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MONETARY POLICY EFFECTS: NEW EVIDENCE FROM THE ITALIAN FLOW OF FUNDS

by Riccardo Bonci* and Francesco Columba*

Abstract

We obtain new evidence on the transmission of monetary policy to the economy by analyzing the effects of restrictive monetary policy shocks on Italian flows of funds over the period 1980-2002. Firms reduce their issuance of debt and their acquisitions of financial assets, so there is no evidence of strong financial frictions. Households increase short-term liabilities and diminish purchases of liquid assets and shares in the first quarter following a shock. The public sector increases net borrowing during the first two years. Financial corporations decrease their borrowing for three quarters, while the foreign sector increases borrowed funds. The results shed new light on the role played by the financial decisions of the various economic sectors in the transmission of monetary policy.

JEL Classification: E32, E52.

Keywords: flow of funds, monetary policy, VAR.

Contents

* Bank of Italy, Economics, Research and International Relations.

1. Introduction[1]

Since Sims (1980) a vast literature has assessed the effects of exogenous monetary policy shocks using vector auto-regression models (VAR). However, the impact of such shocks on the flows of borrowing and lending of economic agents, such as firms, households and the public sector, has been less investigated. Following Christiano, Eichenbaum and Evans (1996) (henceforth CEE, 1996) we make use of Italian flow-of-funds data to shed light on the pattern of financing and investment decisions of the sectors of the economy in response to unexpected variations in the policy interest rate.

CEE (1996) studied the effects of U.S. monetary policy with a VAR model applied to flow-of-funds data from 1961 to 1991. With this dataset it was possible to analyse variations in the financial assets and liabilities of each economic sector and, within those two aggregates, in the different classes of financial instruments. Despite the promising start, though, the literature did not , to our knowledge, pursue this research line further, probably because historical time series of adequate length, frequency and level of detail were lacking.

The recent availability of newly reconstructed quarterly flow-of-funds time series for Italy from 1980 has, for the first time, made it possible to analyse the effects of monetary policy on the financing and investment choices of the Italian economic sectors (namely non-financial firms, households, general government, financial corporations, plus the foreign

[1] We are especially grateful to Stefano Neri for useful suggestions and comments and to Francesco Nucci for helpful discussions. We thank, without implicating, Massimo Caruso, Larry Christiano, Riccardo De Bonis, Leonardo Gambacorta, Andrea Nobili, Luigi Federico Signorini, two anonymous referees and seminar participants at the 38th Annual Conference of the Money, Macro and Finance Research Group, at the 12th Conference of the Society for Computational Economics, at the XV International Tor Vergata Conference on Banking and Finance, at the SaDiBa conference on the Italian financial accounts, at the Bank of Italy and at the University of Rome, Tor Vergata, for useful comments and discussions. Massimo Coletta helped us with the flow-of-funds dataset. Any remaining errors are our own. The views expressed are those of the authors and do not involve the responsibility of the Bank of Italy.

sector) with a VAR model. We find new evidence on the heterogeneous responses of the different sectors to monetary policy shocks.

Our results for the main macroeconomic aggregates (our VAR model also contains variables such as output and the price level) are consistent with the literature and do not seem to be affected by the empirical puzzles that have plagued a number of works. Moreover, new features of the transmission of monetary policy shocks are provided through the flow-of-funds responses. Non-financial firms decrease both their acquisition of new financial assets and their issuance of liabilities up to a year after the shock; there is no strong evidence in favour of financial frictions that would prevent firms from adjusting their nominal expenditures promptly. In the first quarter after the shock, households increase their short-tem liabilities, diminish the acquisition of liquid assets and shares and increase the amount of securities in their portfolio. The public sector increases net borrowing (the public deficit rises) until almost two years after the shock. Financial corporations decrease the funds borrowed up to three quarters, while during the same period the foreign sector increases the amount of borrowed funds (i.e. Italy's net external position improves).

This evidence gathered from observing the response of Italian flow of funds, particularly that of firms and households, to a restrictive monetary shock provides new insights into the behaviour of financial variables that may usefully be taken into consideration in assessing the effects of monetary policy on the economy.

The paper is organized as follows. Section 2 explains how we measure monetary policy shocks in our VAR model. In Section 3 the Italian flow-of-funds dataset is described. Section 4 reports findings on the new features of the transmission of monetary policy obtained with the present analysis. Conclusions are drawn in Section 5.

2. Measures of monetary policy shocks

2.1 Identification

To identify monetary policy shocks we adopt a recursive VAR (vector auto regression) approach, following CEE (1999).[2] Our model includes the industrial production index (IP), the consumer price index (P), the import price of raw materials[3] (P_IMP), the nominal exchange rate of the Italian lira vis-à-vis the German mark[4] (EXR), a policy interest rate, namely the repo rate[5] (R), and a monetary aggregate (M2). All variables, except *EXR* and *R*, are seasonally adjusted.

The endogenous variables vector in our VAR specification (see Appendix 2 for methodological details) is

$$y_t' = \left(IP, P, P\_IMP, EXR, R, M2\right) \tag{1}$$

where variables are ordered from the most exogenous (starting from the left) to the most endogenous, reflecting our identifying assumption that policy shocks (i.e. shocks to *R*) have only lagged effects on the first four variables in brackets in equation (1).

Industrial production, the price level, the price of imported raw materials, and the exchange rate are assumed to be in the information set of the central bank at the time the interest rate is set, so that monetary policy reacts contemporaneously to the non-policy variables ordered before our monetary policy measure (the repo rate, *R*).

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[2] Details of the model can be found in Appendices 1 and 2.

[3] In local currency.

[4] The exchange rate since January 1999 is a constant because of the adoption of the single currency.

[5] From 1980 to 1981: average interest rate on fixed-term advances; from 1982 to 1998: auction rate on repurchase agreements between the Bank of Italy and credit institutions; from 1999 onwards: interest rate on main refinancing operations of the ECB. The latter interest rate does not present a particular break at the beginning of stage three of EMU with respect to the Italian repo rate, even if the convergence of interest rates under way since 1993 accelerated in 1998 (a circumstance that we acknowledge with a dummy variable).

We include the exchange rate in our specification as Italy can be regarded as a small open economy over the period observed. In particular, the exchange rate, which is not the focus of this work, is regarded as a non-policy variable because it was difficult for monetary policy to influence the variable contemporaneously, particularly in the first half of the 1980s. Moreover, as explained in the next section, we do not find compelling evidence in favour of the inclusion of the exchange rate among the policy variables.[6]

We consider the monetary aggregate M2 to be the only policy variable in our VAR specification, that is, the only variable reacting contemporaneously (within the same quarter) to the monetary policy shock. Monetary policy is assumed to respond to variations in M2 only with a lag.[7]

Our choice of the non-policy variables parallels that of Kim and Roubini (2000), who study the effects of monetary policy innovations on the G7 countries with a SVAR (structural vector auto regression) model, and seems to deal successfully with the empirical puzzles that trouble much of the rest of the literature.

We choose the interest rate as an indicator of monetary policy in line with the approach of Bernanke and Blinder (1992) and of De Arcangelis and Di Giorgio (2001), who argue that interest rate indicators outperform the ones based on monetary aggregates in identifying Italian monetary policy shocks. In particular, we decide to use the interest rate on repurchase agreements between the central bank and the credit institutions which, also according to

[6] We also checked for a treatment of the exchange rate as a policy variable without detecting significant changes in the results (see also footnote 13 and Neri, 2004).

[7] We chose not to perform cointegration analysis, in line with the empirical approach to modelling the effects of unexpected monetary policy shocks usually employed in the literature. Secondly, according to Sims, Stock and Watson (1990) standard asymptotic tests are still valid if the VAR is estimated in levels, even if the variables are cointegrated.

