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MONETARY POLICY IMPULSES, LOCAL OUTPUT AND THE TRANSMISSION MECHANISM

by Massimo Caruso*

Abstract

This paper evaluates the effects of unanticipated monetary policy shocks on Italian output on the basis of highly disaggregated data and a VAR methodology. The impact of unexpected changes in the money market interest rate on the pattern of industrial production - based on qualitative business opinion survey data - has been computed for 164 local industries. The perceived output effects of monetary impulses go up for local industries with higher investment expenditures, less liquid firms and for industrial sectors that have a higher correlation with the aggregate business cycle. The hypothesis that small firms bear a disproportionate burden of monetary policy does not find support in this sample.

JEL classification: E52, E58, R12.

Keywords: monetary policy shocks, business opinion surveys, heterogeneity.

Contents

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1. Introduction[1]

The analysis of monetary policy transmission across heterogeneous countries or regions constitutes an important area of new research. Several studies document how monetary policy shocks impinge upon real activity and review the main channels of monetary transmission.[2] This work pursues a disaggregated empirical approach and evaluates the effects of monetary policy shocks on output in Italy (1986-1998) across 164 local industries (comprising 19 regions and the main manufacturing sectors). It is fairly well established that the magnitude of monetary policy shocks varies systematically across sectors and regions. Gainly and Salmon (1997) find that in the UK economy the sensitivity of output to monetary policy changes differs markedly across industries. Carlino and DeFina (1998) and de Lucio and Izquierdo (2002) provide evidence on differential geographical effects of monetary policy, respectively across the US states and the Spanish regions. Mihov (2001) reports empirical results on the presence of regional heterogeneity in output responses to monetary policy shocks for France, Germany and Italy. Dedola and Lippi (2000) show on the basis of numerous estimated VAR systems (with reference to 5 OECD countries and 21 manufacturing industries) that there is significant cross-industry heterogeneity of policy effects, while heterogeneity across countries is limited. Peersman and Smets (2002) examine the cross-industry differences in output responses to monetary policy changes in seven euro area countries. These contributions also try to identify the sources of the observed heterogeneity, by ascertaining whether the policy effects on output are related to structural differences (such as industry composition, firm size and financial characteristics) that can proxy the asymmetries suggested by the large theoretical literature on the channels of monetary policy.

[1] I am grateful to Leonardo Gambacorta, Stefano Siviero and the anonymous referees for helpful comments on a earlier draft. I also wish to thank Alessandro Fabbrini, Paolo Finaldi Russo and Luigi Leva for their kind advice on the firm-level and census data used in Section 3.

[2] With reference to the Euro area, see Angeloni, Kashyap, Mojon and Terlizzese (2002); Guiso, Kashyap, Panetta and Terlizzese (1999). Evaluations of the Italian case are growing rapidly; recent contributions based on macroeconomic data include De Arcangelis and Di Giorgio (2001); Chiades and Gambacorta (2000); Gaiotti (1999). Microeconomic evidence is offered by Gaiotti and Generale (2003); Gambacorta (2001).

In this study monetary policy impulses on output are computed from 164 estimated VAR systems, one for each regional manufacturing industry. Observations on local output are based on business surveys conducted monthly by ISAE ("Istituto di studi e analisi economica") on the tendencies of Italian industrial production as perceived by the respondents (managers and entrepreneurs). The cross-section analysis of monetary shocks is centred on their estimated impact on the perceived behaviour of real activity. Business opinion surveys make it possible to proxy the unobserved, high frequency local output patterns and thus may offer indirect measures of the relative size of monetary policy shocks across industries and regions. Accordingly, this empirical analysis based on monthly survey data controls for fixed effects across industries and regions (without focusing on their differences) in order to ascertain whether heterogeneity in economic and financial conditions across 164 local industries has systematically affected the sensitivity of perceived output patterns to unanticipated monetary policy measures. Does the longitudinal distribution of impulses perceived locally support the "interest rate channel" and the "broad credit channel" views of monetary policy transmission? Some potential explanatory variables have been selected; they can be organised into four groups.

(i) Investment data. After a restrictive monetary policy shock, the relative price of capital goes up and according to the interest rate channel more capital-intensive local industries can be expected to reflect relatively heavier effects of monetary restrictions on output.

(ii) Data on firm size. The role of this variable in the transmission mechanism is an open question. Following the influential paper by Gertler and Gilchrist (1994), the "a priori" view in the literature usually stresses the amplification effect of policy shocks on small firms due to imperfect capital markets and asymmetries in borrowing capacity. Small firms are more "opaque", relatively more likely to be credit constrained in a policy tightening and can be expected to feel the effects of monetary policy more. However, several arguments also point to the opposite direction. The most commonly cited is an "invisible handshake" between small banks and small

firms; long-term relationships with their customers may lead specialised financial intermediaries to smooth out changes in the cost of capital available to small firms, that are bank-dependent for external finance.

The proposition that small businesses bear a disproportionate share of the output response to monetary policy must not be taken for granted; two-way effects may play a role and the empirical evidence is mixed. Gertler and Gilchrist (1994), Dedola and Lippi (2000) notice that a smaller firm size is associated with a stronger impact of monetary policy on manufacturing output, respectively in the US and in a sample of 5 main industrialised countries. Carlino and DeFina (1998, page 585) ascertain on US regional data that a firm size variable is insignificantly different from zero when a two-tailed test is used. Peersman and Smets (2002, page 23) find that in the euro area firm-size indicators do not explain the average impact of monetary policy, while industries with a higher share of small firms show larger responses in recessions than in expansions. Gaiotti and Generale (2001) study a panel of Italian firms and find an impact of monetary policy on investment unfavourable to small firms, but to a very limited extent. The contribution of firm size can also be country-specific and influenced by institutional characteristics. Angeloni, Buttiglione, Ferri and Gaiotti (1995) find that in Italy large banks tighten credit conditions more than small banks following a monetary restriction; they also note that bank size and borrower are positively correlated, implying a lower impact of monetary policy on small firms.

Inter-temporal considerations may also be relatively more important for large firms, for instance because they may invest relatively more in research or human capital. If small firm size proxies both less access to capital markets, as suggested by Gertler and Gilchrist (1994), and lower capital intensity - with reference to capital deepening activities which are broader than those covered by the fixed investment statistics but influenced in a similar way by the relative price of capital - local sectors with a higher incidence of large firms may suffer the consequences of an adverse monetary policy shock to a relatively greater extent. There is also the fact that large firms usually export a higher fraction of output than small firms and could be more

effected by the indirect effects of monetary policy changes through the exchange rate. Moreover, variations in the relative price of future consumption in terms of current consumption due to policy shocks modify the composition of demand, and there are no a priori reasons to expect these changes to disadvantage small or large firms, it is an empirical matter.

(iii) Data on the financial conditions of firms and local industries. According to the credit view of monetary policy transmission (see the recent survey by Bean et al., 2002, among others) to the extent that more liquid and leveraged local industries proxy for less stringent financial constraints, they may suffer less from a monetary tightening. However, while a higher-than-average liquidity position may act as a buffer against adverse liquidity shocks and is likely to signal credit-worthiness, the role of leverage is somewhat uncertain a priori. As suggested by Peersman and Smets (2002), a high leverage ratio may be an indication of the firm's ability to borrow; on the other hand, highly leveraged firms may experience difficulties in obtaining new funds.

(iv) Cyclical correlation with aggregate output. The co-movement of local output with the aggregate business cycle has also been introduced as an additional explanatory variable of the effects of monetary impulses. It may allow a "core" and a "periphery" to be distinguished in the propagation of policy shocks and their perceived impact on local output.

The plan of the paper is the following: Section II presents the data and the estimated VAR systems; Section III reports the cross-section results and Section IV briefly concludes.

2. Monetary policy impulses across 164 local industries: some VAR results

In this work the output effects of monetary policy in Italy are analysed on the basis of qualitative monthly business opinion survey data, for the time-span 1986-1998. Recent years have not been included because EMU convergence is likely to imply an important structural break. A large cross-section of cyclical indicators of the behaviour of local output has been considered.

