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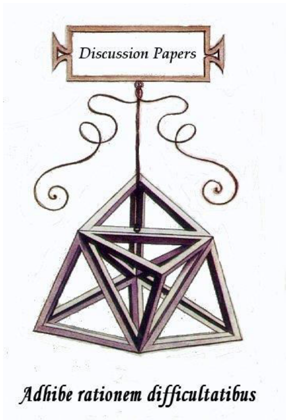

Giuseppe Conti - Luciano Fanti

Alternative monetary approaches and causal nexus breakdown in rate of interest and currency reserves in Italy, 1961-1990

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Indirizzo degli Autori:

Dipartimento di Economia e Management
Via Ridolfi 10
56100 Pisa
gconti@ec.unipi.it
lfanti@ec.unipi.it

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Abstract

Following a renewed interest for the investigation of the monetary policy in the Italian experience, this paper focus on the role of the official reserves as a target of Bank of Italy for the period 1961-1990, motivated by a long lasting tradition (e.g. Hawtrey, Keynes, Kaldor) for which reserves were crucial for the central bank behaviour. This paper analyses, mostly by using the Granger causality test, if this "traditional" rule could have been working for Italy in recent periods as well, regardless of exchange rate regimes and the mainstream monetary theories.

Main conclusions neatly support the existence of two sub-periods: a first one (before 1979) during which the "traditional" praxis occurs; and a second one (after 1979) when the "alternative" praxis seems to prevail. This would confirm the break in monetary targeting adopted by the Italian central bank at the end of the Seventies.

Keywords: Monetary policy, interest rate, reserve ratio, Bank of Italy, Granger test

JEL: : E52, E58

1. Introduction

A renewed interest for the investigation of the monetary policy in the Italian experience has been recently witnessed by some articles, e.g. De Arcangelis-Di Giorgio (1998) in this Journal. While these latter authors has focused on: 1) 1990's; 2) control of interest rates versus control of monetary aggregates in the operative procedure of central bank, we focus on: 1) the period 1961-1990; 2) the issue of the official reserves as main target of Bank of Italy versus the abandoning of such a target. Our focus has been motivated by a long lasting tradition stressed by many great economists for which reserves were crucial for the central bank behaviour. This article aims to investigate the latter issue, filling a gap due to a progressive "vanishing" of such an issue in the recent literature.

Indeed many authoritative economists, such as, among others, Hawtrey, Keynes, Roosa, and more recently Kaldor, maintained that central bank follows, as a main rule, the protection of its reserves, independently of the changes in the international monetary systems and in the exchange regimes. A twofold reason may be evidenced in this statement: 1) a "sound" microeconomic behaviour of the central bank; 2) an approach of "mercantilist flavour" of monetary policy. Indeed, official reserves may be seen as a stock buffer allowing for a more discretionary central bank policy, as sharply evidenced by Keynes: «the effective strength of a central bank entirely depends in practice of the amount of its *excess* reserves»[1]. This "traditional policy" should be seen as an academic exercise without practical importance after the end of the old monetary regime, and as a consequence recent monetary policy textbooks neglect it: the emphasis has been concentrated rather on the transmission mechanisms of monetary policy than on official reserves.

Our hypothesis is that this "traditional" rule aiming to preserve a certain independence in central banking could have been working in recent periods as well, regardless of exchange rate regimes and the mainstream monetary theories.

According to the recent monetary history, two alternative monetary policy approaches prevailed: on the one side the maintainers of control on interest rates, on the other side the supporters of quantitative control. Main theoretical basis of this dispute referred to Keynesian or Monetarist paradigms developed in many ways: discretional versus fixed rules, instruments adequacy to targets, transmission channels of monetary policy, even though both parties believed in the effectiveness of monetary policy in halting inflation during the 1970s and the 1980s. However, the firmly established tradition as a mix of a long experience and of some banking and monetary doctrines may be alive in the II post World War period. Its

[1] Keynes (1930), p. 243 (italics in the original text).

main proposition can be summarised as follows: the central bank has reliance that the discount rate is the means of regulating its reserves[2].

As regards the Italian case, recent studies focused on the distinction on a first post war period ante 1980 in which a qualitative policy was prevailing (monetary policy based on direct or indirect regulation of banks' liquidity) and a second period post 1980 in which a quantitative approach dominated (Padoa-Schioppa, 1987; Gaiotti, 1999)[3], while a less recent work by Baffi-Occhiuto (1963) also focused on the role of official reserves in monetary policy.