Gaiotti (1999) and Gambacorta and Iannotti (2007), better describes the monetary policy operating procedures adopted at the Bank of Italy.[8]

We include four lags in our VAR model, driven by the selection criteria reported in Table 1 (LR and final prediction error), in line with most quarterly VARs in the empirical literature. The VAR residuals show no autocorrelation (see the LM test results in Table 2). Furthermore, the hypothesis of normality is not rejected at high significance levels for all the variables considered for the single equations of the VAR (see the Jarque-Bera test results in Table 3). Three point dummies are included in the model in order to obtain well-behaved residuals in the six estimated equations.[9]

2.2 Assessing monetary policy shock measures

Our monetary policy shock measure is an orthogonalised shock to the repo rate, *R*. Figure 1, where shaded areas correspond to the recessions of the Italian economy as identified by Altissimo, Marchetti and Oneto (2000),[10] shows that the residuals of the interest rate equation fit quite well with the chronology of the recessions. Monetary policy stance is relatively tight in the period before each recession and becomes looser during the recession period.[11] Our measure of monetary policy is also consistent with the period of

[8] We tried to use alternative monetary policy indicators, such as reserve aggregates, in line with CEE (1996). Difficulties in interpreting these data, particularly at the beginning of the 1980s, put us in the same position as De Arcangelis and Di Giorgio (2001), who considered that a market-based approach did not give a good description of monetary policy in those years. We therefore resort only to interest rate indicators.

[9] The three dummies are also related to the three major turmoil in monetary policy in the period observed. The dummy in the third quarter of 1992 accounts for the contraction of monetary policy during the exchange rate crisis in autumn 1992; the second dummy, in the first quarter of 1995, corresponds to the monetary restriction that contrasted inflationary pressures and the exchange rate depreciation; the dummy in the third quarter of 1998 considers the series of interest rate cuts put in place to achieve convergence of the national interest rates with the common level of the new currency area created in 1999.

[10] The authors identified three recessions, respectively between March 1980 and March 1983, March 1992 and July 1993, November 1995 and November 1996.

[11] With the possible exception of the first period, when the policy rate is highly volatile.

monetary restriction from 1994 to 1996, during which inflationary pressures arising from the exit of the lira from the European Monetary System (EMS) exchange rate mechanism (in 1992) and the depreciation shock (in 1995) were counteracted (see Gaiotti, 1999).

To check the proper identification of monetary policy shocks further, we control for the response to a one standard deviation increase in the monetary policy interest rate of the macroeconomic variables directly affected by monetary policy: impulse response functions are reported in Figure 2.[12] Industrial production declines, although initially with limited significance, for about two years after the shock and then bounces back to the pre-shock level three years later. This result is consistent with existing empirical literature for Italy and for other G7 countries. Prices, as measured by the consumer price index, start declining two quarters after the shock, as the theory predicts.[13] The exchange rate appreciates (a lower value of EXR means an appreciation of the Italian currency with respect to the German mark), although with limited statistical significance, reaching the maximum effect three quarters after the shock.[14] The monetary aggregate M2 declines immediately, consistently

[12] The responses of the variables to a monetary policy shock are computed with 1000 Monte Carlo simulations over 16 quarters; following Sims and Zha (1999) the confidence bands are one standard error wide, corresponding to a 68 per cent confidence interval, since "[…] for characterising likelihood shape, bands that correspond to 50% or 68% posterior probability are often more useful than 95% or 99% bands, and confidence intervals with such low coverage probabilities do not generally have posterior probabilities close to their coverage probabilities."

[13] We do not find what is known in the literature as the "price puzzle", that is an increase in the price level after a monetary restriction, contrary to the theory which predicts instead a decrease (see Kim and Roubini, 2000). The inclusion of the price of imported raw materials among the endogenous variables properly has the purpose of tackling the price puzzle. This is in line with CEE (1996), who include the price of commodities, as conjectured by Sims (1992), to take account of inflation indicators in the reaction function of the central bank that may be missing from the VAR model.

[14] This result allows our results to be exempt from the "exchange rate puzzle" (even excluding from the sample the last four years when the exchange rate is constant), i.e. an impact depreciation of the currency after a monetary contraction (see Sims, 1992, and for Italy, Chiades and Gambacorta, 2004 and De Arcangelis and Di Giorgio, 2001). We believe this is mainly because of the different identification scheme adopted and the inclusion of the price of imported raw material, since even restricting the sample to the years examined in the two works on Italy we have cited does not change our results. As we have no evidence of exchange rate puzzle we do not think it is necessary to depart from the recursiveness assumption (which we also prefer for preserving comparability with the results in CEE, 1996) in order to allow simultaneous causality between the policy rate and the exchange rate as other authors have done in order to address the puzzle (see Clarida, Galì

with the presence of a liquidity effect,[15] and then bounces back, losing statistical significance after a year. Quite interestingly, this is also the period in which the response of the interest rate is significantly different from zero, i.e. the first four quarters following the shock.

To provide further evidence on the quality of our identification of monetary policy shocks, we also examine the responses of other main macroeconomic aggregates excluded from our benchmark VAR specification. As reported in Figure 3, the decline in private consumption is small but persistent, reaching a maximum after 5 quarters. Collective consumption, on the other hand, does not show a significant reaction, in line with the well-known low cyclicality of this variable in Italy. The decrease in gross fixed investments, probably due to the decline in expected future profitability, is much more marked than that in private consumption, in line with theoretical priors. As expected, the unemployment rate also displays a small positive reaction to the monetary policy shock in the short-run. Real wages react negatively to the increase in the interest rate, coherently with the fall in production and the rise in unemployment; this result reconciles Italian evidence both with the theory and with US stylized facts. The reaction of these macroeconomic variables supports our identification of the repo rate as the monetary policy indicator, and strengthens our confidence in a correct identification of the monetary policy shocks in our model.

The forecast error variance decomposition of each variable (including the ones not in the benchmark VAR specification used to check our identification) at different time horizons is reported in Table 4. Interest rate policy shocks account for more than 20 per cent of

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and Gertler, 1998; Dornbusch, Favero and Giavazzi, 1998; Gaiotti, 1999; and Smets, 1997). Nevertheless, for the sake of robustness we allow for simultaneous causality between the two rates by adopting an identification scheme *à la* Kim and Roubini (2000), widely considered adequate to deal with the exchange rate puzzle, without detecting any major change in the impulse responses (results are available on request).

[15] We have no evidence of the "liquidity puzzle" found when monetary policy shocks are identified as innovations in monetary aggregates and innovations appear to be associated with increases rather than decreases in nominal interest rates.

fluctuations in industrial production at the peak, while they explain between 5 and 10 per cent of fluctuations in price level, exchange rate and import prices. Observing the results for the other main macroeconomic variables we can confirm that monetary policy is an important source of output fluctuations in our framework. Monetary policy shocks account for one-third of the 2-year-ahead forecast error of fixed investment and for about one-fifth of private consumption and unemployment rate.

Our results are consistent with the theoretical predictions of the effects of unexpected monetary policy shocks and with the empirical literature using VAR models,[16] without being affected by significant empirical puzzles.

2.3 Robustness

Motivated by the vast literature, we also explored different specifications of our VAR model, although the main results stay virtually unchanged as regards the qualitative and quantitative responses. In particular, we considered different interest rates, such as the three-month interest rate, the overnight interest rate and different averages of these rates and of the repo rate, as policy rate. In alternative to industrial production, we also considered GDP measures. Moreover, we tried to use other monetary aggregates in place of M2, such as M1 and M3 measured with simple or moving averages, and different definitions of each aggregate.[17] We also used alternative measures of inflation (the GDP deflator) and of commodities prices (including or excluding oil) and a number of definitions of the exchange rate: effective, vis-à-vis the German mark, vis-à-vis the US dollar, real or nominal. We also

[16] Notably, Gaiotti (1999) describes in detail the transmission of monetary policy in Italy from 1967 to 1997.