Business survey results on the pattern of industrial production as perceived by the respondents (managers and entrepreneurs) are conducted monthly by ISAE and are available from 1986. Managers' views on the tendencies of production are collected across 19 Italian regions (data for the small Valle d'Aosta area are not reported) and refer to the main manufacturing industries; after checking for missing observations, the data set used in this paper sums up to 164 disaggregated monthly indicators for the time period 1986–1998 and covers between 6 and 9 industrial sectors for each region (basic metals; non-metallic mineral products; chemicals; fabricated metal products and machinery; vehicles and transport equipment; food, beverages and tobacco; textile and leather industries; paper and paper products, printing and publishing; wood products, rubber and other manufacturing industries).[3]

[3] In practice, the choice of these data is dictated by lack of monthly or quarterly observations on actual output behaviour at this level of disaggregation. The most analytic regional data sources are the Regional Economic Accounts (Istat "Conti Economici Regionali"). This data set presents a rich longitudinal dimension (17 industries and 20 regions) but its yearly frequency makes it unsuitable for a VAR analysis of the output effects of monetary policy, owing to lack of degrees of freedom and, especially, difficulty in applying the recursive scheme necessary for proper identification of a policy shock. As will be explained in more detail later in this Section, an unanticipated monetary policy innovation can be identified using the Choleski decomposition and an ordering of the series that separates the non-policy from the policy variables; it is assumed that policy shocks do not affect some macroeconomic variables within the current period, a reasonable proposition with high-frequency data but much harder to defend for annual observations. The monthly panel used in this work is unbalanced because some regional industries are missing; see the Data Appendix for a list of the disaggregated series. Some missing monthly values have been corrected by computing the average values for the adjacent months. "Textiles" include data on wearing apparel and leather industries, and "other manufacturing industries" have been averaged with "wood products" and "rubber", where available.

Qualitative assessments on tendencies (higher, lower and unchanged) are transformed in summary quantitative indicators by computing the balances between the replies (higher minus lower). As it is well known (Gennari, 1994, among others) these indicators represent deviations from an unmeasured and possibly changing perception of "normality", they may depend on the subjective assessment of the respondents and are only proxies of the underlying cyclical patterns. In any case, they convey timely information on the likely evolution of an unobserved variable, the tendencies of local industrial output. Their limitations notwithstanding, these business survey results trace out fairly well the pattern and the turning points of the Italian business cycle, as summarised by both the coincident indicator (Figure 1) proposed by Altissimo, Marchetti, Oneto (2000) or the pattern of aggregate industrial production (Figure 2). The figures show weighted averages of local output, based on the local industries' shares in real value added in 1995, culled from Istat data. The business survey indicators and the growth rates on the corresponding month of the previous years of the aggregate series fluctuate closely and the average duration of cycles is similar; this suggests that these surveys have useful disaggregated information on the tendencies of the Italian business cycle.[4]

Following the applied literature, the identification of unanticipated monetary policy changes is based on a Choleski decomposition of a VAR system covariance matrix, with an appropriate ordering of the variables (Bernanke and Mihov, 1998; Dedola and Lippi, 2000; Bean, Larsen and Nikolov, 2002).

[4] The coincident indicator provides a proxy of the cyclical co-movement of economic variables. The correlation between the weighted monthly output indicator computed from disaggregated survey data and the composite coincident indicator in the years 1986-2002 is .799, higher than the correlation with the most widely used single reference series, the industrial production index (.652). This result is robust to different filters used for getting rid of the low frequency component (first differencing or the use of a Hodrick-Prescott filter), and to the introduction of leads and lags. Regional output indicators are currently under revision by ISAE; however, the planned revision mainly concerns data from 1995 and the aggregation methodology, not the elementary series utilised in this empirical exercise.

FIGURE 1 – Weighted monthly indicators of output across 164 local industries and the coincident indicator of the Italian business cycle

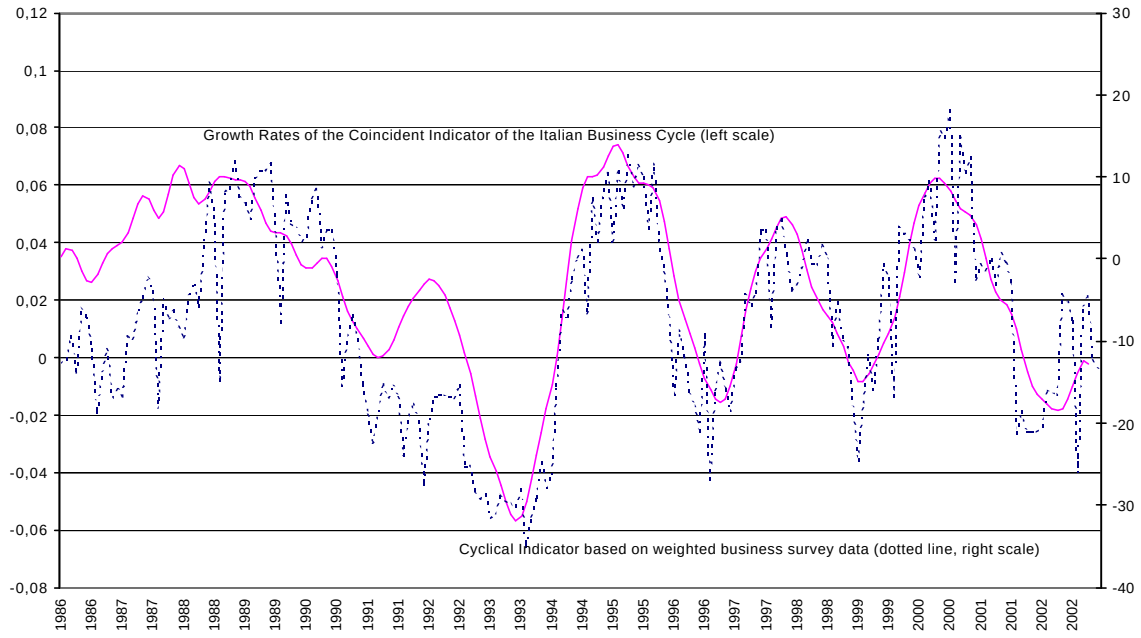
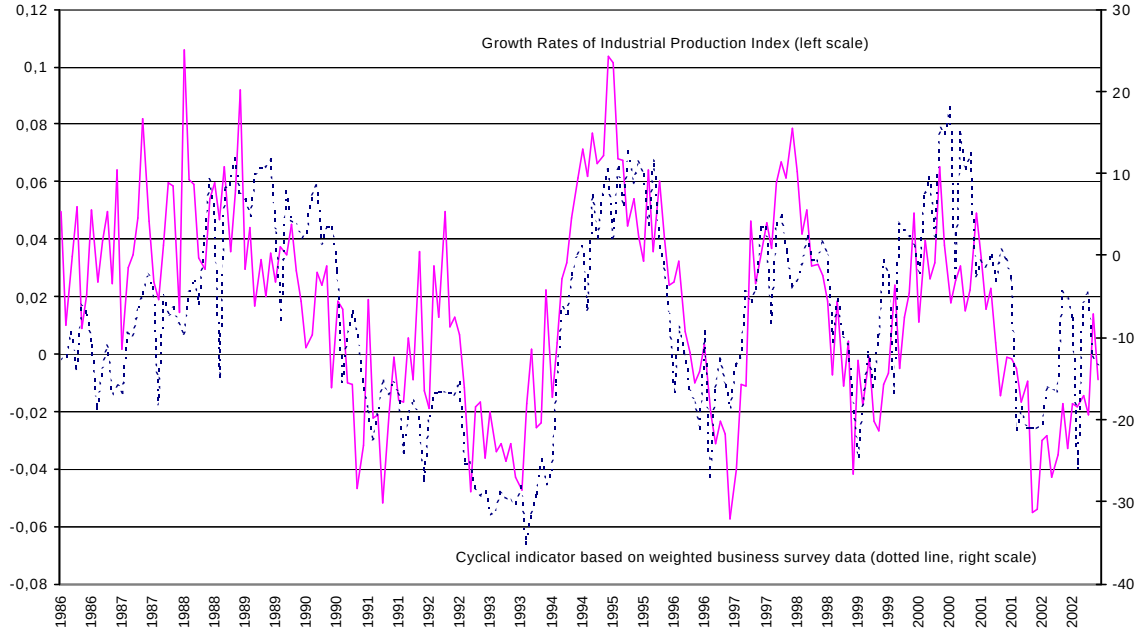


FIGURE 2 – Weighted monthly indicators of output across 164 local industries and the industrial production index



An unanticipated policy shock does not influence the non-policy variables contemporaneously but the policy variables react to them; these non-policy aggregates can be ordered first, and the policy variables follow. In a VAR system the error variance decomposition of the first variable at forecast horizon zero (contemporaneous events) has one in its own cell, zero elsewhere and it is exogenous (in this period), unaffected by contemporary economic conditions; on the contrary, the last ordered variable is completely endogenous within the current period. Accordingly, the other variables react contemporaneously to the magnitudes ordered before them and are independent at horizon zero from the variables that follow. Dedola and Lippi (2000, page 27) show how this recursive approach to the identification issue requires to partition "variables not responding contemporaneously to monetary policy but to which the policy variable responds contemporaneously", the policy variable, and "variables responding contemporaneously to policy but to which the policy variable does not respond contemporaneously".

