0.546)	0.306	(0.201)	0.425	(0.580)
20	0.131	(0.152)	0.610	(0.532)	0.332	(0.213)	0.424	(0.591)
21	0.131	(0.159)	0.619	(0.534)	0.356	(0.228)	0.426	(0.597)
22	0.131	(0.167)	0.622	(0.522)	0.379	(0.243)	0.428	(0.602)
23	0.130	(0.167)	0.623	(0.530)	0.403	(0.259)	0.428	(0.603)
24	0.130	(0.168)	0.618	(0.531)	0.426	(0.277)	0.428	(0.601)
25	0.137	(0.170)	0.589	(0.522)	0.446	(0.295)	0.430	(0.598)
26	0.144	(0.168)	0.558	(0.519)	0.464	(0.313)	0.431	(0.593)
27	0.150	(0.159)	0.521	(0.524)	0.482	(0.331)	0.431	(0.587)
28	0.158	(0.156)	0.474	(0.513)	0.499	(0.348)	0.430	(0.581)
29	0.167	(0.152)	0.419	(0.502)	0.514	(0.365)	0.428	(0.574)
30	0.178	(0.149)	0.355	(0.479)	0.528	(0.379)	0.426	(0.567)
31	0.186	(0.146)	0.293	(0.453)	0.542	(0.392)	0.422	(0.561)
32	0.191	(0.143)	0.236	(0.421)	0.556	(0.403)	0.416	(0.555)

Figures not in parentheses refer to the M-VAR against the PD-VAR.
Figures in parentheses refer to the M-VAR against the RE-VAR.
[a] The distance is the absolute value of the differences of the responses to a monetary policy shock.
[b] The impact response of output and prices is restricted to zero in all VARs.

Table 8

Distance[a] test on second component of impulse responses

quarters	distance Y		p-value		distance P		p-value	
1[b]	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
2	0.048	(0.016)	0.000	(0.000)	0.003	(0.013)	0.621	(0.013)
3	0.106	(0.060)	0.000	(0.000)	0.003	(0.012)	0.846	(0.386)
4	0.178	(0.118)	0.000	(0.000)	0.001	(0.021)	0.950	(0.361)
5	0.183	(0.124)	0.000	(0.019)	0.006	(0.017)	0.879	(0.604)
6	0.163	(0.105)	0.011	(0.148)	0.023	(0.003)	0.676	(0.946)
7	0.178	(0.150)	0.041	(0.109)	0.042	(0.019)	0.570	(0.765)
8	0.185	(0.147)	0.114	(0.231)	0.052	(0.032)	0.579	(0.692)
9	0.185	(0.159)	0.187	(0.280)	0.065	(0.047)	0.567	(0.645)
10	0.181	(0.148)	0.258	(0.374)	0.087	(0.064)	0.513	(0.599)
11	0.181	(0.147)	0.311	(0.416)	0.113	(0.083)	0.460	(0.556)
12	0.180	(0.131)	0.341	(0.488)	0.134	(0.099)	0.429	(0.526)
13	0.183	(0.130)	0.352	(0.505)	0.154	(0.116)	0.394	(0.493)
14	0.167	(0.121)	0.391	(0.534)	0.177	(0.131)	0.345	(0.459)
15	0.158	(0.121)	0.389	(0.518)	0.205	(0.148)	0.277	(0.413)
16	0.151	(0.121)	0.363	(0.485)	0.231	(0.161)	0.214	(0.369)
17	0.150	(0.125)	0.298	(0.419)	0.253	(0.173)	0.152	(0.317)
18	0.138	(0.131)	0.233	(0.318)	0.278	(0.187)	0.086	(0.247)
19	0.133	(0.139)	0.116	(0.187)	0.306	(0.201)	0.033	(0.168)
20	0.131	(0.152)	0.007	(0.041)	0.332	(0.213)	0.006	(0.091)
21	0.131	(0.159)	0.000	(0.001)	0.356	(0.228)	0.001	(0.027)
22	0.131	(0.167)	0.000	(0.000)	0.379	(0.243)	0.000	(0.002)
23	0.130	(0.167)	0.010	(0.000)	0.403	(0.259)	0.000	(0.000)
24	0.130	(0.168)	0.096	(0.009)	0.426	(0.277)	0.000	(0.000)
25	0.137	(0.170)	0.176	(0.051)	0.446	(0.295)	0.000	(0.000)
26	0.144	(0.168)	0.234	(0.121)	0.464	(0.313)	0.000	(0.000)
27	0.150	(0.159)	0.261	(0.194)	0.482	(0.331)	0.000	(0.000)
28	0.158	(0.156)	0.269	(0.249)	0.499	(0.348)	0.000	(0.001)
29	0.167	(0.152)	0.253	(0.284)	0.514	(0.365)	0.000	(0.002)
30	0.178	(0.149)	0.221	(0.298)	0.528	(0.379)	0.001	(0.008)
31	0.186	(0.146)	0.186	(0.297)	0.542	(0.392)	0.001	(0.019)
32	0.191	(0.143)	0.146	(0.282)	0.556	(0.403)	0.003	(0.033)

Figures not in parentheses refer to the M-VAR against the PD-VAR.
Figures in parentheses refer to the M-VAR against the RE-VAR.
[a] The distance is the absolute value of the differences of the responses to a monetary policy shock.
[b] The impact response of output and prices is restricted to zero in all VARs.

Table 9

Distance[a] test on third component of impulse responses

quarters	distance Y		p-value		distance P		p-value	
1[b]	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
2	0.048	(0.016)	0.000	(0.092)	0.003	(0.013)	0.582	(0.033)
3	0.106	(0.060)	0.000	(0.019)	0.003	(0.012)	0.839	(0.422)
4	0.178	(0.118)	0.000	(0.011)	0.001	(0.021)	0.950	(0.428)
5	0.183	(0.124)	0.002	(0.057)	0.006	(0.017)	0.882	(0.656)
6	0.163	(0.105)	0.035	(0.206)	0.023	(0.003)	0.672	(0.952)
7	0.178	(0.150)	0.060	(0.148)	0.042	(0.019)	0.542	(0.785)
8	0.185	(0.147)	0.103	(0.210)	0.052	(0.032)	0.520	(0.690)
9	0.185	(0.159)	0.120	(0.186)	0.065	(0.047)	0.468	(0.601)
10	0.181	(0.148)	0.125	(0.190)	0.087	(0.064)	0.357	(0.497)
11	0.181	(0.147)	0.094	(0.148)	0.113	(0.083)	0.222	(0.375)
12	0.180	(0.131)	0.054	(0.107)	0.134	(0.099)	0.111	(0.247)
13	0.183	(0.130)	0.010	(0.024)	0.154	(0.116)	0.029	(0.110)
14	0.167	(0.121)	0.000	(0.000)	0.177	(0.131)	0.000	(0.016)
15	0.158	(0.121)	0.000	(0.000)	0.205	(0.148)	0.000	(0.000)
16	0.151	(0.121)	0.000	(0.000)	0.231	(0.161)	0.000	(0.000)
17	0.150	(0.125)	0.004	(0.026)	0.253	(0.173)	0.000	(0.000)
18	0.138	(0.131)	0.059	(0.086)	0.278	(0.187)	0.000	(0.000)
19	0.133	(0.139)	0.135	(0.120)	0.306	(0.201)	0.000	(0.000)
20	0.131	(0.152)	0.175	(0.109)	0.332	(0.213)	0.000	(0.003)
21	0.131	(0.159)	0.173	(0.085)	0.356	(0.228)	0.000	(0.005)
22	0.131	(0.167)	0.132	(0.042)	0.379	(0.243)	0.000	(0.004)
23	0.130	(0.167)	0.061	(0.011)	0.403	(0.259)	0.000	(0.001)
24	0.130	(0.168)	0.003	(0.000)	0.426	(0.277)	0.000	(0.000)
25	0.137	(0.170)	0.000	(0.000)	0.446	(0.295)	0.000	(0.000)
26	0.144	(0.168)	0.000	(0.000)	0.464	(0.313)	0.000	(0.000)
27	0.150	(0.159)	0.002	(0.000)	0.482	(0.331)	0.000	(0.000)
28	0.158	(0.156)	0.050	(0.021)	0.499	(0.348)	0.000	(0.000)
29	0.167	(0.152)	0.125	(0.102)	0.514	(0.365)	0.000	(0.000)
30	0.178	(0.149)	0.178	(0.192)	0.528	(0.379)	0.000	(0.000)
31	0.186	(0.146)	0.215	(0.261)	0.542	(0.392)	0.000	(0.000)
32	0.191	(0.143)	0.235	(0.310)	0.556	(0.403)	0.000	(0.000)

Figures not in parentheses refer to the M-VAR against the PD-VAR.
Figures in parentheses refer to the M-VAR against the RE-VAR.
[a] The distance is the absolute value of the differences of the responses to a monetary policy shock.
[b] The impact response of output and prices is restricted to zero in all VARs.