[17] During the period of observation, apart for the major methodological break in 1999 when new definitions of monetary aggregates were adopted, M2 witnessed changes in its definition; moreover different definitions of M1 are conceivable. Finally, we considered M1 and M2 evaluated at the end of each period as (simple or moving) averages and as seasonally adjusted or not.

tried to control for the exogeneity of commodity prices, but we detected a worsening in the quality of the response of the monetary aggregate without observing improvements in the response of the other variables and therefore we prefer to assume commodity prices are endogenous. Finally, even if we are not concerned with structural parameters, we excluded the last four years of the sample to account for a possible change in the monetary policy regime at the start of the single currency area, without detecting significant changes in our results[18].

3. Italian Flow of Funds

Flow-of-funds data generally enable us to examine the linkages between the financial positions of the different sectors of the economy, reconciling the identity of saving and real capital formation in any period, for the economy as a whole, with the fact that at the same time individual spending units (sectors) have the option of investing (in real assets) more or less than they have saved. In fact, for each sector the difference between fixed investment and gross saving causes a change in the net financial position, also called "net lending/net borrowing", towards the rest of the economy (considering both the other domestic sectors and the foreign sector). For sector *i*:

$$I^i - S^i = FL^i - FA^i = net\ funds\ raised \qquad (1)$$

where *S* is saving, i.e. the excess of disposable income over consumption, *I* is tangible investment (fixed capital formation and changes in inventories), *FL* and *FA* are the net incurrence of financial liabilities and the net acquisition of financial assets, respectively.

[18] This may be due to the small size of the policy interest rate shock in the four years considered compared with the previous part of the sample.

Since any financial asset is necessarily a liability to someone else, for the economy as a whole equation (1) reduces to the well-known national accounts identity $S = I$.

We consider the following sectors: (i) households, (ii) non-financial firms, (iii) financial firms, (iv) general government, and (v) the foreign sector.[19] For each sector in turn, besides net funds raised, we look at its transactions in financial assets (new asset acquisitions) and liabilities (new debt issuances), that is *FA* and *FL* respectively. Moreover, in the case of households and non-financial firms we provide further insight by observing the responses of financial transactions at a more disaggregated level. For households we split assets among deposits (and cash), short-term securities, long-term securities and equity (both listed and unlisted), and we distinguish among liabilities between short-term and long-term loans. In the case of non-financial firms we focus mainly on liabilities, distinguishing between short-term and long-term debt, and further splitting the latter into equity and other long-term debt (corporate bonds and long-term loans).

Regarding financial assets and liabilities of the various sectors, we exploit a recent reconstruction of quarterly flow-of-funds data for Italy from 1980 done at the Bank of Italy.[20] These data are presented in Figure 4, in which each graph shows net funds borrowed (positive values) or lent (negative values) by the different sectors in the period 1980-2002. Not surprisingly, at least for the Italian economy, households are net lenders over the whole

[19] In the present work we consider a genuine "consumer" household sector, while in the Italian flow of funds the household sector comprises "producer" households (small unincorporated firms and sole proprietorships with less than five employees). We prefer to include the latter among non-financial firms so as to include all the producer units in the non-financial sector, regardless of firm size or of legal form. The other sectors are consistent with the ESA95 (European System of National Accounts) classification, which is also applied in the Italian flow of funds. Financial firms include banks, money market funds, financial auxiliaries and insurance companies and pension funds (the Bank of Italy is excluded). The general government sector includes central government, local government and social security funds. The foreign sector includes all the units not resident in Italy.

[20] In the former dataset the time series show a discontinuity in 1995 because of differences in the compilation method, in the classification criteria and in the accounting principles introduced with the adoption

period; the opposite happens for general government and, with very few exceptions, for non-financial firms.

4. Effects of monetary policy shocks on flow of funds

VAR models have been very widely used to assess the effects of unexpected monetary policy shocks on the economic system.[21] Here we recall briefly the main results of the works that we think are most relevant to our analysis.

CEE (1996) address the empirical evaluation of the response of the borrowing and lending behaviour of different categories of economic agents to monetary policy shocks using US flow-of-funds data. One of their main results is that net funds raised by firms in the financial markets increase for about a year after a monetary policy tightening and begin to fall later on, when recession gains momentum. The authors explain this finding by the existence of financial frictions, mainly due to contracts in place that would prevent firms from immediately adjusting their level of inventories to the new (lower) level of demand as predicted by standard monetary business cycle models. A second result found by CEE (1996) is that households do not adjust their financial position to monetary policy shocks for a number of quarters, in line with the predictions of limited participation models that claim households show a certain degree of rigidity in adapting their financial choices. Finally, there appears to be a (surprising) temporary reduction in government net borrowing. The authors themselves find the latter result "puzzling" and point, as a possible explanation, to a

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of the ESA95 (European System of Accounts 1995; see Eurostat, 1996).

[21] For a review of the literature see, among others, Bagliano and Favero (1998), Bernanke and Mihov (1998), Christiano, Eichenbaum and Evans (1999), Kim (1999), Rudebusch (1998) and Walsh (2003).

temporary increase in personal tax receipts that vanishes after about a year as the recession takes hold.

Our work aims to extend the analysis of the transmission of monetary policy shocks in Italy by bringing the investigation of flow-of-funds variables into the picture.[22] Following CEE (1996), we assess the effects of monetary policy shocks (an unexpected one standard deviation increase in the policy interest rate, corresponding to 92 basis points in our case) on the borrowing and lending activities of the various economic sectors. To this end we analyse the flow-of-funds series to detect the dynamic responses of non-financial firms, households, general government, financial firms and the foreign sector to such shocks.

In order to achieve this goal we employ what is known as the "marginal method", that is, we take our benchmark (six-variable) VAR specification and then add, as the last variable (the most endogenous), each of the flow-of-funds series in turn. This implies that monetary policy does not react in the short run to changes in the patterns of such variables, but that these financial variables respond to monetary policy shocks within the same quarter they have occurred. In the rest of this section we describe our results for the borrowing and lending behaviour of the sectors of the Italian economy after an unexpected monetary policy restriction.

Non-financial firms. – The accumulation of assets by non-financial firms decreases significantly in the first two quarters after the monetary shock. After that period the variation fades completely. Total financial liabilities also diminish, but for a longer time (two years). Among new liabilities issued by firms, shares and other equity (unlisted) decline

[22] Quite interestingly for our focus on financing and investment decisions, Dedola and Lippi (2005) find that output responses to monetary policy shocks differ among different industry sectors and are systematically related to output durability, financing requirements, borrowing capacity and firm size, both in Italy and in other

significantly for only one quarter, while the decrease in bonds issued and in long-term loans is protracted for one and a half years. At the same time, we do not observe a strong reaction to the monetary policy shock on the part of net funds raised by non-financial firms owing to the two counterbalancing responses observed on the asset and the liability side (see Figure 5).

Following a contractionary monetary policy shock, CEE (1996) observe an increase in firms' financial assets and liabilities, but in their case the two effects do not completely offset, so that net borrowing eventually rises. The authors point to some degree of inertia in firms' level of nominal expenditures as a possible explanation.[23] Our results appear different in some respects: except for a slight increase in the same quarter as the shock, the response of net funds raised is never significant in our model. The reduction in firms' issuance of new debt seems more consistent with both the "money view" (standard IS/LM models) and the "credit view" (e.g. Bernanke and Blinder, 1988) of the transmission mechanisms of monetary policy and also with monetary business cycle models (Fuerst, 1994). We do not find evidence in support of cost inertia, with the possible exception of a small (and non-significant) increase in short-term liabilities in the first three quarters following the shock. The fall we observe in firms' acquisition of new financial assets also appears to be in line with standard predictions of the effects of a restrictive monetary policy shock. Our findings as for the smaller financial frictions on firms' assets and liabilities, compared with those found by CEE (1996), may be due to structural differences between the Italian and US economies, as well as to the different time span examined. The 1961-1992 sample used by CEE (1996) in fact contains the years before the "great moderation" (namely the 1970s),

industrialized countries. Gaiotti and Generale (2002) estimate the effects of monetary policy on the investment behaviour of Italian firms with a panel dataset, finding that financial variables do matter.