In this application, the first group of variables has useful information for policymakers but does not respond at horizon zero to policy shocks. It comprises the volume of world imports, commodity and oil prices, Italian industrial production, contractual wages and consumer prices (data are plotted in Figure 3 and are described in the Appendix).[5]

Imports in real terms proxy for world demand conditions (an alternative indicator, world industrial production, is highly correlated with the national industrial production index and has been discarded in order to prevent multicollinearity). Commodity prices and contractual wages have information on expected future inflation and oil prices represent an important conditioning variable for an economy with scarce natural resources. The information set of the policymakers is thus wider than domestic inflation and production alone, and reflects the fact that they potentially try to anticipate events. Moreover, the degree of openness of the Italian economy is

[5] Gaiotti (1999) discusses the role of contractual wages in a VAR model of the Italian economy. Kim (1999) introduces commodity prices in VAR systems applied to the G-7 countries and Caruso (1997) reports empirical evidence for Italy.

high but the propensity to export differs widely across regions and industries and is concentrated in the Northern and Central areas (exports of goods from the Southern regions, albeit growing, are still about one tenth of the total). Controlling for changes in the external economic conditions may help to ascertain the "true" impact of the monetary policy variables on local output.

The intermediate and final blocks of variables include the policy variable, a short term interest rate that the monetary authorities are able to influence closely (the money market rate, MMR), and some macroeconomic variables that respond contemporaneously to innovations on the MMR but are not directly controlled by monetary policy. They also depend on agents' expectations and relative labour costs (the real exchange rate), liquidity preferences (real money balances), the commercial policies of the banking system (the spread between the lending rate and the yield on Government bonds with average maturity of more than one year, the pattern of domestic credit) and are ordered after the short-term rate.[6]

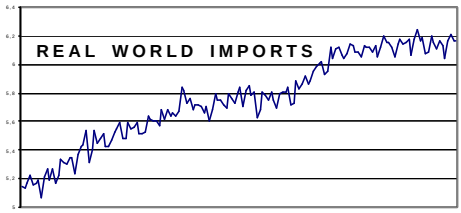
The estimated VAR systems thus control for several potential channels of monetary transmission, including an interest rate channel (MMR), a credit channel (SPREAD, RDC), for real exchange rate movements (RER) and liquidity or wealth effects (M2 in real terms).[7]

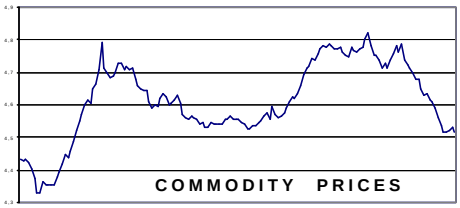
Local output data (ISAE indicators) have been added to this benchmark VAR as the last block of variables. Disaggregated output responds contemporaneously to all the other variables in the system, comprising the policy variable. Monetary policy does not respond contemporaneously to idiosyncratic output, because it is plausible

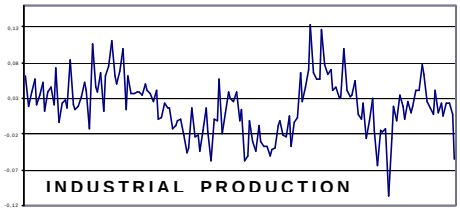
[6] It is assumed that the exchange rate responds contemporaneously to policy but the money market rate does not respond at forecast horizon zero to it; in the VAR, however, a dummy is introduced for the period of speculative attacks on the lira and exchange rate defence (1992.6-9 and 1995.3), circumstances that may have required an immediate policy response.

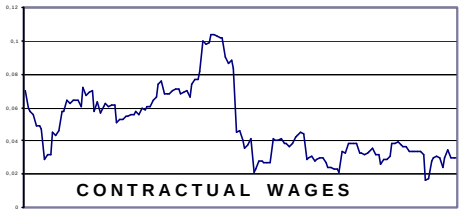
[7] The role of the exchange rate in the monetary transmission mechanism is studied by Gaiotti (1999) and De Arcangelis and Di Giorgio (2001). Chiades and Gambacorta (2000) report VAR results on the effectiveness of the transmission of monetary policy through the credit channel and Fiorentini and Tamborini (2001) offer a critical survey of the literature.

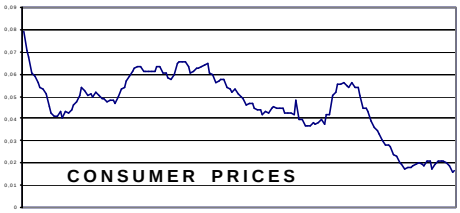
FIGURE 3 – VAR system: data description, 1986-1998

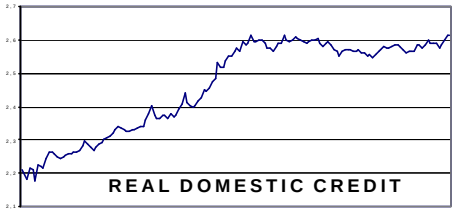


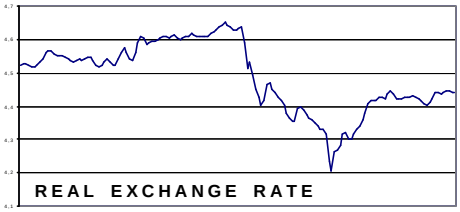


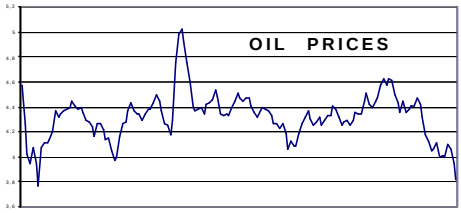


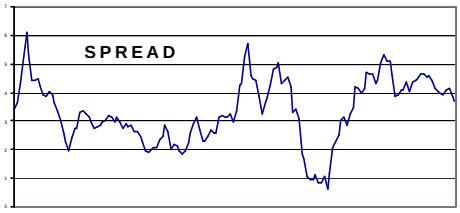


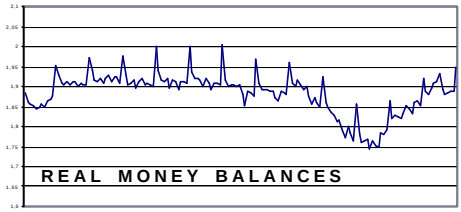


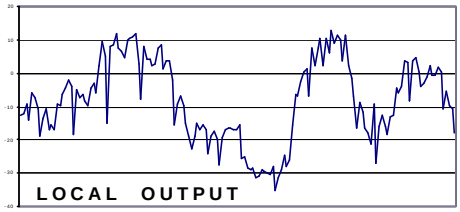












that monetary authorities take into account mainly aggregate rather than local output patterns.