Table 10

Overall distance[a] test

component	χ^2 Y		p-value		χ^2 P		p-value	
first	368.56	(409.08)	0.0	(0.0)	19.45	(54.30)	0.960	(0.008)
second	398.34	(165.54)	0.0	(0.0)	834.75	(825.67)	0.0	(0.0)
third	393.31	(569.86)	0.0	(0.0)	3292.18	(2001.58)	0.0	(0.0)

Figures not in parentheses refer to the M-VAR against the PD-VAR.
Figures in parentheses refer to the M-VAR against the RE-VAR.
[a] The distance is the absolute value of the differences of the responses to a monetary policy shock.

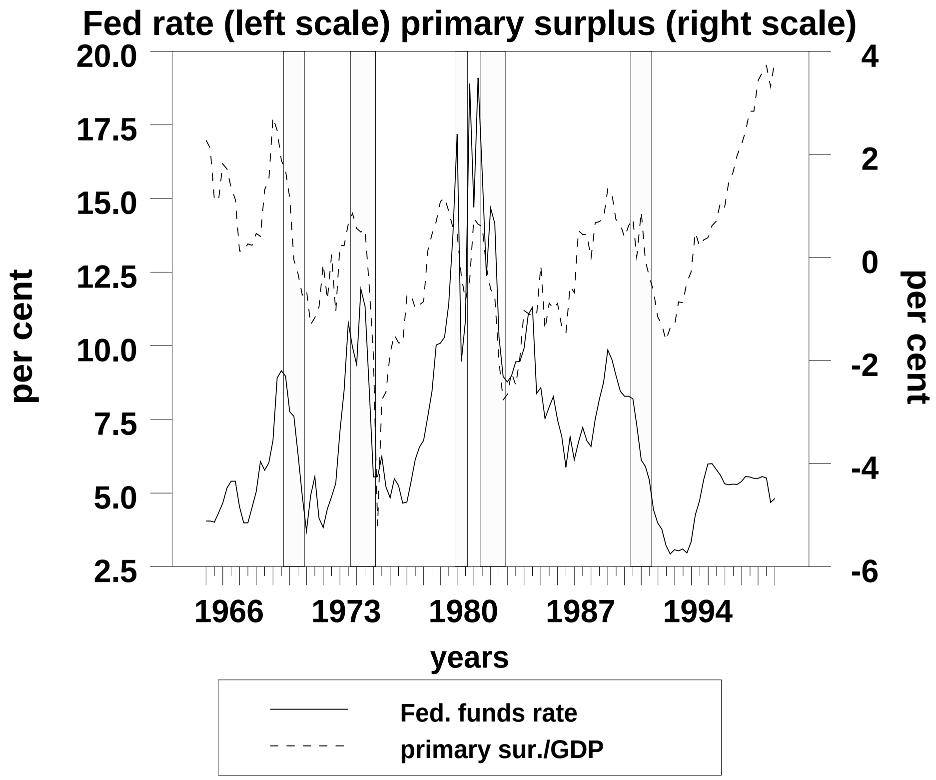

Fig. 1 Federal funds rate and primary surplus/GDP ratio

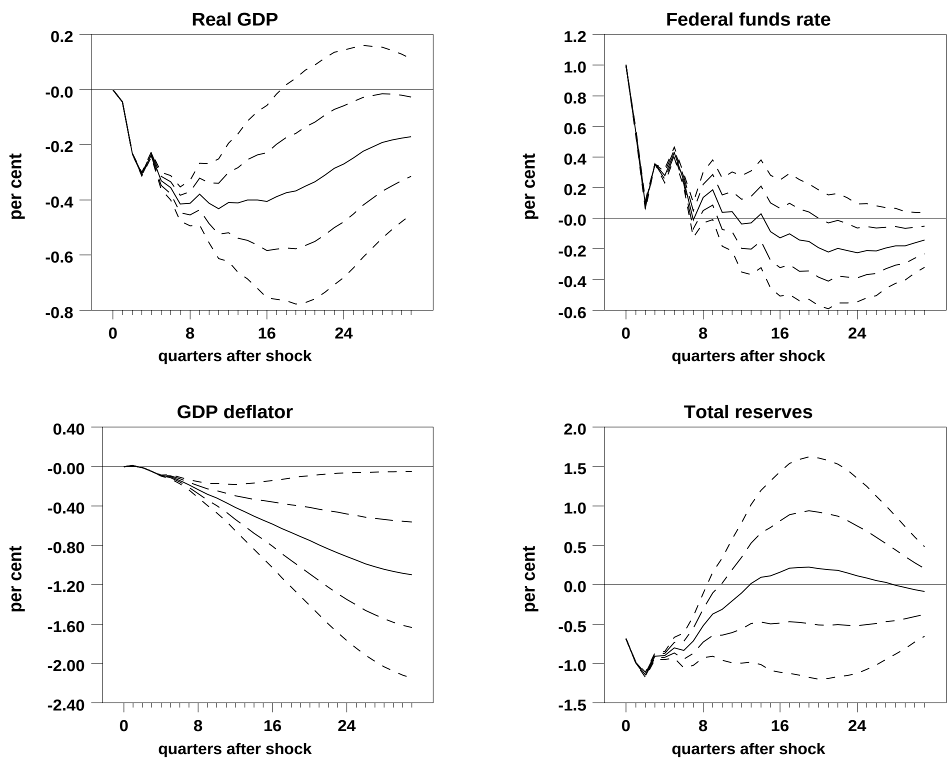

Fig. 2 Monetary policy shock: first component .68 and .95 probability bands (M-VAR)

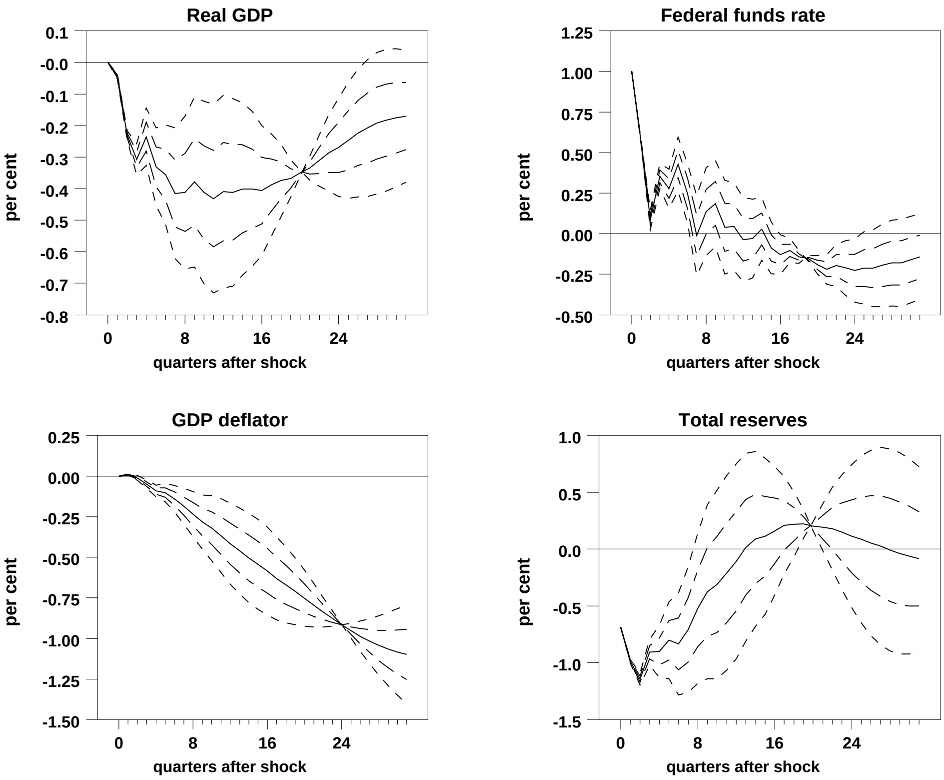

Fig. 3 Monetary policy shock: second component .68 and .95 probability bands (M-VAR)