[23] See also Bernanke and Blinder (1992) and Gertler and Gilchrist (1993).

when financial variables displayed considerable volatility and market mechanisms experienced substantial frictions (Justiniano and Primiceri, forthcoming; Smets and Wouters, 2005 and 2007). The circumstance that in CEE (1996) the reduction in firms' incurrence of new debt is concentrated in the short-term component, while it concerns more the long-term component in our results, may in fact be due to the role of the above financial frictions (typically affecting the shorter-term response to the restrictive shock) and to differences in firms' expectations regarding long-term interest rate patterns after the restrictive shock.

Households. – Net funds borrowed by households decline significantly over the first year following the contractionary shock, thus improving their net financial position as a result of smaller debt issuance and a larger amount of funds lent to other sectors (Figure 6).

The strong evidence on net funds raised is the result of two opposite (and weaker) effects observed on the asset and on the liability side. The maximum negative effect on the flows of new financial liabilities is reached in the second quarter, while financial assets increase significantly only in the first quarter, after which the positive effect vanishes. It should be noted that the responses of the flows of households' assets and liabilities were much stronger in CEE (1996).

Among financial assets, currency, deposits and shares decline sharply in the first quarter. Deposits might decrease because of an increase in their opportunity cost,[24] which happens if financial corporations do not adjust passive interest rates as quickly as rates adjust on alternative liquid instruments on the market, such as short-term Treasury securities.[25]

[24] Although in the Italian financial accounts there is no distinction between deposits and currency (which add up to M1), we know from monetary statistics that on average currency accounted for only one sixth of M1 in Italy in the period examined.

[25] This could reflect some sluggishness in the response of bank deposit rates as found by Gambacorta and Iannotti (2007), especially before the introduction of the Consolidated Law on Banking in 1993.

Accordingly, acquisition of short-term securities increases in the first quarter, benefiting from the temporary increase in the interest rate differential with demand deposits. The following reduction in the acquisition of short-term securities up to the second year after the shock may indeed reflect a return of the interest rate differential with demand deposits to the pre-shock level. After an initial upsurge the acquisition of bonds (long-term securities) does not react much to the shock, in line with the interest rate shock affecting only on the short-term part of the interest rate curve, as is normally believed to be the case. The decrease in the acquisition of shares may be connected with the worse prospects for economic activity perceived by households after the restrictive shock.

As for liabilities, short-term loans taken out by households increase in the first quarter, pointing to some tensions in cash needs, but this does not impair the overall result of a decrease in net funds borrowed after the shock. Long-term loans, on the other hand, decrease significantly up to the third quarter.

Other sectors. – We complete the analysis of the overall effects of an unexpected restrictive monetary policy shock on the net financial flows of the Italian economic sectors by looking at the responses of net funds raised by financial corporations, general government and the foreign sector (see Figure 7).

We find that in conjunction with the initial decrease in funds borrowed by non-financial firms and by households, funds borrowed by the public sector and the foreign sector increase, as do those lent by financial corporations.

General government experiences a deterioration of its net financial position, increasing the financial resources borrowed by the other sectors, in line with what one would expect during a slowdown of the economy. Our result differs from that of CEE (1996), who find a decrease in the public deficit following a monetary shock, possibly due to the structure of the US tax system.

Turning to financial corporations, after an initial increase they decrease net funds borrowed up to three quarters after the shock. Nevertheless, due to the low statistical significance of the responses of both assets and liabilities, we prefer to play down this result, partly because of the high volatility of the time series involved (see Figure 4).

The foreign sector increases the amount of funds borrowed until the third quarter after the shock[26] (see Figure 7) after which the variation fades completely. The increase in liabilities in the first year after the shock might be attributed to the differences in the timing of the variation in the demand for funds coming from the Italian economy and from the rest of the world that are induced by the restrictive shock. The contraction of the domestic economy would decrease the internal demand for funds, while the request for funds from the foreign sector would not be equally affected by the shock.[27]

5. Conclusions

From an analysis of the responses of financial saving and investment decisions by the Italian economic sectors to an unexpected one standard deviation increase in the policy interest rate we reach the following conclusions.

[26] The slight decrease observed in the first quarter after the shock is not statistically significant.

[27] This could apply particularly to the restriction in Italian monetary policy between 1994 and 1996.

Non-financial firms decrease both financial assets and liabilities in the first four quarters following the unexpected monetary tightening. We do not find evidence in favour of strong financial frictions that would prevent firms from adjusting their nominal expenditures promptly. In our model firms behave as predicted by standard monetary models, reducing their liabilities after the shock. Households diminish the acquisition of liquid assets and of shares in the first quarter after the shock and increase that of securities. The public sector increases net borrowing until almost two years after the shock owing to the increase in the burden of the public debt following the interest rate increase and to the fall in tax receipts induced by the economic slowdown. Financial corporations decrease net funds borrowed for up to three quarters after the shock, while the foreign sector increases the amount of funds borrowed from Italian domestic sectors until the third quarter after the shock.

As regards other main macroeconomic variables, the results of the VAR analysis are consistent with most theoretical predictions and with the empirical evidence available in the literature. In the first four quarters after the shock (a 92 basis point unexpected increase in the repo rate) industrial production decreases by around 40 basis points, the price level declines by 11 basis points, while the money stock drops by 34 basis points. Moreover, our results are not affected by any price, liquidity and exchange rate puzzles.

Appendix 1: data description

VAR endogenous variables:

IP: log of seasonally adjusted industrial production index (Source: OECD, Units: base 1980:1 = 100).

P: log of seasonally adjusted consumer price index (Source: IMF, International Financial Statistics, base 1980:1 = 100).

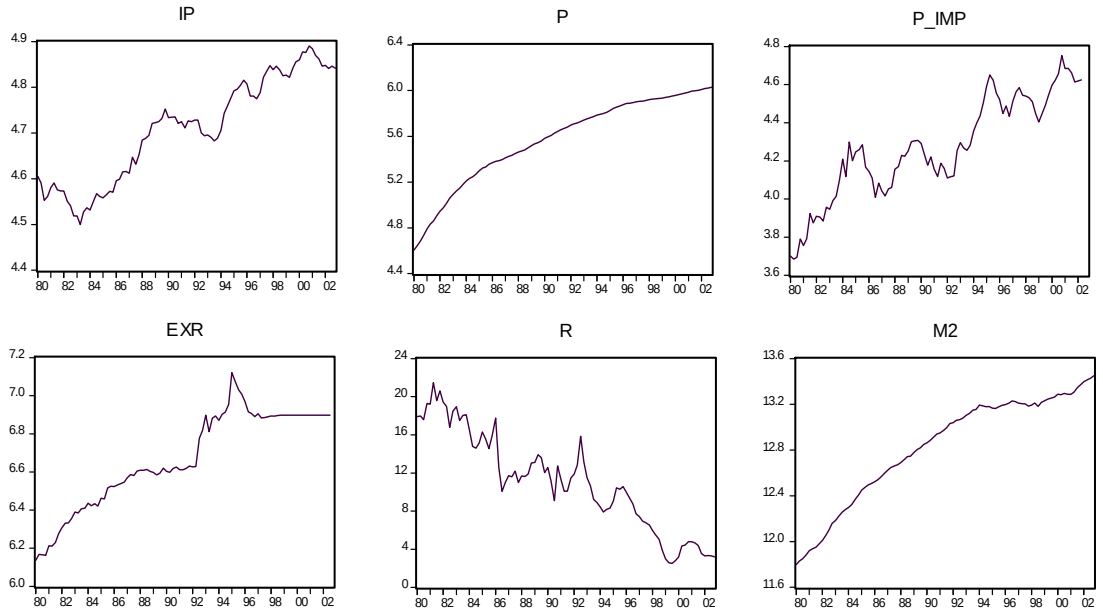
P_IMP: log of seasonally adjusted import price of raw materials (Source: OECD, index number, in local currency).