A total of 164 VAR systems have been estimated, one for each local industry. Table 1 shows the results for the benchmark model (an eleven-variables system) to which local output series have been added; as it is to be expected (it is plausible that most information run from the aggregate variables to the small local industries, rather than vice versa), the results for each specific VAR model do not differ drastically from this basic specification. On the basis of the Akaike Information Criterion, four lags have been selected (a similar lag structure – five lags – applies to the 100 VARs for the OECD industries estimated by Dedola and Lippi, 2000). As usual in this literature, a trend-stationary specification has been followed (introducing variables in levels and a time trend); this enhances comparison and prevents a loss of low-frequency information due to the first differencing of the monthly variables. A trend component for each local industry controls for possible patterns of long-run divergence or convergence in local output, as perceived by survey respondents. The deterministic components also include seasonal dummies and some dummies controlling for a few exogenous events in the sample period. They enter the system at conventional significance levels, according to the deletion tests reported in Table 1. [8]

The VAR system has good statistical properties (Table 1). Standard errors of regressions are acceptable and each variable cannot be excluded from the system, on the basis of the results of block non-causality tests. The estimated system passes tests of stability, absence of serial correlation and normality of residuals. Exceptions are some remaining serial correlation for oil prices; there are signs of heteroschedastic residuals for contractual wages and the real exchange rate.

[8] The dummies include: commodity and oil price shocks (1988.6 and 1990.8), periods of exchange rate turbulence and defense of the lira (1992.6-9 and 1995.3), inflation variability due to the effects of changes in value added taxes (1994.3, 1995.4) and discontinuities in wage patterns connected to the impact of new collective contracts (1991.5 and 1991.12).

TABLE 1 - The benchmark VAR(4) model (an eleven-variables system)

VAR (RWI, NFCP, OIL, TIND, TWAGE, TCPI, MMR, RER, RM2, SPR ,RDC)
Deterministic components: C, TIME, SQ2-4, DUOIL, DULIRA, DUCPI, DUWAGE.
Estimation period: 1986.M5 – 1998.M12 T=152

VAR(4) Diagnostics (p-values in parentheses):

Variables:	R^2	SER	W. NO. [a]	ARCH [b]	BLOCK CA. [c]
REAL WORLD IMPORTS: $Log(RWI)_t$	.992	.034	(.482)	(.576)	119.6 (.000)
NON-FUEL COMMODITY PRICES: $Log(NFCP)_t$	.987	.017	(.395)	(.635)	85.9 (.000)
OIL PRICES: $Log(OIL)_t$	.921	.067	(.000)	(.725)	142.8 (.000)
INDUSTRIAL PRODUCTION (GROWTH RATES): $Log(IND)_t - log(IND)_{t-12}$	.716	.027	(.171)	(.209)	96.8 (.000)
CONTRACTUAL WAGES (GROWTH RATES): $Log(WAGE)_t - log(WAGE)_{t-12}$	.974	.004	(.880)	(.072)	147.9 (.000)
CONSUMER PRICES (GROWTH RATES): $Log(CPI)_t - log(CPI)_{t-12}$	.992	.002	(.671)	(.961)	105.2 (.000)
MONEY MARKET RATE: MMR_t (percentage points)	.990	.337	(.324)	(.310)	190.2 (.000)
REAL EXCHANGE RATE: $Log(RER)_t$	.992	.012	(.661)	(.082)	117.7 (.000)
REAL MONEY BALANCES: $Log(M2/CPI)_t$	.936	.017	(.171)	(.311)	161.9 (.000)
SPREAD (LENDING RATE – GOVT BOND YIELD): SPR_t (percentage points)	.963	.274	(.998)	(.534)	118.8 (.000)
DOMESTIC CREDIT IN REAL TERMS: $Log(DC/CPI)_t$	.998	.008	(.716)	(.526)	169.9 (.000)

VAR(4) system's statistics: AIC=3763.4; LL=4412.4. All the eigenvalues lie inside the unit circle (stability conditions are satisfied). VAR(4) system's serial correlation diagnostics at lag order j (Lagrange Multiplier tests, $\chi 2$ with 121 degrees of freedom): LM(1) = 118.9 (p-value=.537), LM(2) = 137.8 (p-value=.141), LM(3) = 127.1 (p-value=.334). VAR(4) system's Jarque-Bera test for non-normality (distributed as $\chi 2$ (22)) = 26.14 (p-value=.246). Skewness = 12.66 (p-value=.316). Kurtosis = 13.48 (p-value=.263).

[a]W. NO. indicates a test for white noise on single equations' results, based on a Bartlett's B-statistics applied to the cumulative periodogram of the sample spectral density. [b]ARCH is a LM test for autoregressive conditional heteroskedasticity distributed as χ^2 (2). [c] The block non-causality test for a regressor rejects the null that its lagged values are all zero in the system; it is a Likelihood Ratio test distributed as χ^2 (40). LR deletion tests for the dummies distributed as χ^2 (11) accept at the 1 percent level of confidence the presence in the system of the time dummies introduced: DUCOM (commodity and oil price shocks, 1988.6 and 1990.8) = 38.2 (.000); DULIRA (exchange rate turbulence and speculative attacks, 1992.5-9 and 1995.3) = 101.8 (.000); DUCPI (impact of changes in value added tax on consumer prices, 1994.3 and 1995.4) =50.2 (.000); DUWAGE (impact of collective contracts on wages, 1991.5 and 1991.12) = 21.0 (.033).

A description of the variables is reported in the Data Appendix (Panel B); they are plotted in Figure 3.

Figure 4 reports the impact on industrial production of innovations in the policy variable and other macroeconomic impulses in the VAR (with 10 percent level confidence bands); Figure 5 gives information on the congruency of the system and shows the effects of policy shocks on the other variables. The overall results are plausible; controlling for all the system variables, changes in money market rates are a useful approximation of a truly unanticipated, exogenous monetary policy shock.

Impulses to the money market rate mainly influence real money balances (Figure 5) and, with a lag, real output (Figure 4). An unexpected monetary tightening (a one standard deviation innovation in the short-term rate) has a negative and persistent effect on real money balances.[9] The effect on output is negative after twelve months and the largest estimated impact on industrial production of a monetary policy shock occurs after about two years. The sensitivity of output to innovations in the real exchange rate and the banking spread is plotted in Figure 4. The largest estimated negative impact on output of an appreciation of the real exchange rate occurs after one year and an unanticipated impulse from the spread brings a short-term negative production response. This is not in contrast with previous VAR results for the Italian economy; Chiades and Gambacorta (2000, Figures 2 and 4) notice that the negative response of industrial production to a widening of the banking spread is significant in the first two months, while the highest output effect of a monetary policy impulse occurs after about one year and persists for two years. Gaiotti (1999) finds that the output effects of a money market rate shock show up after 6-12 months and peak after 18 months; De Arcangelis and Di Giorgio (2001, Figure 1) indicate that the output response to a policy impulse arising from the overnight rate is larger after ten months and lasts about two years. Figure 5 suggests that a monetary tightening has also indirect effects on output; it causes the exchange rate to appreciate and widens the

[9] Regarding prices, data seem to support some broad "international monetarism" proposition, and inflation responds to unanticipated changes in real money balances, external conditions and the spread, and indirectly to the short-term rate.