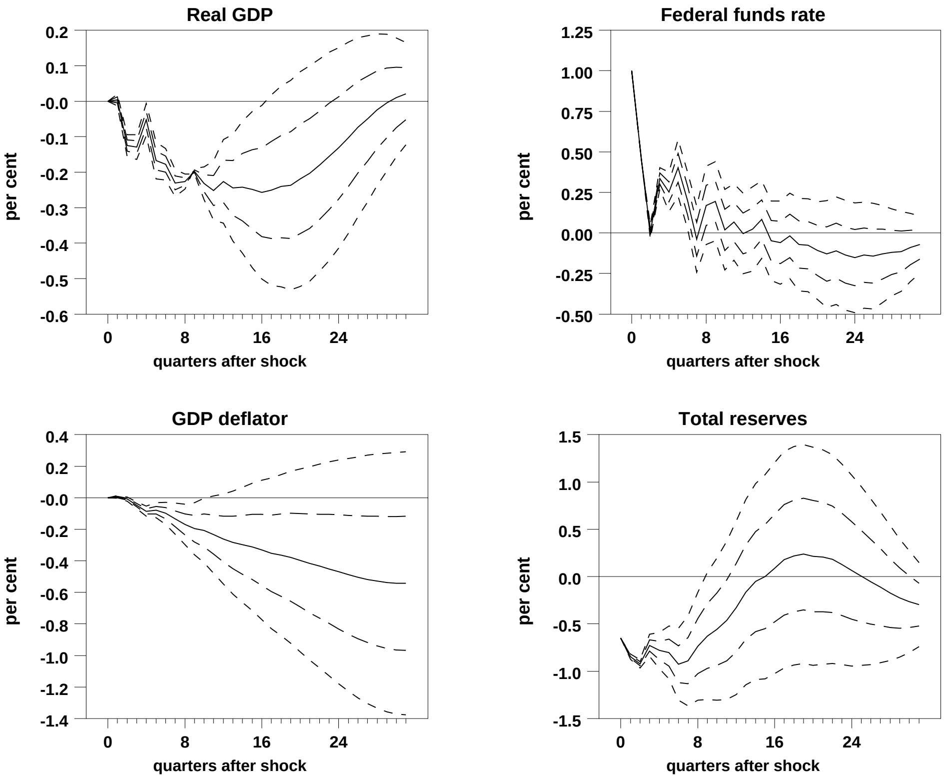

Fig. 4 Monetary policy shock: first component .68 and .95 probability bands (PD-VAR)

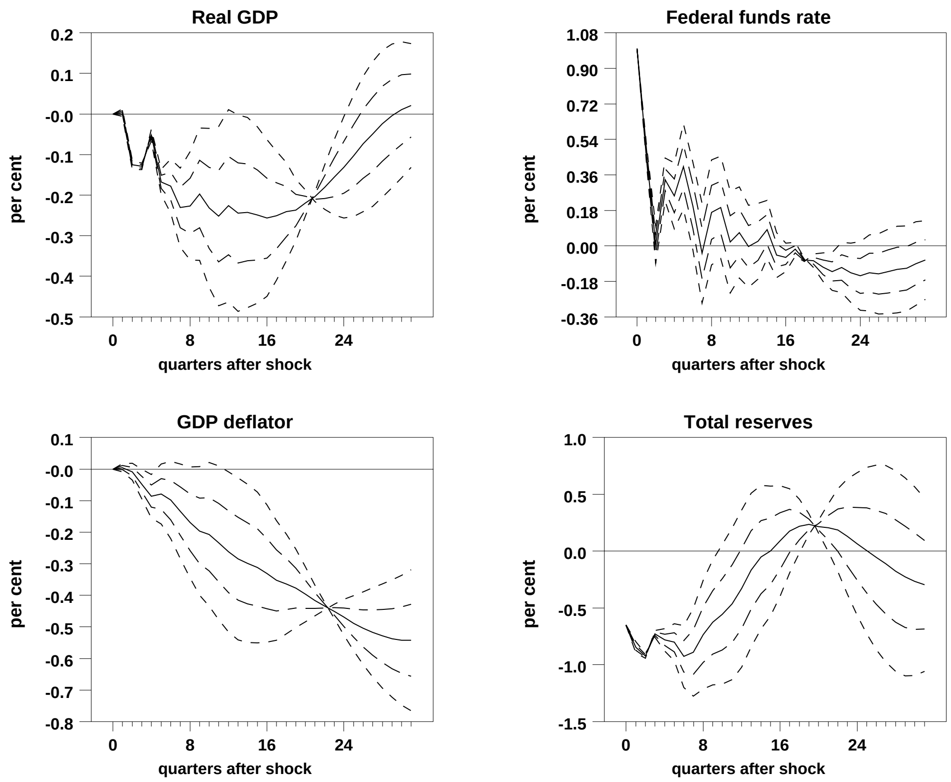

Fig. 5 Monetary policy shock: second component .68 and .95 probability bands (PD-VAR)

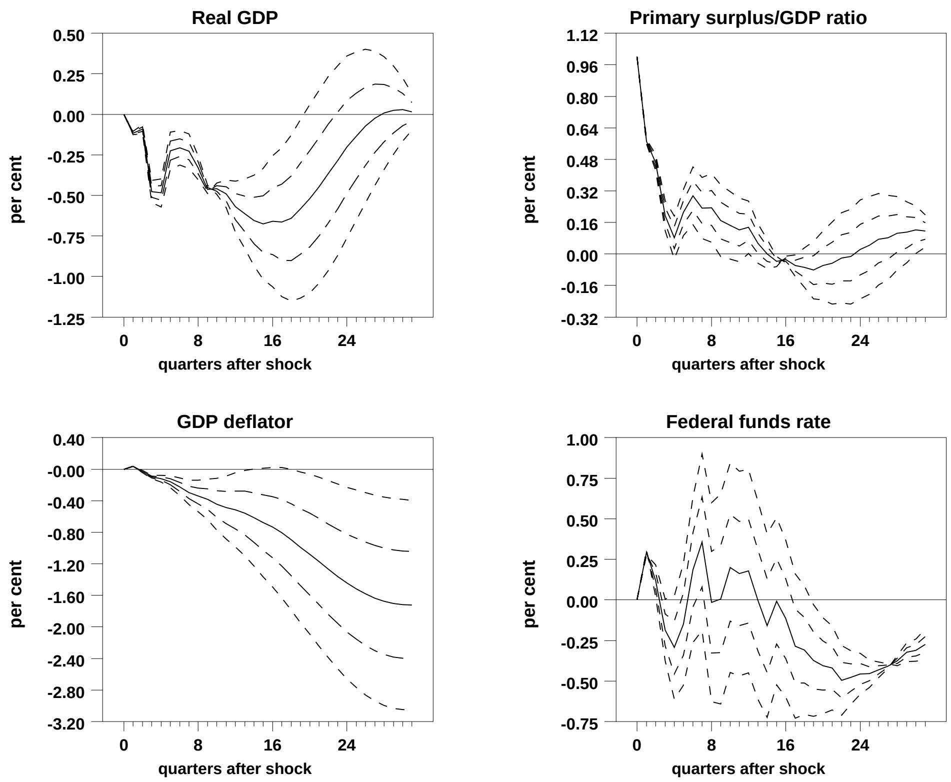

Fig. 6 Fiscal policy shock: first component .68 and .95 probability bands (PD-VAR)

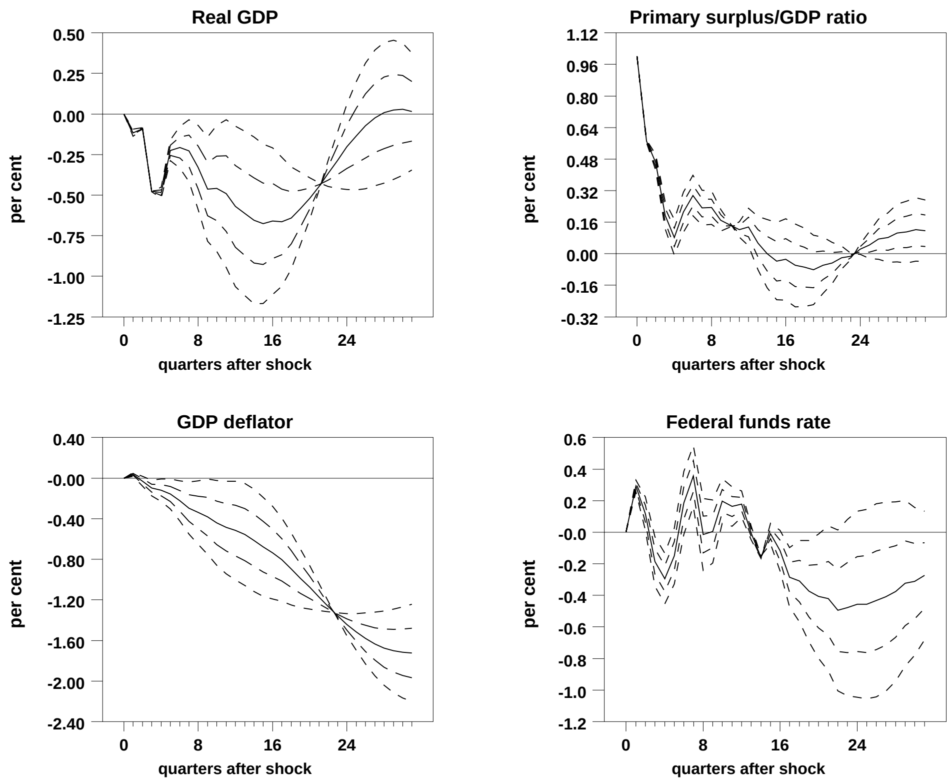

Fig. 7 Fiscal policy shock: second component .68 and .95 probability bands (PD-VAR)