EXR: log of nominal exchange rate (ITL per DM; from 1999 it is a constant) (Source: Banca d'Italia).

R: short-term interest rate (from 1980 to 1981: average interest rate on fixed term advances; from 1982 to 1998: auction rate on repurchase agreements between the Bank of Italy and credit institutions; from 1999 onwards: interest rate on main refinancing operations of the ECB) (Source: own calculations from Banca d'Italia and ECB data).

M2: log of seasonally adjusted monetary aggregate M2 (Source: Banca d'Italia).

Graphs of VAR endogenous variables



Financial accounts series (converted to billions of 1995 ITL using the GDP deflator, and seasonally adjusted):

- non-financial corporations: total financial assets (NFTAS), total financial liabilities (NFTLI), net funds raised (NFNET=NFTLI-NFTAS), short-term liabilities (NFSLI), shares and other equity (NFELI), other long-term debt (NFDLI), long-term liabilities (NFLLI=NFELI+NFDLI);

- financial corporations: total financial assets (FCTAS), total financial liabilities (FCTLI); net funds raised (FCNET=FCTLI-FCTAS);

- households: total financial assets (HTTAS), total financial liabilities (HTTLI), net funds raised (HTNET=HTTLI-HTTAS), currency and deposits (HTDAS), short-term securities (HTSAS), long-term securities (HTBAS), shares and other equity (HTEAS), short-term loans (HTSLI), long-term loans (HTLLI);

- general government: total financial assets (GGTAS), total financial liabilities (GGTLI); net funds raised (GGNET=GGTLI-GGTAS),

- rest of the world:, total financial assets (RWTAS), total financial liabilities (RWTLI), net funds raised (RWNET=RWTLI-RWTAS)

Appendix 2: methodological issues

We assume the economy is described by a structural form equation such as the following:

$$A(L)y_t = u_t \tag{1}$$

where *A(L)* is a matrix polynomial in the lag operator *L*, y_t is an n×1 vector containing the variables of interest, and u_t is an n×1 structural disturbances vector. Let Ω be the n×n variance-covariance matrix of the *structural disturbances*; since u_t are assumed to be mutually uncorrelated, the matrix Ω is diagonal, the n diagonal elements being the variances of the n structural disturbances.

Writing (1) in reduced form gives the following representation:

$$y_t = B(L)y_t + e_t \tag{2}$$

which can be estimated using OLS equation by equation. *B(L)* is a matrix polynomial in the lag operator *L* and the e_t terms in equation (2) are the VAR (reduced-form) *residuals* resulting from the estimation of the n regressions. We call Σ the variance-covariance matrix of the residuals.

The structural disturbances u_t and the reduced form residuals e_t are related by:

$$e_t = A_0^{-1}u_t \tag{3}$$

where the coefficients in the A_0 matrix are those of the contemporaneous relations among the variables in the y_t vector. From eq. (3) and remembering that $\text{var}(e_t) = \Sigma$ and $\text{var}(u_t) = \Omega$:

$$\Sigma = A_0^{-1}\Omega A_0^{-1\prime} \tag{4}$$

To recover the parameters in the structural form equations (1) from the coefficients estimated in the reduced form equations (2) sample estimates of Σ can be used in order to obtain maximum likelihood estimates of Ω and A_0. We make use of a Choleski factorization in order to orthogonalize the residual covariance matrix Σ. In practice, this is equivalent to imposing just $n \times (n-1)/2$ restrictions on the matrix A_0, which is supposed to be lower triangular (all the upper diagonal elements are set to be 0); as a result, the VAR is just identified.

Appendix 3: Figures and Tables

Fig. 1 – Estimated interest rate policy shocks
(three-quarters centred moving average)