FIGURE 4 – Benchmark VAR model: impulses on industrial production

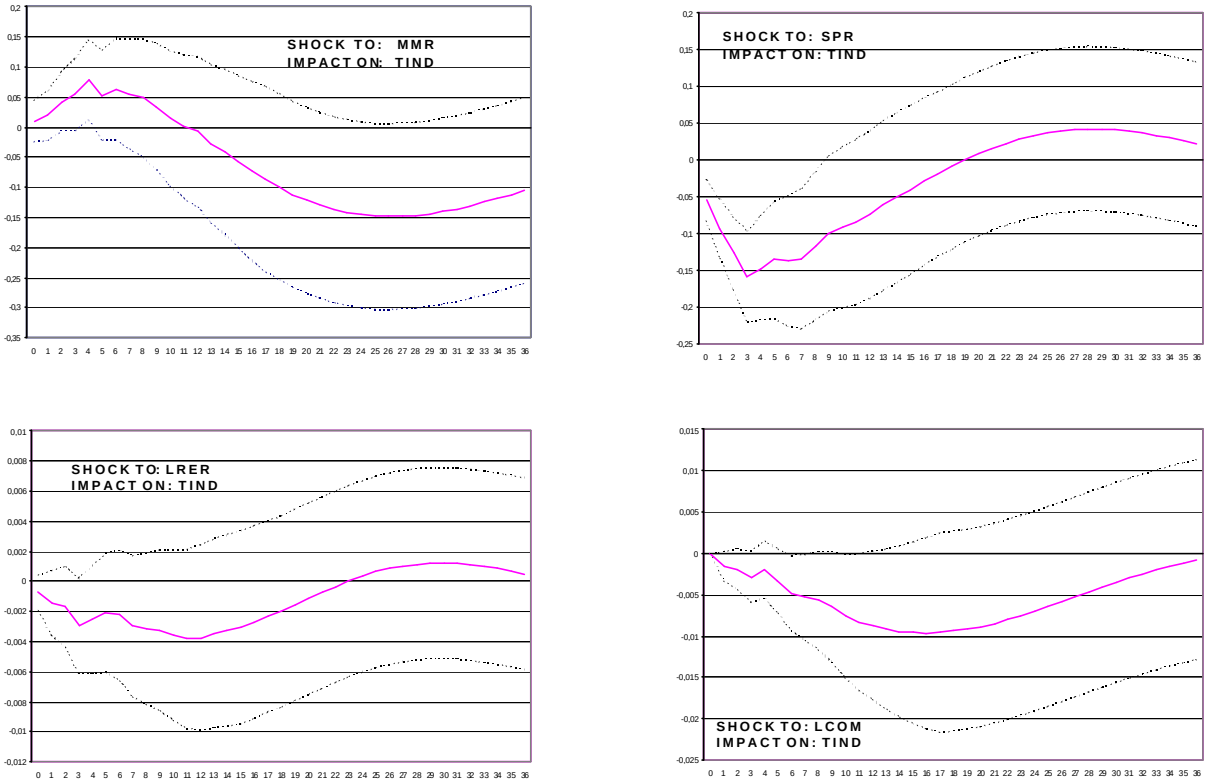
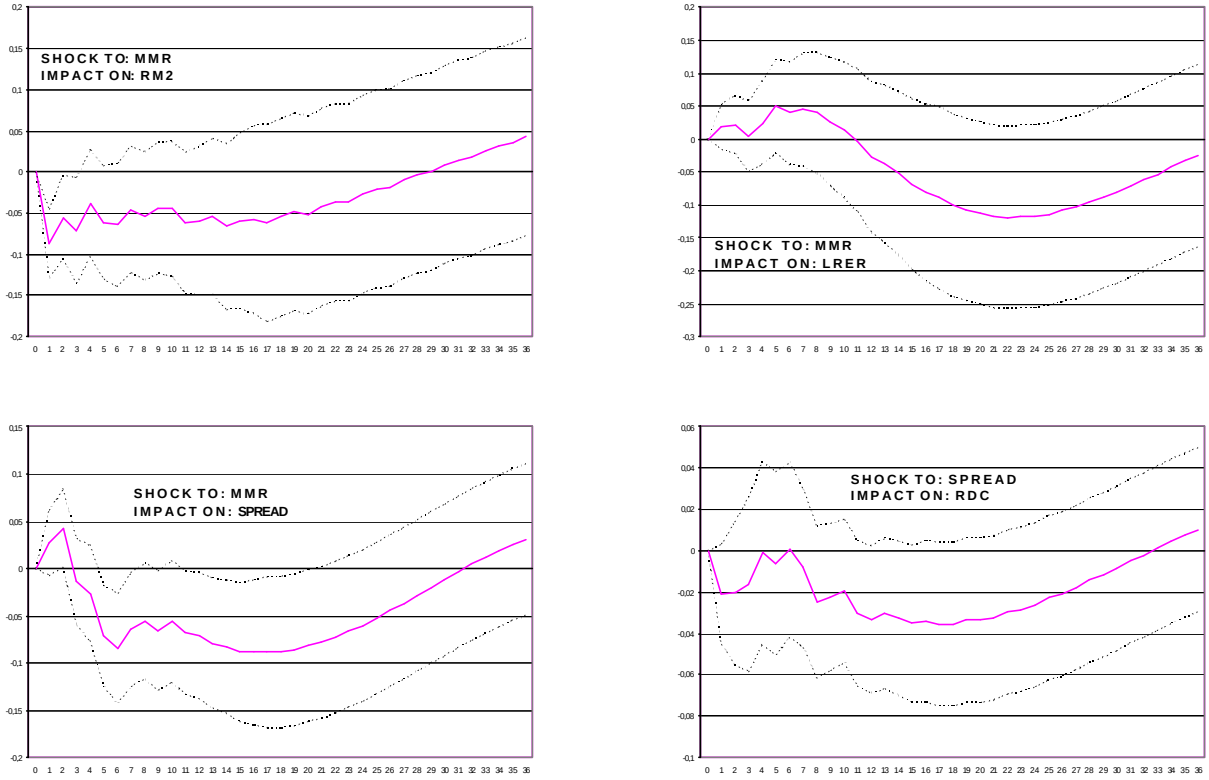


FIGURE 5 – Benchmark VAR model: effects of monetary policy shocks



banking spread in the short-term; both effects are reversed later.[10] A larger spread determines a lower pattern of real domestic credit.

An analysis of the magnitude of the output impact of monetary policy in this VAR system does not seem to depend too heavily on different theories of the monetary transmission mechanism; both a monetary, an exchange rate and a credit channel are at work in this sample. In the next Section, the cross-section differences in the size of responses of local output to policy impulses are evaluated and discussed.

3. The cross-section distribution of output responses to a monetary policy shock

The estimated responses of local output to an innovation in the money market rate are plotted in Figure 6. Judged on the basis of disaggregated survey data, both local output and aggregate output sensitivities to a policy shock are persistent; the average impact on perceived local output patterns is negative after more than one year, it is larger after about two years-two years and a half, and then goes back slowly to the initial values.

Summary statistics of the estimated effects of monetary policy shocks on local output are reported in Table 2. At a forecasting horizon of two years, the average and median impacts are -0.015 and -0.018, respectively. Higher effects are not infrequent; the 25 and 10 percent largest negative impacts are -0.045 and -0.090. The forecast error variance of local output explained by innovations in the short-term interest rate is in the range of 2.5 - 3.5 percent at different horizons; after two years, the 25 and 10 percent largest forecast error variances due to the effects of monetary policy innovations on output are about 4 and 7 percent, respectively.[11] Do basic differences

[10] Chiades and Gambacorta (1999, Figure 2) also note a positive short-term effect on the spread (a restrictive monetary policy brings the largest widening of the banking spread after about four months, and its impact fades away later).

[11] Calculating the standard error bands of the estimated impulse response functions takes many hours. In practice, it is unfeasible to obtain them for 164 VAR systems.

FIGURE 6 – Impact of unanticipated monetary policy on output patterns, at different monthly forecasting horizons, across 164 local industries

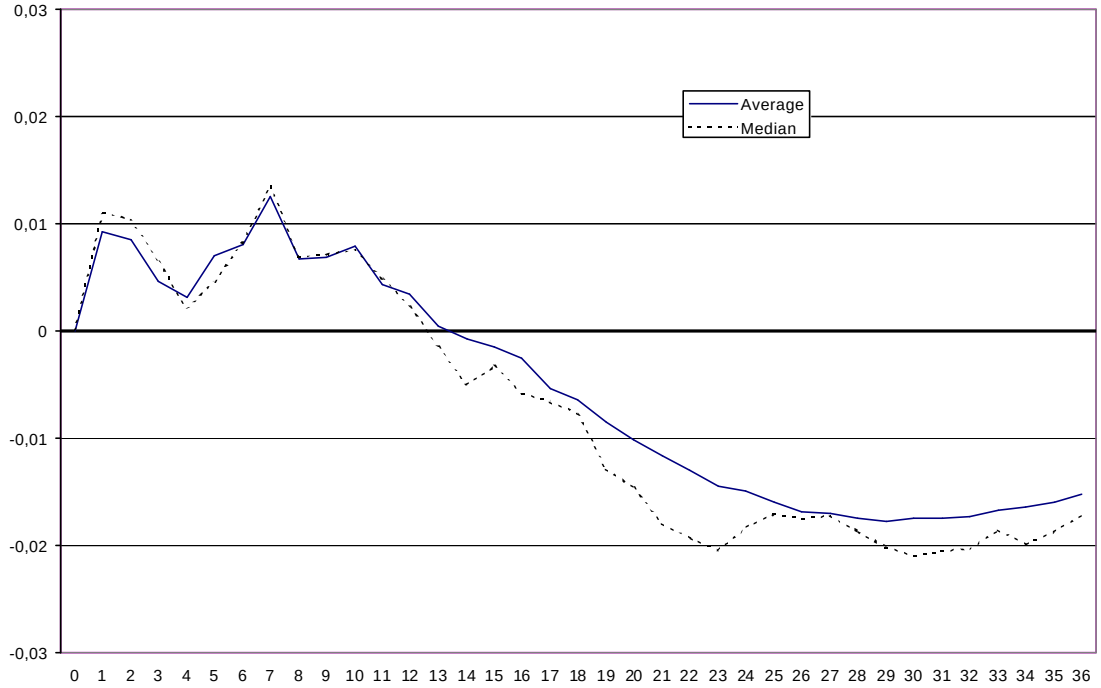


TABLE 2 – Impact on local output of monetary policy shocks (164 observations)