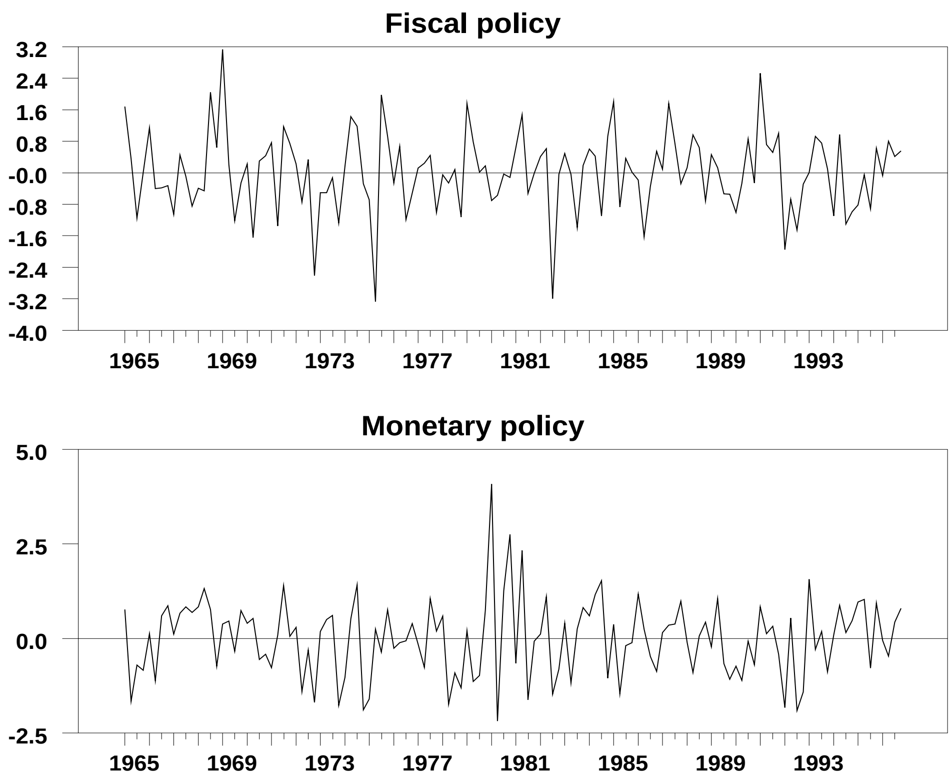

Fig. 8 Structural shocks (PD-VAR)

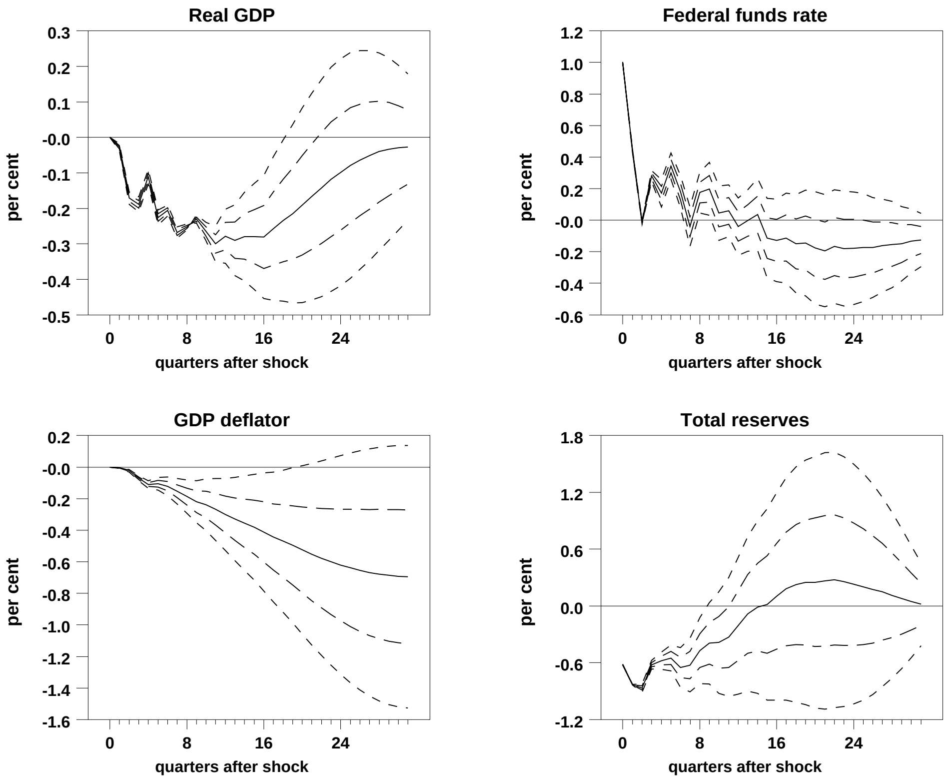

Fig. 9 Monetary policy shock: first component .68 and .95 probability bands (RE-VAR)

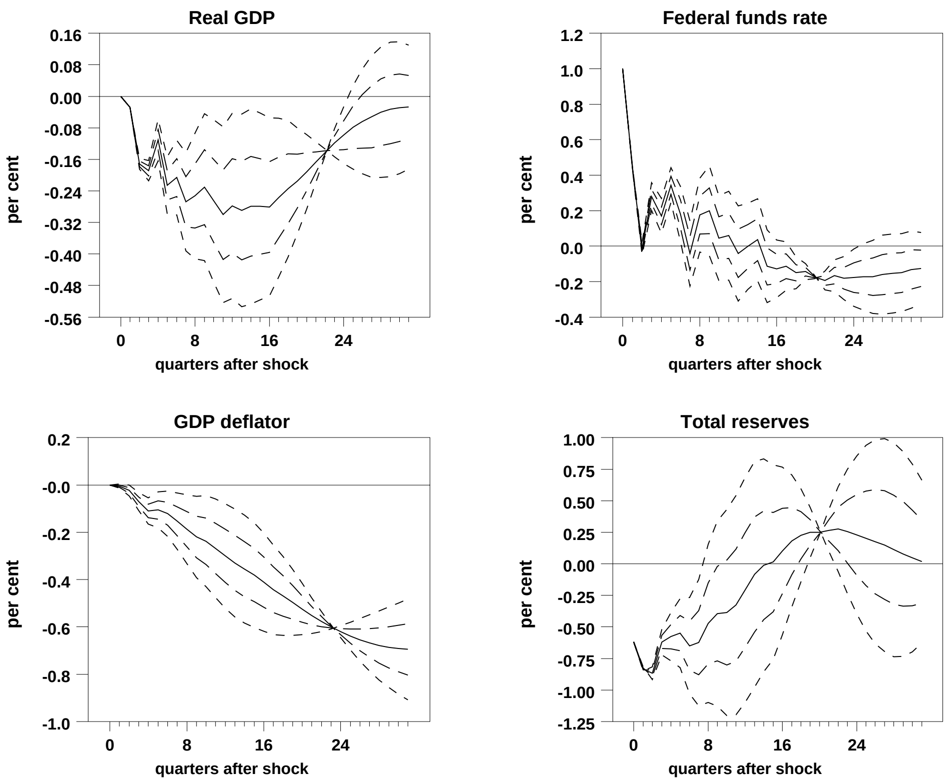

Fig. 10 Monetary policy shock: second component .68 and .95 probability bands (RE-VAR)

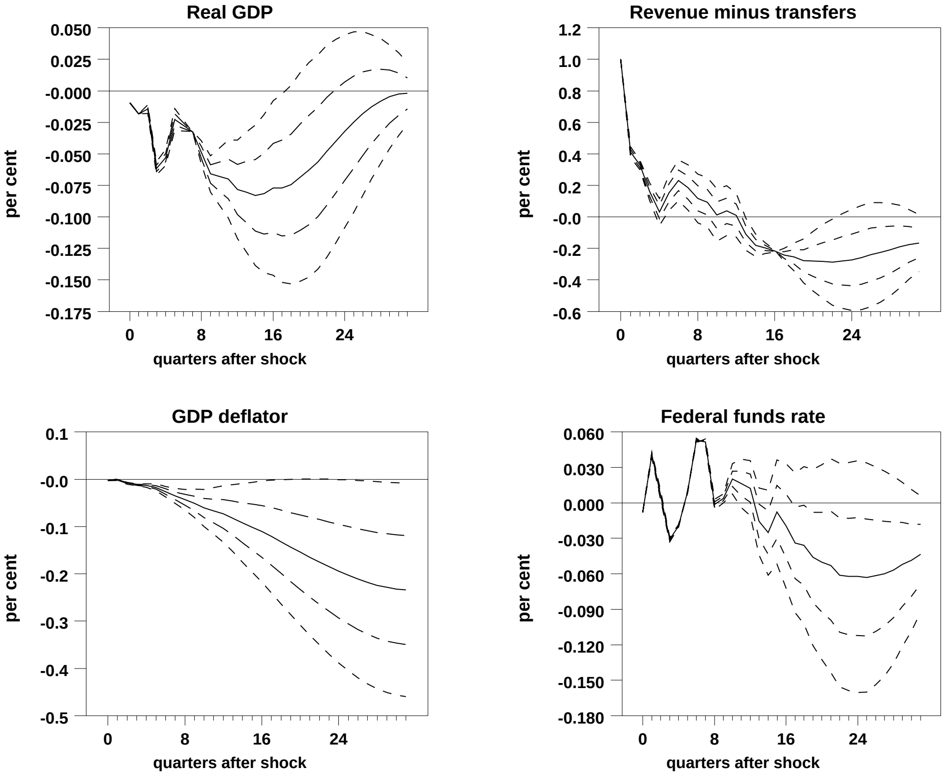

Fig. 11 Fiscal policy shock (revenue): first component .68 and .95 probability bands (RE-VAR)