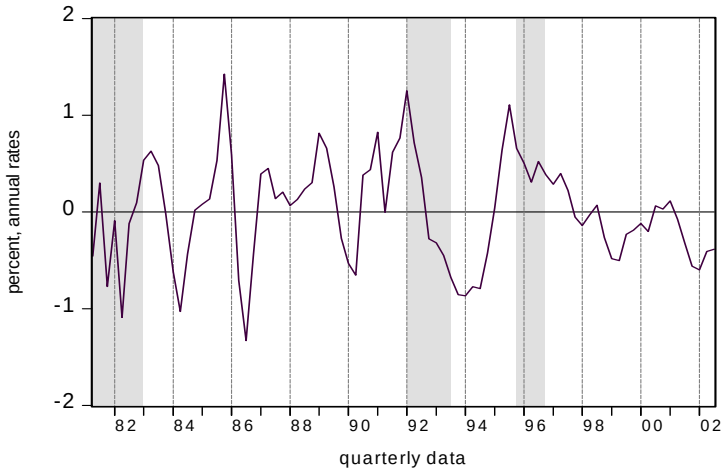
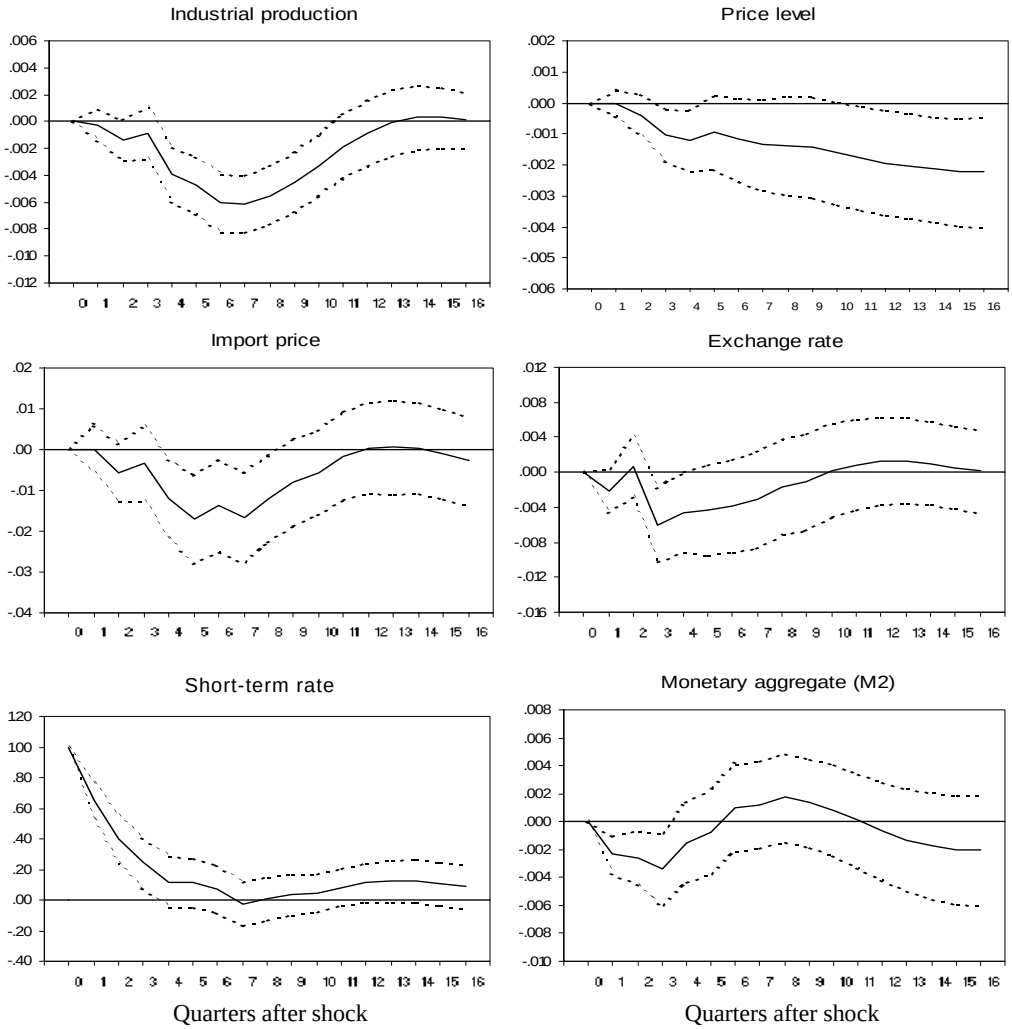
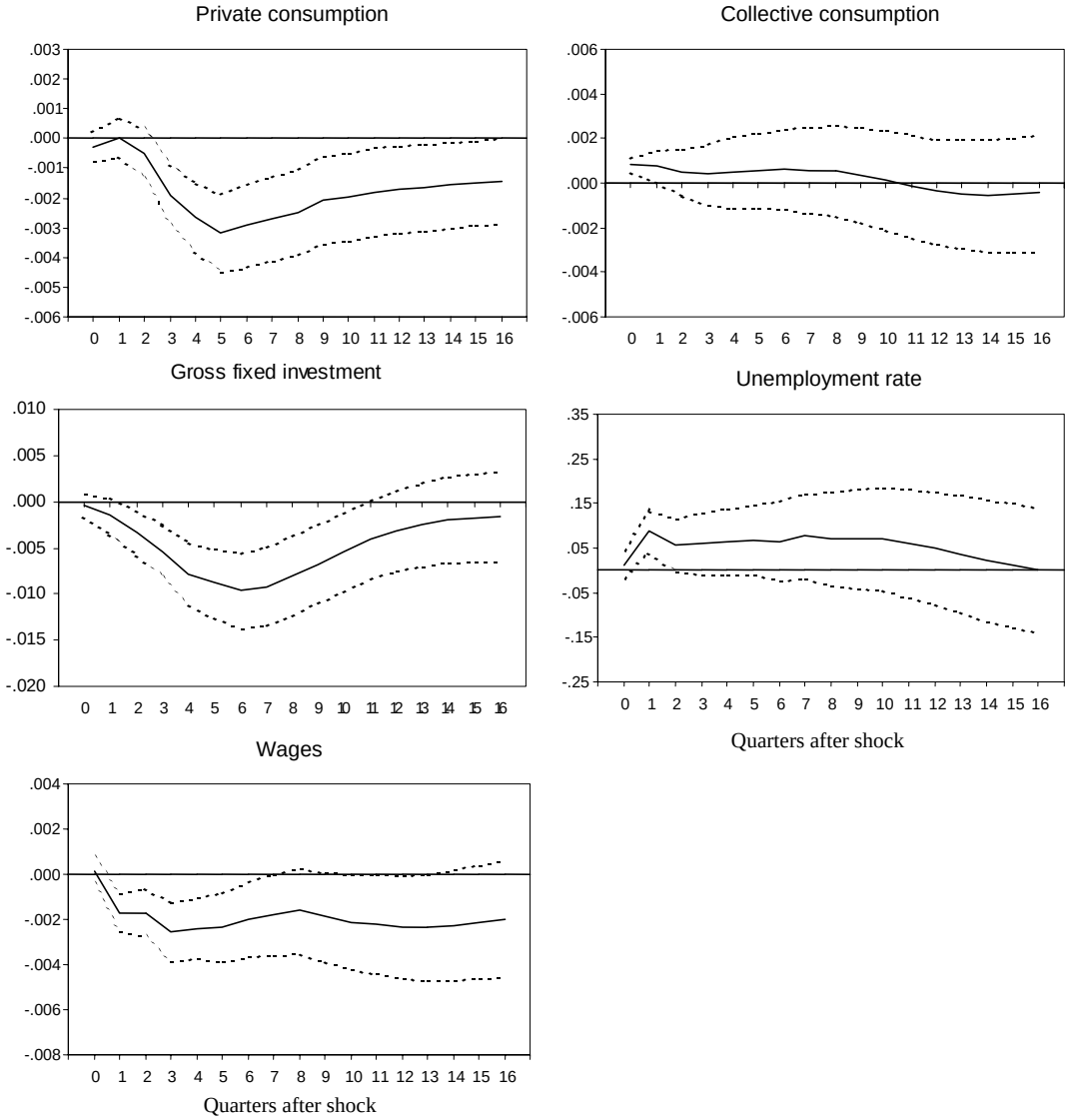


Fig. 2 – Responses to a contractionary monetary policy shock: VAR variables



Note: estimated impulse responses to a one standard deviation increase in the short-term interest rate. The dashed lines are ± 1 standard error bands, computed by means of Monte Carlo integration, following Sims and Zha (1999).

Fig. 3 – Responses to a contractionary monetary policy shock: other macro variables



Note: the estimated impulse responses were estimated from 7-variable VARs in which we added one of the above variables, in turn, to the original 6-variable VAR, placing it in the last position. The dashed lines are ± 1 standard error bands, computed by means of Monte Carlo integration, following Sims and Zha (1999).

Fig. 4 – Flow-of-funds data: net funds raised by sectors
(converted to billions of 1995 ITL using the GDP deflator and seasonally adjusted)

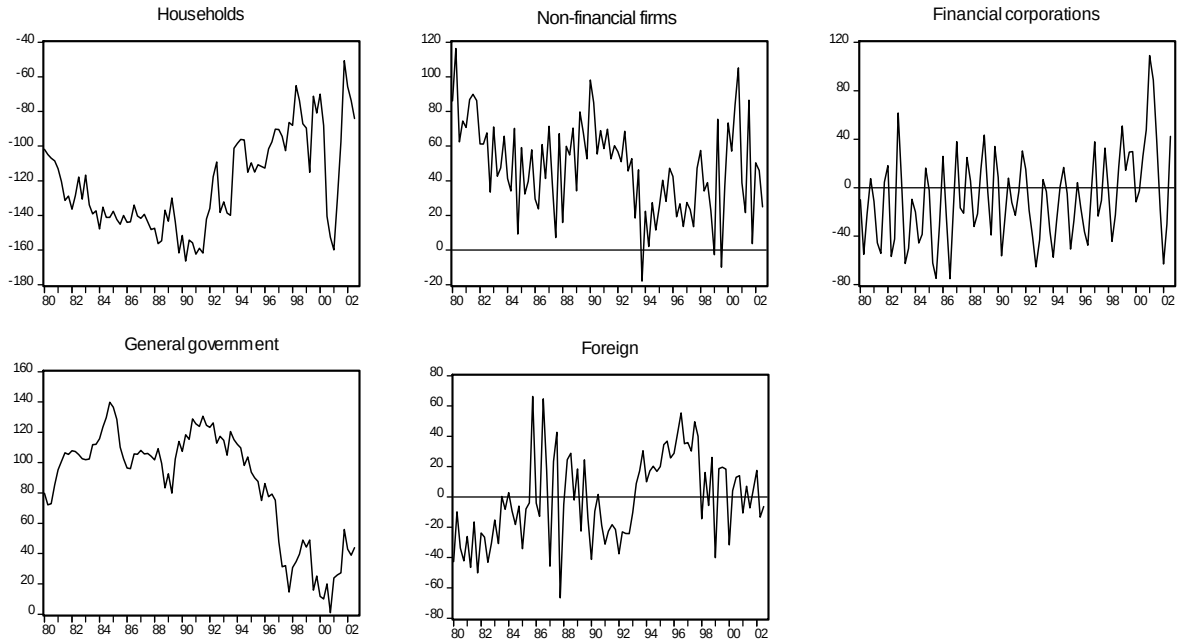


Fig. 5 – Responses to a contractionary monetary policy shock: non-financial firms