	Impulses on local output				
	MMR12	MMR18	MMR24	MMR30	MMR36
Average	.0034	-.0065	-.0150	-.0175	-.0153
Median	.0022	-.0078	-.0184	-.0211	-.0173
25 % largest negative impacts	-.0120	-.0327	-.0453	-.0526	-.0390
10 % largest negative impacts	-.0381	-.0755	-.0896	-.0709	-.0617
	Forecast error variance				
Average	.0246	.0257	.0300	.0342	.0365
Median	.0160	.0177	.0189	.0217	.0252
25 % highest	.0291	.0343	.0400	.0445	.0486
10 % highest	.0568	.0600	.0681	.0827	.0877

in economic and financial conditions across 164 local industries affect the sensitivity of output to unanticipated changes in monetary policy? Following the traditional "interest rate channel" and the "broad credit channel" views of monetary transmission (see the recent survey by Bean et al., 2002), some explanatory variables have been selected; they include investment data, cross-section observations on firm size and the presence of micro firms and small banks, correlation of local with aggregate output, and data on financial conditions of firms and local industries (Table 3).

A cross-section analysis of the impact of monetary policy shocks must rely on exogenous or predetermined variables in order to achieve consistent results. Firm size, the presence of small firms and banks across local sectors, and the cyclical correlation of local output with the aggregate are assumed to be weakly exogenous; these structural features can be influenced by unanticipated changes in monetary policy only indirectly and to a limited extent. Observations on investment have been obtained from predetermined 1981 census data; instead, data availability precludes the introduction of predetermined proxies of firms' financial conditions. Results for this last group of explanatory variables can be regarded as preliminary and are discussed for completeness.

Investment data refer to real investment per worker in 1981, obtained by merging regional accounts and census data (INVAD81). Average real investment proxies for capital intensity (an unobservable variable at this level of disaggregation).

Three variables related to firm size have been computed for each local sector. MSALES represents the median value of sales (1989-1996) according to the Company Accounts Data Service (Centrale dei bilanci), a large panel of Italian firms comprising about 45,000 observations for each year. MICROFIRMS is the share of employment on the total associated with the very small firms (3 to 5 employees) for each of the 164 local industries based on 1996 census data. Micro firms are an important and diffused

TABLE 3 – Firm-level and industry data, descriptive statistics (164 observations)

		Average	Median	Stand. Dev.
INVAD81	Investment at 1990 prices per labour unit, 1981[a]	.0204	.0113	.0330
FIXCAP	Firms' fixed capital / total assets, 1989-1996[b]	.2794	.2737	.0774
MLEV	Firms' leverage (total debt / firms' capital), 1989-1996[b]	1.058	1.016	.4693
LIAT	Firms' liquidity (cash and bank accounts) / total assets, 1989-1996[b]	.0239	.0230	.0100
DBDT	Firms' short-term debt / total debt, 1989-1996[b]	.8808	.8891	.0640
MSALES	Firms' median value of sales, thousands of euro, 1989-1996[b]	5123	4657	2637
MICROB	Small banks' (assets< euro 26 millions), 1990-91[c] Short-term loans / total s. t. loans	.1574	.1446	.0887
MICROF	Small firms' (3 to 5 employees) employment/ total, 1996[d]	.1030	.0974	.0580
CORCOI	Cyclical correlation (local output and coincident indicator), 1986-98[e]	.1102	.0679	.1227

Sources: [a] Istat Regional Economic Accounts. [b] Company Accounts Data Service ("Centrale dei bilanci"). [c] Banca d'Italia, banking statistics. [d] Istat census data. [e] ISAE data and author's estimates.

category of small businesses in Italy; on the aggregate they represent 14.9 percent of total employment and usually depend on local banks for external finance. Ascertaining a differential role for these firms may give support to the "bank lending channel" view of monetary transmission. The variable MICROBANKS is defined as the average share of the smallest banks (with total assets less than about euro 26 millions) of short-term loans granted to each local industry in 1990-91. This category includes most of the small savings banks and the credit co-operatives. Küppers (2001) finds that in Germany the smallest banks tend to shield their customers from the full effects of a policy tightening.

As a proxy of "localism", the cyclical correlation of industry output with the aggregate has been computed (CORCOI); its introduction makes it possible to distinguish between a "core" and a "periphery" in the propagation of policy shocks. To this end, 164 coefficients of determination (R^2) have been computed by regressing the patterns of local output based on survey data on the growth rate of the coincident indicator of the Italian business cycle described in Figure 1.

On the basis of Company Accounts Data Service (Centrale dei bilanci) data, three proxies of basic financial conditions across firms and local industries have been obtained. They concern the median firms' liquidity position (LIAT, cash in hand and bank accounts over total assets), the median leverage (LEV, total debt over firms' capital) and the median short-term to total debt ratio (DBDT) for each local industry (1989-1996). According to the credit view of monetary policy transmission, to the extent that more liquid and leveraged local industries proxy less stringent financial constraints, these sectors may suffer less from a monetary tightening. A counter-cyclical monetary policy may have differential effects on firms with heterogeneous financial structures. It is well known that measures of firms' financial position tend to reflect different features of the same underlying conditions. However, the cross-section is fairly large and this prevents multi-collinearity; the highest correlation among the three financial variables is 0.12. The highest correlation across all the explanatory variables is -0.38 (between MICROFIRMS and CORCOI; small firms are less present across the "core" local industries). Other correlation coefficients are low; for instance, the correlation between micro firms and micro banks is 0.10 and the negative coefficient between median sales across industries and the presence of micro firms is equal to -0.19.

Cross-section estimates are reported in Table 4. Dependent variables are the impulse responses at 18, 24, 30 and 36 months, forecasting horizons that are associated with relatively higher negative output effects of money market interest rate shocks (Figure 6). The long-run responses to policy impulses are influenced less in practice by a particular recursive identification scheme of the VAR (Bean, Larsen and Nikolov, 2002) and this enhances the overall robustness of the empirical findings. Impulse response functions cannot be measured and evaluated individually with precision; a large number of cross-sectional units may increase their informative content. In each regression, 8 industry and 18 regional dummies controlling for fixed effects have been introduced. In order to improve the signal-to-noise ratio, weighted OLS have been utilised (Table 4, Panel a). Weights are given by (i) the forecast error variance explained by the impulses (monetary policy innovations on local output) at

different forecasting horizons and (ii) the R^2 in the equation for local output in the VAR systems. Larger effects of monetary policy shocks and more precisely estimated relationships in the first stage gain more weight in the tests based on longitudinal data.[12]

A truncated sample has also been considered (Table 4, Panel b). It is plausible that the estimated impacts on local output lower than the median convey more information on the effects of monetary policy, because a negative impact is expected a priori from a policy tightening while positive or close to zero magnitudes mainly reflect measurement errors or other factors. Tobit regressions have been estimated on the impulses on local output lower than the median only, while the others are put to zero. It can also be useful to concentrate on the "particularly large" negative effects of unexpected monetary policy changes on output using Probit models. In this case, the dependent variable is dycotomic (1 for values lower than the 3rd quartile and zero otherwise). The Probit models ascertain whether the proposed explanatory variables are able to predict the probability of particularly wide local output sensitivities to monetary policy changes; they signal the direction of the effects and are not influenced by possible numerical outliers (because the dependent variable is binary) and thus help to check the overall robustness of the results. It should be noted that, by construction, the signs of the coefficients in the Probit model are reversed with respect to the Tobit or OLS regressions.