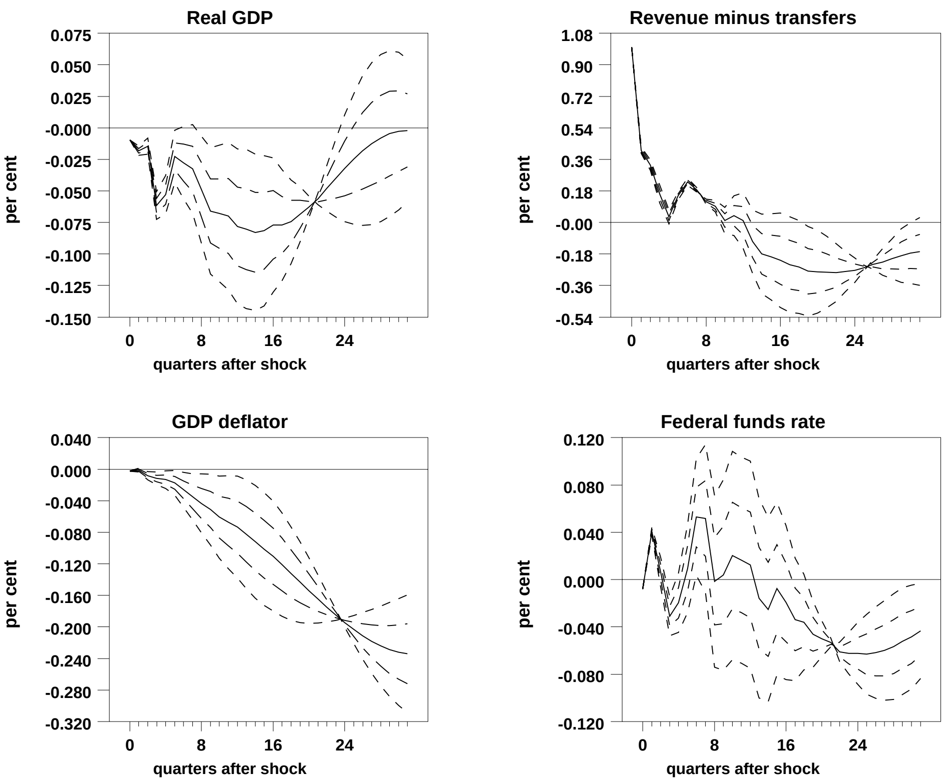

Fig. 12 Fiscal policy shock (revenue): second component .68 and .95 probability bands (RE-VAR)

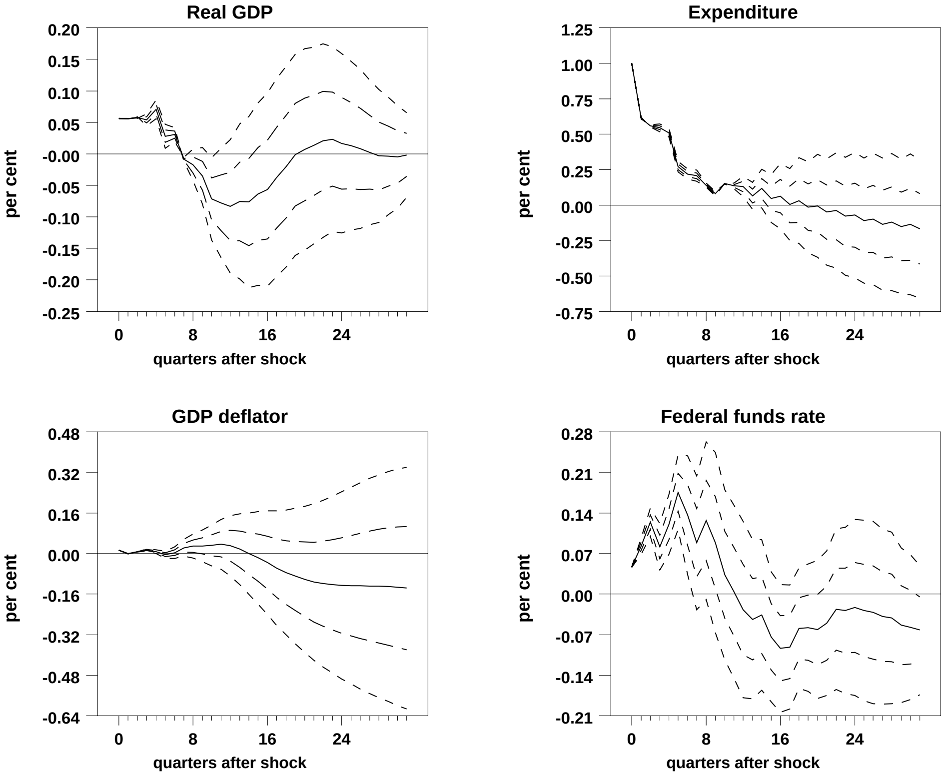

Fig. 13 Fiscal policy shock (expenditure): first component .68 and .95 probability bands (RE-VAR)

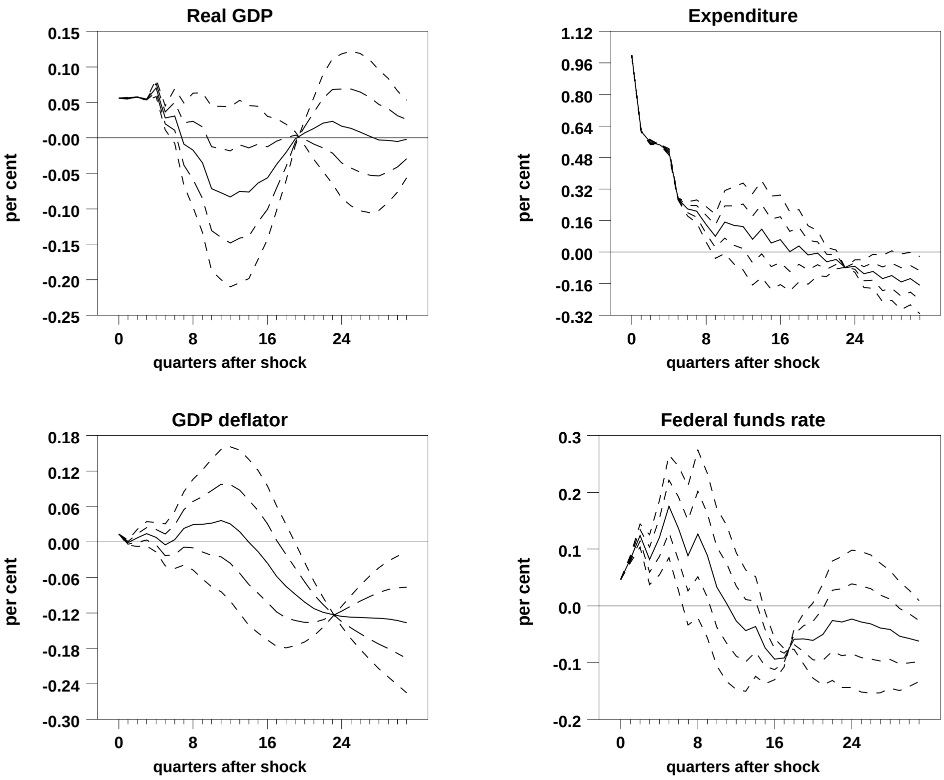

Fig. 14 Fiscal policy shock (expenditure): second component .68 and .95 probability bands (RE-VAR)

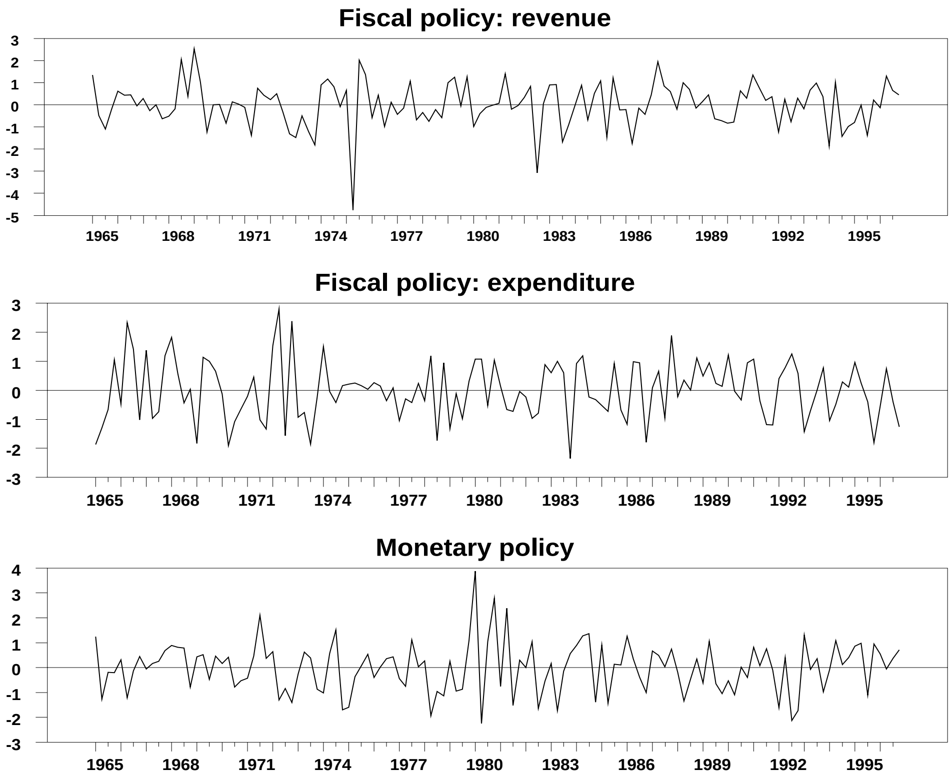

Fig. 15 Structural shocks (RE-VAR)