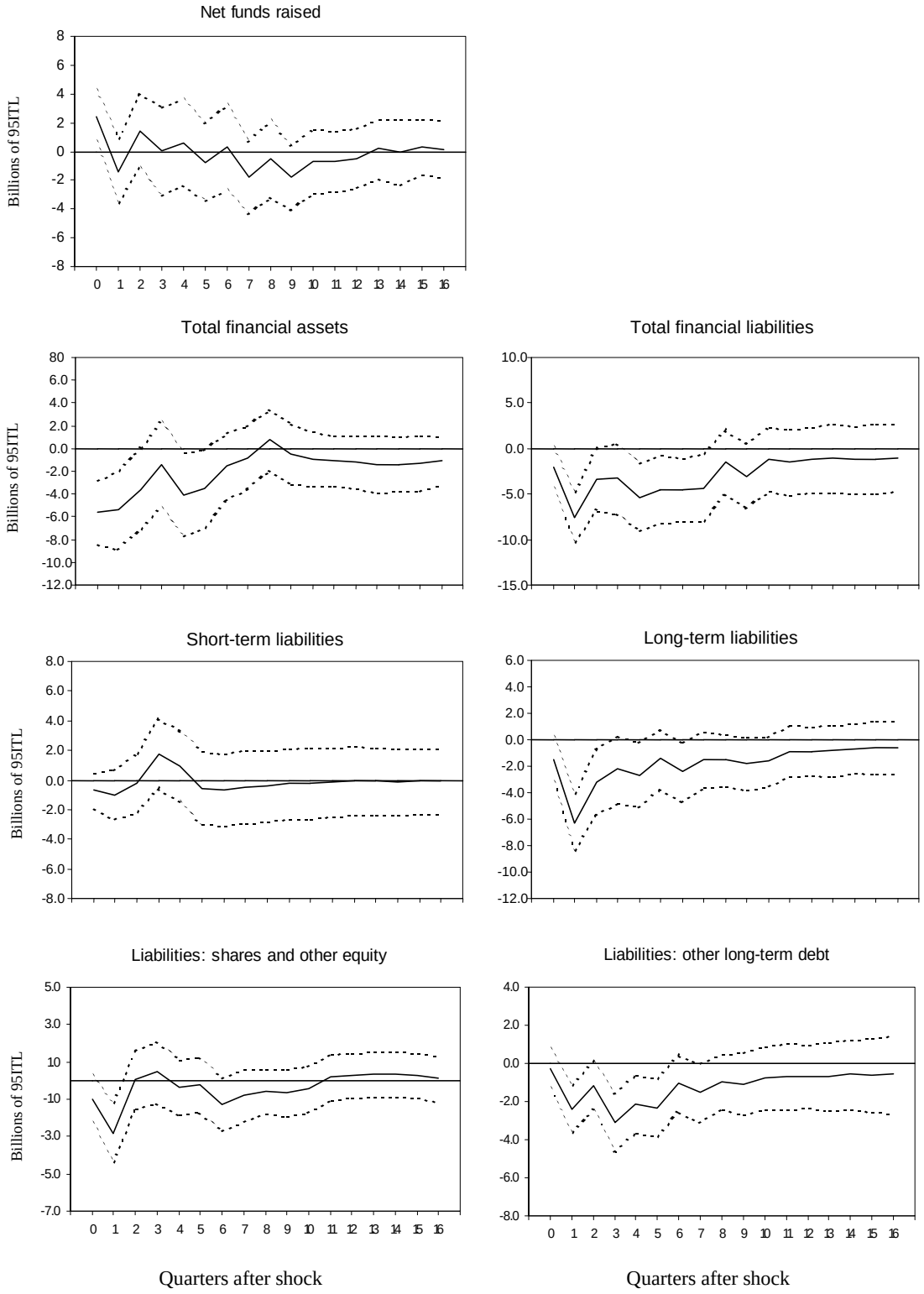


Fig. 6 – Responses to a contractionary monetary policy shock: households

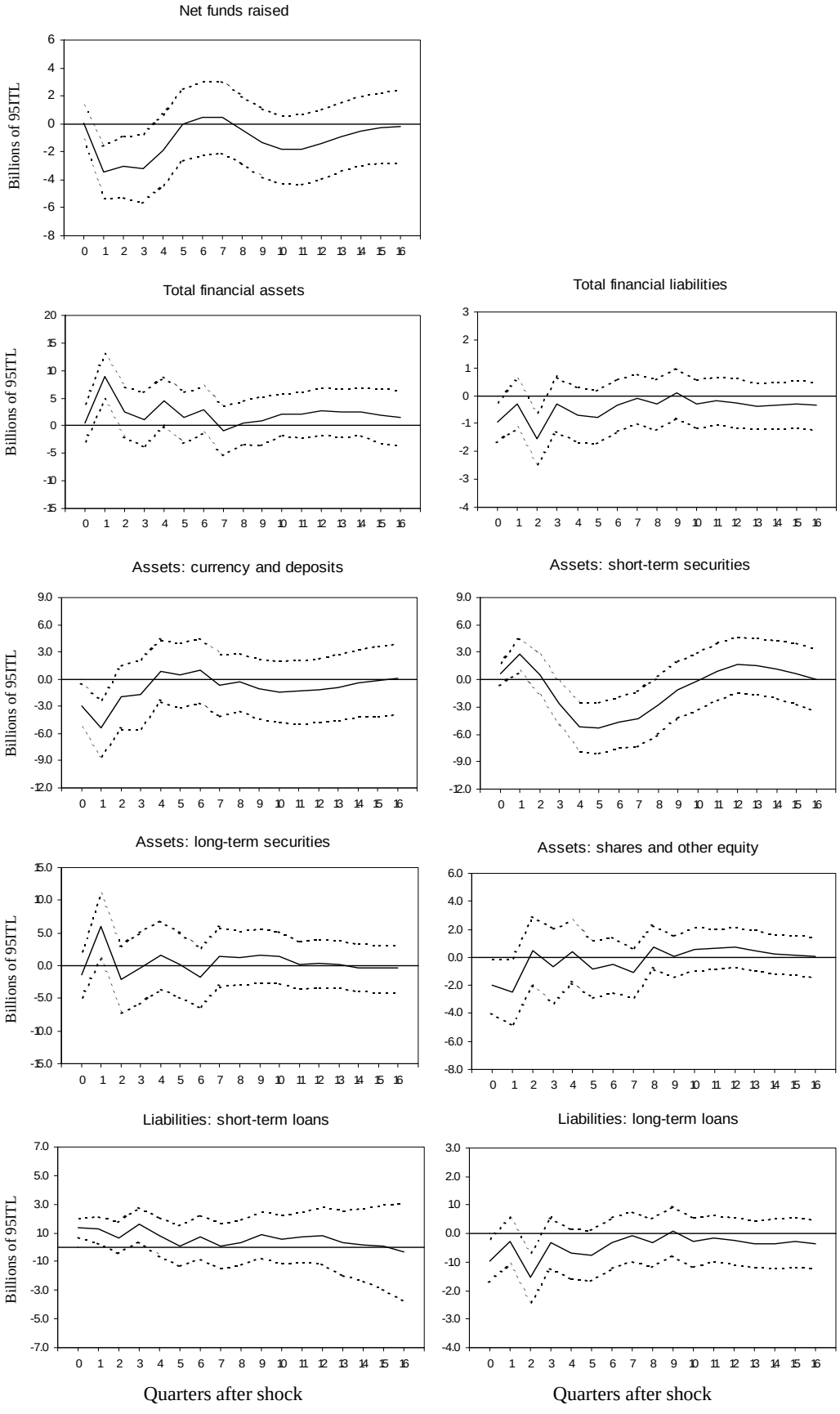
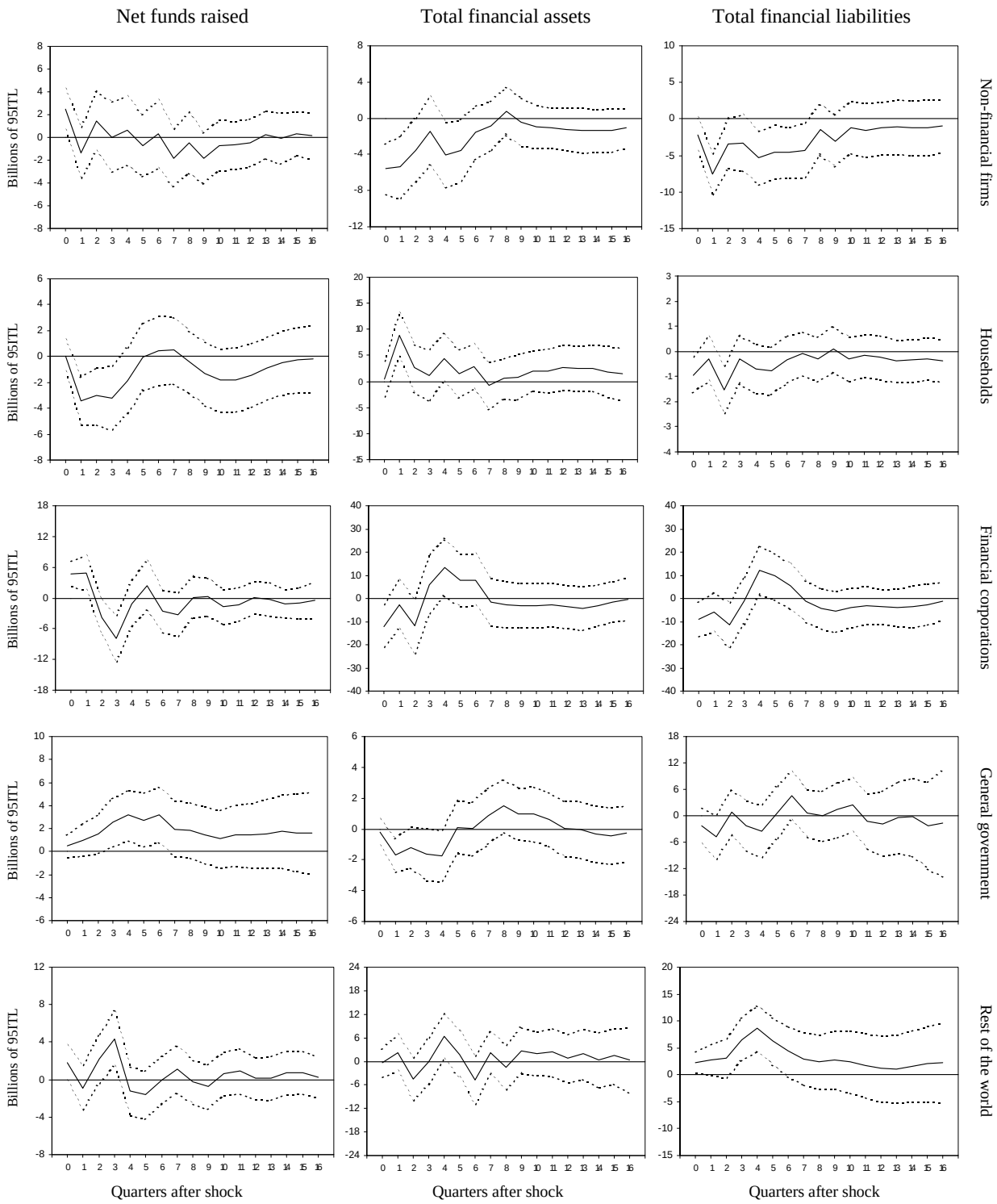


Fig. 7 – Responses of the flow-of-funds data to a contractionary monetary policy shock



Note: the estimated impulse responses were estimated from 7-variable VARs in which we added one of the above variables, in turn, to the original 6-variable VAR, placing it in the last position. Dashed lines are ± 1 Monte Carlo standard error bands.

Table 1

VAR diagnostic tests: lag order selection

Lag	LogL	LR	FPE	AIC
0	325.650	NA	3.33e-11	-7.09766
1	1090.81	1350.27	1.19e-18	-24.2543
2	1128.94	61.9144	1.15e-18	-24.3046
3	1168.47	58.5918	1.11e-18	-24.3875
4	1208.92	54.2555*	1.08e-18*	-24.4923
5	1246.37	44.9327	1.19e-18	-24.5263*

(*) indicates lag order selected by the specific criterion. LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion.

Table 2

VAR diagnostic tests: autocorrelation LM test
(H_0: no serial correlation at lag order h)

Lags	LM-Stat	Prob.
1	42.3	0.22
2	36.5	0.45
3	43.1	0.19
4	38.7	0.35
5	23.6	0.94
6	40.0	0.30
7	30.9	0.71
8	31.3	0.69

Probs from chi-square with 36 d.o.f.

Table 3

VAR diagnostic tests: residual descriptive statistics and normality test

Residuals from equation for:	Industrial production	Price level	Import price	Exchange rate	Interest rate	M2
Mean	2.32E-15	-1.25E-15	1.96E-13	3.91E-14	-3.64E-12	-8.03E-15