[12] In the estimated VAR systems the average and median R^2 of the local output equations are 0.635 and 0.642, respectively; their standard deviation is 0.107. The largest R^2 is 0.895 and the lowest 0.403. It can be seen that the survey data are bounded variables (from –100 to +100) and this may require a robust estimation procedure; however, the balances between the replies fluctuate far from the bounds most of the time and rarely touch them (agents are not unanimously optimistic or pessimistic) and OLS estimation techniques are adequate in practice. Models for truncated samples and binary choices are discussed by Greene (1990) and Judge et al. (1985). The Probit model assumes a normal distribution and requires deterministic or exogenous stochastic explanatory variables. The Tobit and Probit models are only used as a basis for comparison with the regressions results reported in Table 4, panel (a).

TABLE 4 – Explaining the cross-section distribution of local output responses to monetary policy shocks (164 observations)

PANEL (A)	Weights: VAR forecast error variance				Weights: VAR explanatory power			
Weighted OLS	MMR18	MMR24	MMR30	MMR36	MMR18	MMR24	MMR30	MMR36
INVESTMENT:								
INVAD81	-.555	-.699	-.538	-.264	-.363	-.386	-.290	-.152
FIRM SIZE:	(-2.65)*	(-3.48)*	(-3.61)*	(-2.05)**	(-1.87)***	(-1.94)***	(-2.11)**	(-1.86)***
MEDIAN SALES	-.007	-.008	-	-	-.005	-.005	-	-
	(-2.33)**	(-2.40)**			(-1.94)***	(-1.88)***		
MICRO FIRMS	.343	-	-	-	-	-	-	-
	(1.65)***							
MICRO BANKS	-	-	-	.114	-	-	-	-
DEGREE OF LOCALISM:				(1.70)***				
CYCLICAL CORRELATION	-	-	-.087	-.113	-	-	-.106	-.113
FINANCIAL VARIABLES:			(-1.77)***	(-2.99)*			(-2.89)*	(-3.63)*
LEVERAGE	-	-	-	-	-	-	-	-
LIQUIDITY	1.607	1.764	-	-	-	-	-	-
	(1.73)***	(1.74)***						
SHORT-TERM DEBT	-	-	-	-	-	-	-	-
INDUSTRY DUMMIES:								
Basic metals	-	-	-	-	-.034	-.034	-	-
					(-2.05)**	(-1.85)***		
Chemicals	-	-	-	-.047	-	-	-	-
				(-1.94)***				
Fabric. metals, machinery	-	-	-.054	-.050	-.038	-	-	-
			(-1.66)***	(-2.06)**	(-1.84)***			
Vehicles	-	-	-	-.050	-	-	-	-
				(-1.78)***				
R2	.386	.389	.376	.466	.226	.218	.268	.343
SER	.056	.064	.051	.037	.047	.052	.044	.035

PANEL (B)	Dep. v.= lower than the median, 0 otherwise				Dep. v.= 1 large negative impact, 0 otherwise			
Truncated samples	TOBIT Estimation				PROBIT Estimation			
	MMR18	MMR24	MMR30	MMR36	MMR18	MMR24	MMR30	MMR36
	<-.00781	<-.01838	<-.02106	<-.01726	<-.03272	<-.04527	<-.05257	<-.03901
INVESTMENT:								
INVAD81	-.538	-.412	-	-	.242	-	-	-
FIRM SIZE:	(-2.72)*	(-1.77)***			(2.59)*			
MEDIAN SALES	-	-.005	-	-	-	-	-	-
		(-1.89)***						
MICRO FIRMS	-	-	-	-	-	-	-	-
MICRO BANKS	-	-	-	-	-	-	-.004	-.006
DEGREE OF LOCALISM:							(-1.78)***	(2.13)**
CYCLICAL CORR.	-	-	-.143	-.115	-	-	.034	.026
FINANCIAL VARIABLES:			(-3.14)*	(-3.08)*			(2.21)**	(1.72)***
LEVERAGE	-	-	-	-	-	-	-	-
LIQUIDITY	1.355	1.203	-	-	-.345	-.313	-	-
	(2.49)**	(1.80)***			(-1.83)***	(-1.77)***		
SHORT-TERM DEBT	-	-	-	-	-	-	-	-
INDUSTRY DUMMIES:								
Basic metals	-	-	-	-	.028	-	-	-
					(2.13)**			
Fabric. metals, machinery	-.065	-	-	-	.040	-	-	-
	(-2.42)**				(2.84)*			
Non-metallic minerals	-.046	-	-	-	.031	-	-	-
	(-1.94)***				(2.43)**			
Textiles	-.048	-	-	-	-	-	-	-
	(-1.90)***							
Food, beverages, tobacco	-.048	-	-	-	-	-	-	-
	(-1.78)***							
Paper products	-.048	-	-	-	.032	-	-	-
	(-1.90)***				(2.38)**			

Heteroskedastic-consistent t-statistics. A constant, 8 industry and 18 regional dummies are included in each regression; only coefficients on the explanatory variables significant at the 10 percent level are reported. *, **, *** indicate significance at the 1, 5 and 10 percent level, respectively.

There are some differences across the estimated regressions, but the broad picture is consistent. The magnitude of the output response to the money market rate is higher (more negative) for more capital-intensive local industries. INVAD81 is significant in all the OLS regressions (Table 4). It is reflected in a larger negative impact on output and brings a higher probability of a large negative impact in the Probit regression at a horizon of 18 months. This suggests that an "interest rate channel" operates through shocks to the money market, a result that confirms the findings of previous research (Dedola and Lippi, 2000).[13]

In this sample, firm size amplifies the negative output effects of the policy variable. The explanatory variable MSALES enters with a negative sign in the OLS regressions for forecasting horizons of 18 and 24 months. The share of MICRO firms - which are likely to have very limited access to capital markets and to depend on banks for external financing – yields a positive sign, significant at the 10 percent level, in the 18-months-horizon case. Overall, local industries with smaller firms tend to respond less, rather than more, to monetary policy shocks; this finding is consistent with previous empirical analysis on Italian data (Angeloni, Buttiglione, Ferri and Gaiotti, 1995). The presence of MICRO banks is associated with a perceived less negative impact on local output at long-run forecasting horizons (three years) and is reflected in a lower probability of a large shock. This result is not in contrast with an "invisible handshake" and long-run customers ties that may induce micro banks to smooth the impact of short-term interest rate changes; it confirms the correlation reported by Küppers (1999), based on a sample of German banks.

Regarding the measures of financial conditions, firms' liquidity (LIAT) shows a positive coefficient (at forecasting horizons up to two years) and diminishes the chances of a large negative impact of interest rate changes on local output. Liquidity acts as a buffer and signals better-than-average "financial health", thus lowering the

[13] An indicator of capital intensity based on Centrale dei bilanci data has also been computed, the median ratio of firms' fixed capital to total assets (Table 3, FIXCAP). This measure is negatively correlated with the policy impulses on output at usual significance levels and its explanatory power is similar to that of INVAD81, but it is not a predetermined variable.

overall output effects of monetary policy shocks and confirming the presence of financial frictions in the transmission mechanism. Instead, the degree of leverage and the short-term to total debt ratio of local industries are not significant. Heterogeneity in policy responses is also linked to the dichotomy between "core" and "peripheral" local industries, according to their correlation with the aggregate cycle. In the long run, monetary impulses are larger (more negative) across "core" industries and the probability of observing a large shock is higher. This suggests that the diversification of long-run output responses is also due to local differences in cyclical patterns.[14]

4. Conclusions

This analysis of how monetary policy is transmitted through the real economy on the basis of Italian survey data confirms the presence of heterogeneity in the output sensitivity to unanticipated policy changes. Monetary policy is transmitted by both an interest rate and a broad credit channel. Investment is directly linked to the magnitude of the local responses to interest rate changes. Relatively less liquid local industries share higher-than-average output effects of monetary shocks. Liquidity acts as a buffer and low liquidity firms may also signal difficulty in obtaining new financial resources, thus proxying more binding credit constrains.