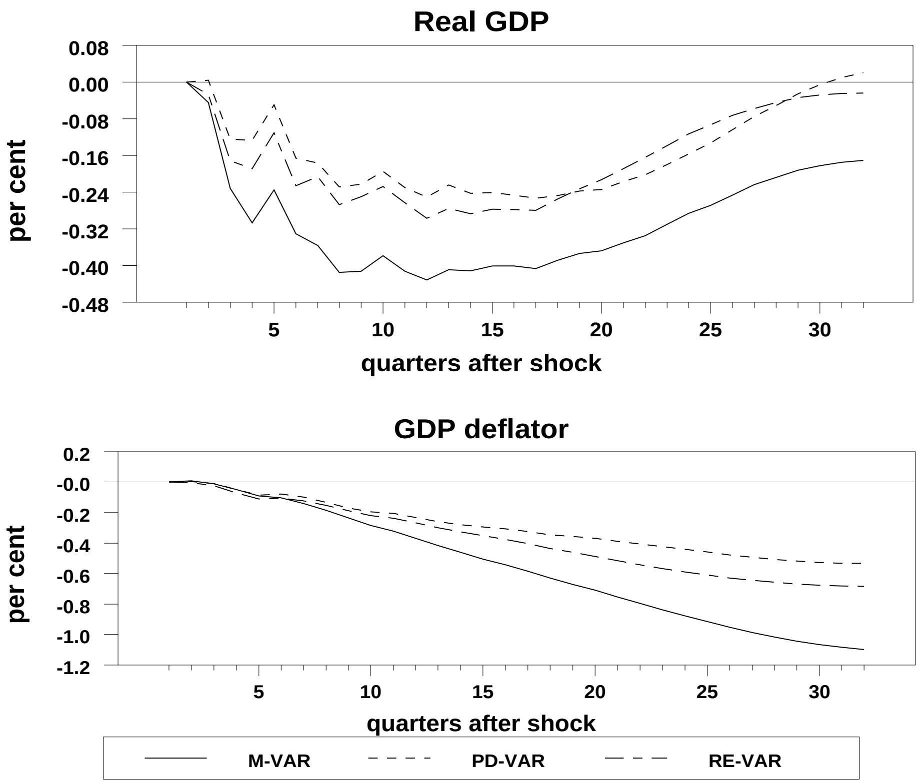

Fig. 16 Comparison of impulse responses to a monetary policy shock

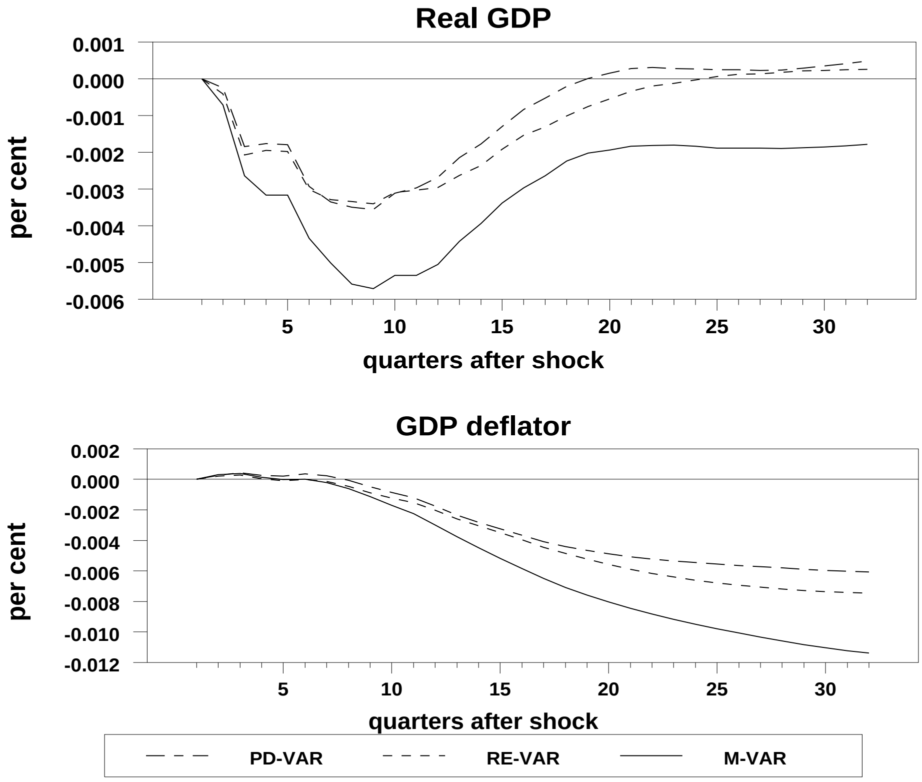

Fig. 17 Comparison of impulse responses to a monetary policy shock: Christiano et al. (1996)

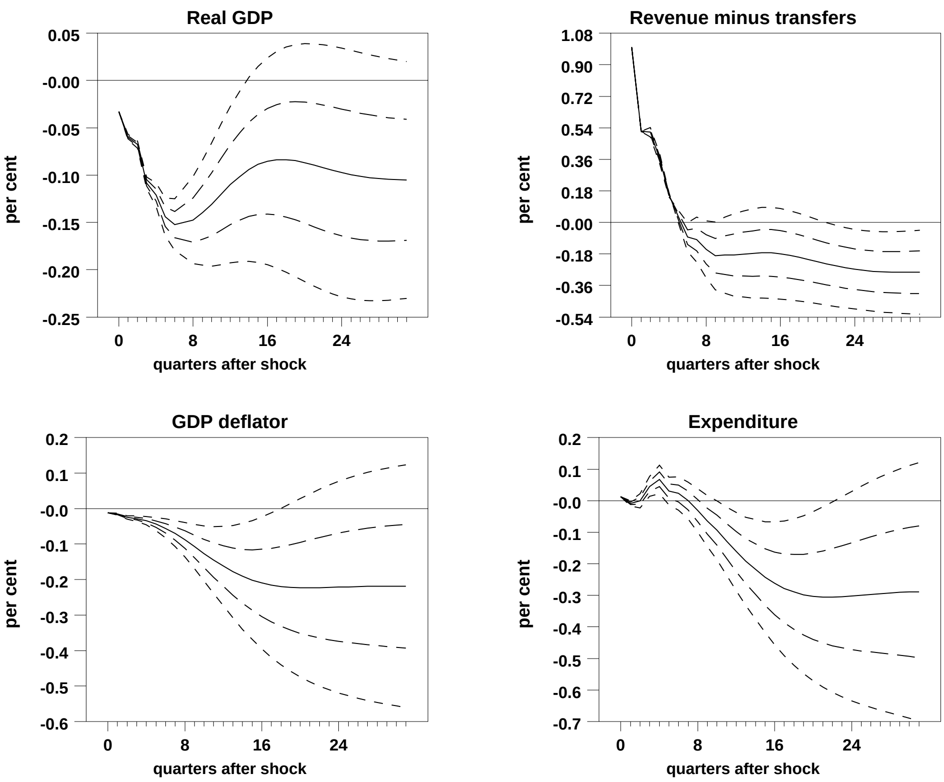

Fig. 18 Revenue shock: first component .68 and .95 probability bands (F-VAR)