Median	-0.0007	6.39E-05	0.0013	0.0004	-0.0006	-0.0004
Max	0.0273	0.0083	0.1076	0.0446	2.7194	0.0230
Min	-0.0246	-0.0085	-0.0967	-0.0502	-2.2028	-0.0255
Std. Dev.	0.0090	0.0030	0.0418	0.0177	0.9212	0.0093
Sum	2.00E-13	-1.07E-13	1.69E-11	3.36E-12	-3.13E-10	-6.91E-13
Sum Sq. Dev.	0.0069	0.0007	0.1487	0.0266	72.133	0.0074
Observations	86	86	86	86	86	86
Skewness	0.237	-0.208	0.041	0.063	0.125	0.133
Kurtosis	3.496	3.186	2.821	3.835	3.587	3.469
Jarque-Bera	1.687	0.744	0.139	2.558	1.461	1.046
Probability	0.430	0.689	0.933	0.278	0.482	0.593

Table 4

Forecast error variance decomposition due to monetary policy shocks

Variable	1 quarter	2 quarters	1 year	2 years	3 years
VAR variables					
Industrial production	0.0 (1.2)	0.4 (1.6)	3.5 (4.3)	21.9 (10.1)	22.9 (10.2)
Price level	0.0 (0.7)	0.4 (1.7)	3.4 (4.4)	5.6 (6.7)	9.3 (8.9)
Import price	0.0 (1.2)	0.6 (1.9)	2.5 (3.9)	10.6 (7.8)	10.3 (7.6)
Exchange rate	0.5 (1.3)	0.4 (1.4)	3.2 (3.7)	5.1 (4.2)	4.0 (5.2)
M2	3.6 (4.2)	4.2 (4.8)	6.5 (7.0)	4.7 (6.5)	3.6 (6.1)
Other aggregates (*)					
Unemployment rate	9.2 (6.0)	9.8 (7.0)	13.0 (7.8)	15.7 (9.1)	17.0 (10.1)
Gross fixed investment	0.1 (1.7)	1.3 (2.5)	8.9 (6.9)	28.6 (12.2)	31.5 (12.6)
Real wages	4.4 (3.9)	5.7 (5.0)	7.6 (6.5)	5.9 (5.8)	7.0 (6.4)
Private consumption	0.1 (1.6)	0.3 (2.0)	8.1 (6.2)	15.5 (9.4)	15.8 (9.8)

(*) Each variable was added as the last one to the original 6 variables VAR.

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