In this sample, relatively large rather than small firms account for a larger share of monetary policy effects on output. An "invisible handshake" between local businesses and specialised local banks cannot be excluded either. Local industries with a larger proportion of small banks seem relatively more protected from money market shocks. Small businesses do not play the main role in monetary transmission and do not seem to bear a relatively larger policy burden. Overall, these results

[14] Controlling for these factors, the OLS results indicate a higher than the average impact of monetary policy on capital-intensive local sectors (basic metals, chemicals, fabricated metals and machinery, vehicles). Dedola and Lippi (2000, Table 3, maximum elasticity) find on Italian industrial production data a larger impact of unanticipated monetary policy on motor-vehicles, paper and printing, machinery and equipment, non-ferrous metals, iron and steel. The Tobit and Probit results suggest that large impacts are not limited to heavy industries; for instance, non-metallic minerals and paper products are affected more than the average by a monetary tightening, as far as large shocks are concerned. Systematic geographical patterns are difficult to detect; the estimated regional differences are not robust across the specifications.

confirm the findings of Angeloni et al (1995), based on banking data. A higher sensitivity of large firms to monetary impulses may also arise from a higher capital intensity, not entirely accounted for by fixed investment statistics (including human capital or activities influenced by inter-temporal considerations, like investment in research) or by changes in the composition of final demand following a monetary shock unfavourable to large firms and not already captured by the industry and regional dummies. Gertler and Gilchrist (1994, page 313) observe that "monetary policy should have a disproportionate impact on borrowers with limited access to capital markets, everything else equal". Regarding the effects of firm size, many things are not equal. For instance, the classical interest rate channel of monetary policy affects the relative price of capital, and it is not unlikely that small firms are relatively less capital intensive, if a broad definition of capital is introduced. Cohen and Klepper (1996) find on British data that firm size and real R&D expenses are closely and positively related within industries; Fishman and Rob (1999) offer theoretical insights studying a competitive equilibrium model in which larger firms spend more on research. Black, Noel and Wang (1999) report evidence on the presence of economies of scale in on-the job training on US data; larger firms provide more training and more human capital accumulation. Advantages related to large-scale advertising, a form of intangible capital expenses, have also been observed (Brown, 1978). Inter-temporal considerations are important in all these cases.

Evidence on the monetary transmission mechanism in the Italian economy indicates that a perspective based on the existence of credit market frictions and differential access to capital markets is correct but that the overall influence of firm size is not a generalised policy implication and deserves further study. Differences in the cyclical composition of output explain part of the observed heterogeneity. Policy impulses are lower across peripheral local industries, less correlated with the aggregate business cycle. There is confirmation that industry effects influence the impact of monetary policy on the economy. Further research is needed to detect the presence of systematic geographical differences in the transmission mechanism; to this end, actual output data are likely to be more informative than business surveys.

Data Appendix

Panel (A). Disaggregated data utilised in the VAR systems:

Obs.	Acronym	Obs.	Acronym	Obs.	Acronym	Obs.	Acronym	Obs.	Acronym	Obs.	Acronym	Obs.	Acronym
1	METPIE	26	NONEMI	51	CHEABR	76	VEHLOM	101	ALILAZ	126	TEXCAL	151	OTHVEN
2	METLOM	27	NONMAR	52	CHEPUG	77	VEHLIG	102	ALICAM	127	TEXSIC	152	OTHFRI
3	METLIG	28	NONTOS	53	CHECAL	78	VEHTRE	103	ALIABR	128	TEXSAR	153	OTHEMI
4	METTRE	29	NONUMB	54	CHESIC	79	VEHVEN	104	ALIMOL	129	PAPPIE	154	OTHMAR
5	METVEN	30	NONLAZ	55	CHESAR	80	VEHFRI	105	ALIPUG	130	PAPLOM	155	OTHTOS
6	METFRI	31	NONCAM	56	MACPIE	81	VEHEMI	106	ALIBAS	131	PAPLIG	156	OTHUMB
7	METEMI	32	NONABR	57	MACLOM	82	VEHMAR	107	ALICAL	132	PAPTRE	157	OTHLAZ
8	METMAR	33	NONMOL	58	MACLIG	83	VEHTOS	108	ALISIC	133	PAPVEN	158	OTHCAM
9	METTOS	34	NONPUG	59	MACTRE	84	VEHLAZ	109	ALISAR	134	PAPFRI	159	OTHABR
10	METUMB	35	NONBAS	60	MACVEN	85	VEHCAM	110	TEXPIE	135	PAPEMI	160	OTHMOL
11	METLAZ	36	NONCAL	61	MACFRI	86	VEHABR	111	TEXLOM	136	PAPMAR	161	OTHPUG
12	METCAM	37	NONSIC	62	MACEMI	87	VEHPUG	112	TEXLIG	137	PAPTOS	162	OTHBAS
13	METABR	38	NONSAR	63	MACMAR	28	VEHBAS	113	TEXTRE	138	PAPUMB	163	OTHCAL
14	METMOL	39	CHEPIE	64	MACTOS	89	VEHCAL	114	TEXVEN	139	PAPLAZ	164	OTHSIC
15	METPUG	40	CHELOM	65	MACUMB	90	VEHSIC	115	TEXFRI	140	PAPCAM		
16	METBAS	41	CHELIG	66	MACLAZ	91	ALIPIE	116	TEXEMI	141	PAPABR		
17	METCAL	42	CHETRE	67	MACCAM	92	ALILOM	117	TEXMAR	142	PAPPUG		
18	METSIC	43	CHEVEN	68	MACABR	93	ALILIG	118	TEXTOS	143	PAPBAS		
19	METSAR	44	CHEFRI	69	MACMOL	94	ALITRE	119	TEXUMB	144	PAPCAL		
20	NONPIE	45	CHEEMI	70	MACPUG	95	ALIVEN	120	TEXLAZ	145	PAPSIC		
21	NONLOM	46	CHEMAR	71	MACBAS	96	ALIFRI	121	TEXCAM	146	PAPSAR		
22	NONLIG	47	CHETOS	72	MACCAL	97	ALIEMI	122	TEXABR	147	OTHPIE		
23	NONTRE	48	CHEUMB	73	MACSIC	98	ALIMAR	123	TEXMOL	148	OTHLOM		
24	NONVEN	49	CHELAZ	74	MACSAR	99	ALITOS	124	TEXPUG	149	OTHLIG		
25	NONFRI	50	CHECAM	75	VEHPIE	100	ALIUMB	125	TEXBAS	150	OTHTRE		

Note: Industry acronyms: MET = basic metals; NON = non-metallic mineral products; CHE = chemicals; MAC = fabricated metal products and machinery; VEH = vehicles and transport equipment; FOO = food, beverages and tobacco; TEX = textile, wearing apparel and leather industries; PAP = paper and paper products, printing and publishing; OTH = wood products, rubber and other manufacturing industries. Regional acronyms: PIE = Piedmont; LOM = Lombardy; TRE = Trentino-AA; VEN = Veneto; FRI = Friuli-VG; LIG = Liguria; EMI = Emilia-Romagna; TOS = Tuscany; UMB = Umbria; MAR = Marche; LAZ = Lazio; ABR = Abruzzo; MOL = Molise; CAM = Campania; PUG = Puglia; BAS = Basilicata; CAL = Calabria; SIC = Sicily; SAR = Sardinia.

Panel (B). Aggregate data utilised in the VAR systems (IFS refers to the IMF International Financial Statistics tape codes):

Real world imports	world imports c.i.f. deflated by import unit values, log(IFS 001,71d/IFS 001,75d)
Non-fuel commodity prices	log(IFS 001,76axd)
Oil prices	petroleum, log(IFS 001,76aad)
Industrial production	s. a., log(IFS 136, 66..c),
Wages	contractual wages, log(IFS 136,65ey)
Consumer prices	CPI, log(IFS 136, 64)
Money market rate	three-month interbank rate, IFS 136, 60..b
Real exchange rate	based on relative labour costs, log(IFS 136, reu)
Real money balances	M2, national definition, deflated by CPI, log(IFS 136, 39m/IFS 136, 64)
Spread	lending rate (IFS 136, 60..b) minus net average yield to maturity on Government Bonds with residual maturities of more than one year (source Bank of Italy).
Real domestic credit	deflated by CPI, log(IFS 136, 32/IFS 136, 64)

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