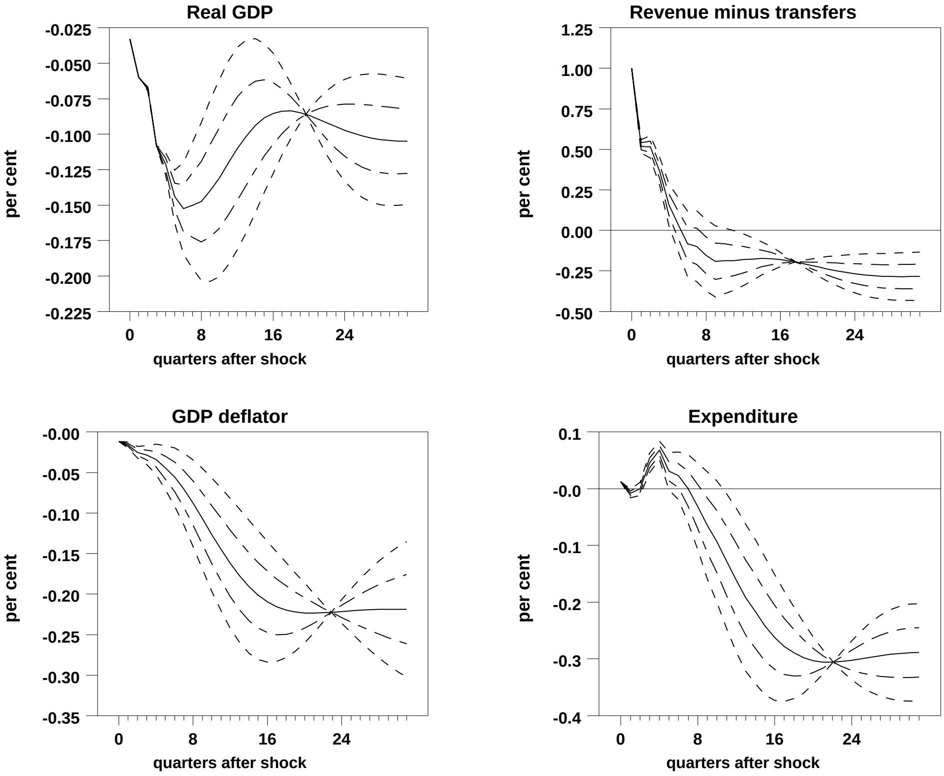

Fig. 19 Revenue shock: second component .68 and .95 probability bands (F-VAR)

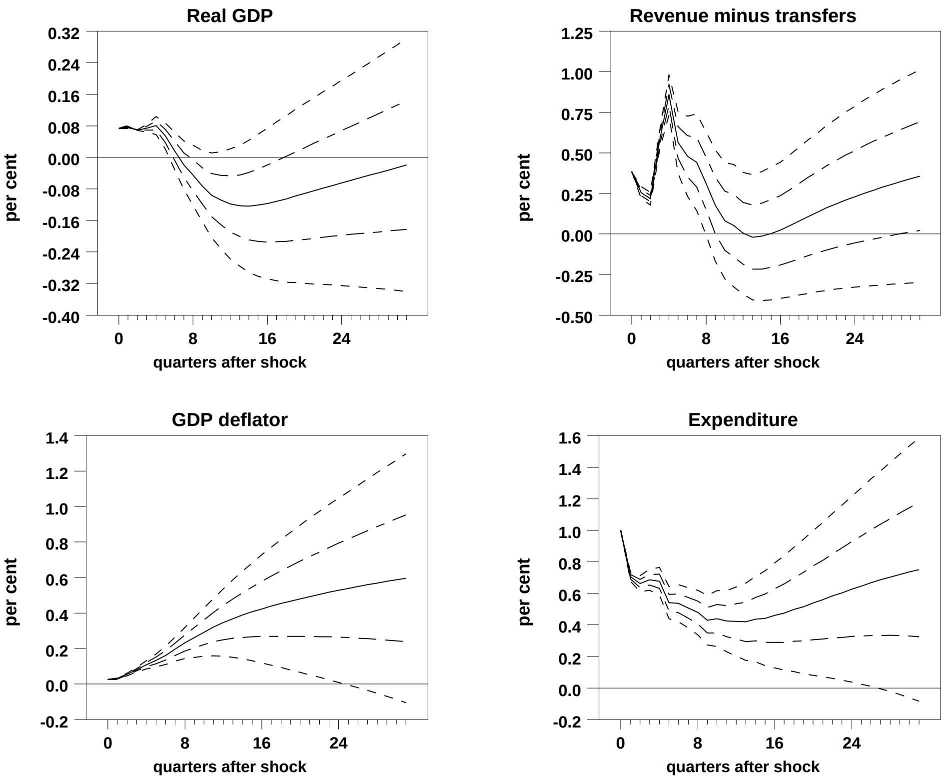

Fig. 20 Expenditure shock: first component .68 and .95 probability bands (F-VAR)

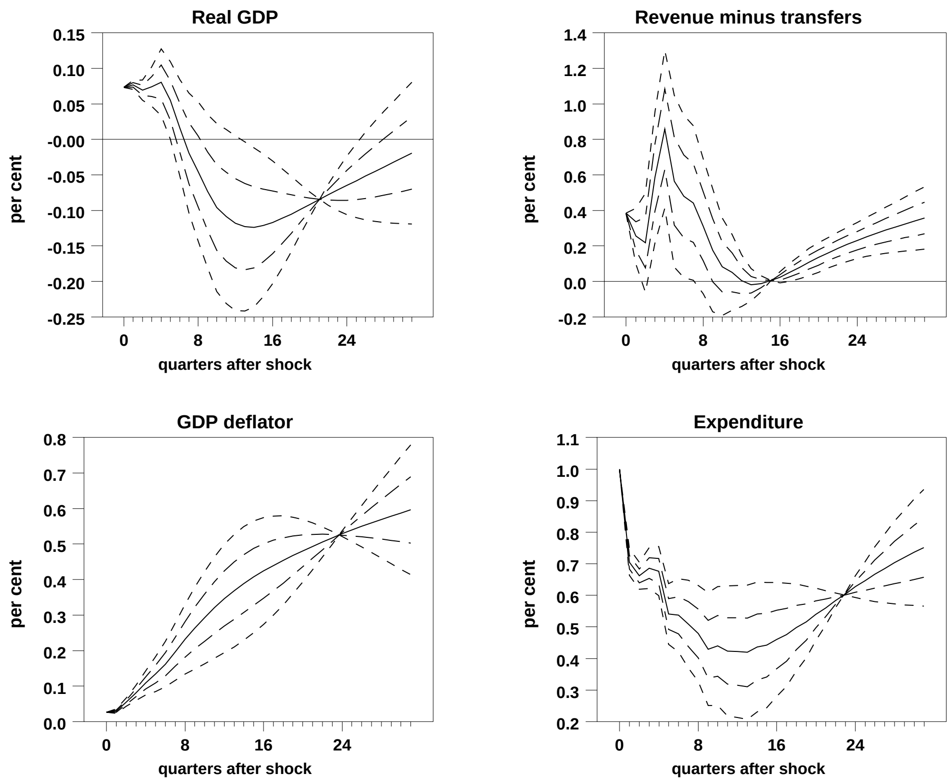

Fig. 21 Expenditure shock: second component .68 and .95 probability bands (F-VAR)

References

Alesina, A. and R. Perotti (1995), "Fiscal expansions and adjustments in OECD countries", *Economic Policy*, No. 21, pp. 205-248.

Alesina, A. and S. Ardagna (1998), "Tales of fiscal adjustment", *Economic Policy*, No. 28, pp. 487-545.

Baxter, M. and R. King (1993), "Fiscal policy in general equilibrium", *American Economic Review*, Vol. 83, No. 3, pp. 315-334.

Bernanke, B. and A. Blinder (1992), "The Federal funds rate and the channels of monetary transmission", *American Economic Review*, Vol. 82, No. 4, pp. 901-921.

Bernanke, B. and I. Mihov (1998), "Measuring monetary policy", *Quarterly Journal of Economics*, Vol. 113, No. 3, pp. 869-902.

Blanchard, O. J. (1985), "Debt, deficits and finite horizons", *Journal of Political Economy*, Vol. 2, pp. 223-247.

Blanchard, O. J. (1990), "Suggestions for a new set of fiscal indicators", Department of Economics and Statistics, Working Paper, No. 79, OECD.

Blanchard, O. J. and M. N. Watson (1986), "Are business cycles all alike?", in *The American business cycle: continuity and change*, Gordon, R. (ed.) University of Chicago Press.

Blanchard, O. J. and R. Perotti (1999), "An empirical characterization of the dynamic effects of changes in government spending and taxes on output", NBER Working Paper, No. 7269.

Blinder, A. (1981), "Temporary income taxes and consumer spending", *Journal of Political Economy*, No. 1, pp. 26-53.

Braun, A. P. and S. Mittnik (1993), "Misspecifications in vector autoregressions and their effects on impulse responses and variance decompositions", *Journal of Econometrics*, Vol. 59, No. 3, pp. 319-341.

Burnside, C., M. Eichenbaum and D. M. J. Fisher (1999), "Assessing the effects of fiscal shocks", Federal Reserve Bank of Chicago, Research Department, Working Paper, No. 18.

Canova, F. (1995), "The economics of VAR models", in Hoover, K. D. (ed.), *Macroeconometrics: Developments, Tensions, and Prospects*, Kluwer Academic Publishers.

Canova, F. and G. De Nicoló (2000), "Monetary disturbances matter for business cycle fluctuations in the G7", Board of Governors of the Federal System, International Finance Discussion, Paper No. 660.

Christiano, L. J., M. Eichenbaum and C. L. Evans (1998), "Monetary policy shocks: what have we learned and to what end?", NBER Working Paper, No. 6400.

Christiano, L. J., M. Eichenbaum and C. L. Evans (1996), "The effects of monetary policy shocks: evidence from the flow of funds", *Review of Economics and Statistics*, Vol. 78, No. 1, pp. 16-34.

Cochrane, J. (1998), "What do the VARs mean? Measuring the output effects of monetary policy", *Journal of Monetary Economics*, Vol. 41, No. 2, pp. 277-300.

Edelberg, W., M. Eichenbaum and J. D. M. Fisher (1998), "Understanding the effects of a shock to government purchases", NBER Working Paper, No. 6737.

Eichenbaum, M. (1992), "Comments on -Interpreting the time series facts: the effects of monetary policy- by Christopher Sims", *European Economic Review*, Vol. 36, No. 5, pp. 1001-1011.

Evans, C. L. and D. A. Marshall (1998), "Monetary policy and the term structure of nominal interest rates: evidence and theory", *Carnegie-Rochester Conference Series on Public Policy*, Vol. 49, pp. 53-111.

Fatás, A. and I. Mihov (1998), "Measuring the effects of fiscal policy", INSEAD, mimeo.

Fatás, A. and I. Mihov (1999), "The macroeconomic effects of fiscal policy", INSEAD, mimeo.

Faust, J. (1998), "The robustness of identified VAR conclusions about money", *Carnegie-Rochester Conference Series on Public Policy*, Vol. 49, pp. 207-244.

Galí, J. (1992), "How well does the IS/LM model fit post-war U.S. data?", *Quarterly Journal of Economics*, Vol. 107, No. 2, pp. 709-738.

Giavazzi, F. and M. Pagano (1990), "Can severe fiscal contractions be expansionary? Tales of two small European countries", NBER Macroeconomic Annual, MIT Press.

Gordon, D. and E. M. Leeper (1994), "The dynamic impacts of monetary policy: an exercise in tentative identification", *Journal of Political Economy*, Vol. 102, No. 6, pp. 1228-1247.

Grossman, H. I. (1995), "American fiscal policy in the 1990s", NBER Working Paper, No. 5109.

Kim, S. (1999), "Do monetary policy shocks matter in the G-7 countries? Using common identifying assumptions about monetary policy across countries", *Journal of International Economics*, Vol. 48, No. 2, pp. 871-893.

Leeper, E. M. (1993), “The policy tango: toward a holistic view of monetary and fiscal effects”, *Economic Review*, Federal Reserve Bank of Atlanta, Vol. 78, No. 4, pp. 1-27.

Leeper, E. M. and G. David (1992), “In search of the liquidity effect”, *Journal of Monetary Economics*, Vol. 29, No. 3, pp. 341-369.

Leeper, E. M., C. A. Sims and T. Zha (1996), “What does monetary policy do?”, *Brookings Papers on Economic Activity*, Vol. 2, pp. 1-78.

Poterba, J. M. (1988), “Are consumers forward looking? evidence from fiscal experiments”, *American Economic Review Papers and Proceedings*, Vol. 78, No. 2, pp. 413-418.

Poterba, J. M. (1996), “Do budget rules work?” NBER Working Paper, No. 5550.

Ramey, V. and M. Shapiro (1998), “Costly capital reallocation and the effects of government spending”, *Carnegie Rochester Conference on Public Policy*, Vol. 48, pp. 145-194.

Romer, C. and D. Romer (1989), “Does monetary policy matter? A new test in the spirit of Friedman and Schwartz”, in O. J. Blanchard and S. Fischer (eds.), *NBER Macroeconomic Annual*, Cambridge MA, MIT Press.

Sims, C. A. (1980), “Macroeconomics and reality”, *Econometrica*, Vol. 48, No. 1, pp. 1-48.

Sims, C. A. (1992), “Interpreting the macroeconomic time series facts: the effects of monetary policy”, *European Economic Review*, Vol. 36, No. 5, pp. 975-1000.

Sims, C. A. (1994), “A simple model for the determination of the price level and the interaction of monetary and fiscal policy”, *Economic Theory*, Vol. 4, No. 3, pp. 381-399.

Sims, C. A. and T. Zha (1999), “Error bands for impulse responses”, *Econometrica*, Vol. 67, No. 5, pp. 1113-1155.

Strongin, S. (1995), “The identification of monetary policy disturbances: explaining the liquidity puzzle”, *Journal of Monetary Economics*, Vol. 35, No. 3, pp. 463-495.

Uhlig, H. (1999), “What are the effects of monetary policy on output?”, Tilburg University, mimeo.

Waggoner, D. F. and T. Zha (1997), “Normalization, probability distribution, and impulse response”, Federal Reserve Bank of Atlanta, Working Paper, No. 11.

Walsh, C. (1998), *Monetary theory and policy*, Cambridge, MA, MIT Press.

RECENTLY PUBLISHED "TEMI" (*)

No. 400 — *Is the Italian Labour Market Segmented?*, by P. CIPOLLONE (March 2001).

No. 401 — *Optimal Debt Maturity under EMU,* by R. GIORDANO (March 2001).

No. 402 — *Il modello di specializzazione internazionale dell'area dell'euro e dei principali paesi europei: omogeneità e convergenza,* by M. BUGAMELLI (March 2001).

No. 403 — *Seasonality and Capacity: an Application to Italy,* by G. DE BLASIO and F. MINI (June 2001).

No. 404 — *The Effects of Bank Consolidation and Market Entry on Small Business Lending,* by E. BONACCORSI DI PATTI and G. GOBBI (June 2001).

No. 405 — *Money Demand in the Euro Area: Do National Differences Matter?,* by L. DEDOLA, E. GAIOTTI and L. SILIPO (June 2001).

No. 406 — *The Evolution of Confidence for European Consumers and Businesses in France, Germany and Italy*, by P. CARNAZZA and G. PARIGI (June 2001).

No. 407 — *A Primer on Financial Contagion*, by M. PERICOLI and M. SBRACIA (June 2001).

No. 408 — *Correlation Analysis of Financial Contagion: What One Should Know before Running a Test*, by G. CORSETTI, M. PERICOLI and M. SBRACIA (June 2001).

No. 409 — *The Role of the Banking System in the International Transmission of Shocks*, by M. SBRACIA and A. ZAGHINI (June 2001).

No. 410 — *International Transmission Via Trade Links: Theoretically Consistent Indicators of Interdependence for Latin America and South-East Asia,* by C. BENTIVOGLI and P. MONTI (June 2001).

No. 411 — *Why is the Business-Cycle Behavior of Fundamentals Alike Across Exchange-Rate Regimes?,* by L. DEDOLA and S. LEDUC (August 2001).

No. 412 — *Political Institutions and Policy Outcomes: What are the Stylized Facts?,* by T. PERSSON and G. TABELLINI (August 2001).

No. 413 — *Equilibrium Welfare and Government Policy with Quasi-Geometric Discounting,* by P. KRUSELL, B. KURUŞÇU and A. A. SMITH, Jr. (August 2001).

No. 414 — *Insurance within the Firm,* by L. GUISO, L. PISTAFERRI and F. SCHIVARDI (August 2001).

No. 415 — *Limited Financial Market Participation: A Transaction Cost-Based Explanation,* by M. PAIELLA (August 2001).

No. 416 — *Decentramento fiscale e perequazione regionale. Efficienza e redistribuzione nel nuovo sistema di finanziamento delle regioni a statuto ordinario,* by G. MESSINA (August 2001).

No. 417 — *Personal Saving and Social Security in Italy: Fresh Evidence from a Time Series Analysis,* by F. ZOLLINO (August 2001).

No. 418 — *Ingredients for the New Economy: How Much does Finance Matter?,* by M. BUGAMELLI, P. PAGANO, F. PATERNÒ, A.F. POZZOLO, S. ROSSI and F. SCHIVARDI (October 2001).

No. 419 — *ICT Accumulation and Productivity Growth in the United States: an Analysis Based on Industry Data,* by P. CASELLI and F. PATERNÒ (October 2001).

No. 420 — *Barriers to Investment in ICT,* by M. BUGAMELLI and P. PAGANO (October 2001).

No. 421 — *Struttura dell'offerta e divari territoriali nella filiera dell'information and communication technologies in Italia,* by G. IUZZOLINO (October 2001).

No. 422 — *Multifactor Productivity and Labour Quality in Italy, 1981-2000,* by A. BRANDOLINI and P. CIPOLLONE (October 2001).

No. 423 — *Tax reforms to influence corporate financial policy: the case of the Italian business tax reform of 1997-98,* by A. STADERINI (November 2001).

No. 424 — *Labor effort over the business cycle,* by D. J. MARCHETTI and F. NUCCI (November 2001).

(*) Requests for copies should be sent to:
Banca d'Italia – Servizio Studi – Divisione Biblioteca e pubblicazioni – Via Nazionale, 91 – 00184 Rome (fax 0039 06 47922059). They are available on the Internet at www.bancaditalia.it