As a matter of fact, the "traditional" rule was subject to many attacks being challenged during the Seventies. Inflationary processes and monetarism success reduced its credibility. A new phase in monetary policy was announced in many occasions between the late Seventies and the early Eighties.

The aim of this paper is to investigate a possible change in Italian monetary policy in the 1961-1990 period. Monetary authorities did not tackle a very difficult historical phase during the 1960s. Many unusual monetary and economic problems came up in the mid-Seventies, requiring new solutions and new approaches.

The two paradigms mentioned above may have behavioural implications, which can be econometrically tested. In particular we have emphasized two policy behaviours. A variation in the reserve ratio preceding a change in the interest rates spread can be seen as belonging to the "traditional" view, while an inverse temporal precedence should occur according to its abandon. An appropriate empirical testing is the Granger causality test which is a true test of "precedence"[4]. Main conclusions neatly support the existence of two sub-periods: a first one (before 1979) during which the "traditional" praxis occurs; and a second one (after 1979) when the "new" praxis seems to prevail. Section 2 describes historical monetary facts and data definitions. Section 3 shows the estimation and testing procedure with the methodology of VAR modelling and presents empirical results. Some conclusions are given in section 4.

2. The old and the new paradigms: the problems and the evidences

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[2] For instance, Keynes (1930, p. 189) argues that «the governor of the whole system is the rate of discount».

[3] For instance, Gaiotti (1999) uses as a unique indicator of monetary policy the (short-term) interest rates. However, he points out that such an indicator might not be the better measure for monetary policy: «The issue of using a reserve measure rather than an interest rate is left as a topic for further research. However, no explicit decision to target reserves was ever taken by the Bank of Italy in the period considered, unlike the Fed» (Gaiotti, 1999, p. 15n.). De Arcangelis and Di Giorgio (1998) have shown that interest rates should be preferred to reserves in the 90s. For a summary of the post war monetary policy events see Gaiotti (1999), Buttiglione - Ferri (1994) and the literature therein cited.

[4] An other econometric test suited to investigate the possible structural break in the monetary policy in 1979 could be an estimate of a structural reaction function of Monetary authority also including alternative targets such as money or exchange rates. However, the use of a «post hoc ergo propter hoc» test is more suited to represent an inductive historical method with respect to the investigation about which behavioural rule has been historically prevailing independently of having developed a microfounded model which deductively derived such behaviours.

Inquiries, reports, and internal dossiers emphasize the pragmatic policy adopted by central banks. This view has been acknowledged by central bankers, practitioners and maintained in many theoretical approaches from Bagehot on. For instance, R. G. Hawtrey thought that «the reliance of the Bank of England on its discount rate or "Bank Rate" as the means of regulation its reserves had come to be universally accepted. […] This procedure had become a firmly established tradition – so firmly established that the reasoning on which it had been founded had been clean forgotten. […] In recent years the traditional Bank rate policy has been frequently challenged. It has been challenged on the ground that it is injurious to trade and industry and sacrifices their interests to a pedantic monetary correctitude. It has been challenged on the contradictory ground that its supposed efficacy is a fiction based on fallacious reasoning» (Hawtrey, 1938 [1962], p. 1).

As an other example Kaldor (1985) states that historically the central bank policy aims mainly to protect their reserves, by small changes in its discount rate for given international rates, with the (unpleasant for Monetarists) implication that money passively adjusts to credit demand[5].

In other words, this main rule is that central bank sought to protect its gold (or other precious metals) reserves as well as its foreign currencies reserves. The traditional view created in the gold standard age may also be persistent in a flexible changes regime. In normal periods, the bank rate is lowered when reserve inflows increase and it is raised when outflows decrease the reserve level. Changes in the bank rate (which determine domestic interest rates for given foreign rates) succeed in reabsorbing an excess in gold or foreign currencies reserves (and vice versa) through international capital flows. Bank rate changes adjust supply of and demand for money, but in crisis periods when such changes could be less effective. The central bank fulfils all creditworthy applicants' demand for refinancing if corresponding variations in money supply do not threaten its main targets (i.e. the defence of its reserve ratio). In other words, the bank adopts interest rates policy, leaving money supply free to react to credit demand. The latter behaviour could be interpreted according to the so-called "endogenous determination approach of money supply"[6].

This paradigm of monetary policy changed in 1979. On October, 6th, the governor Paul Volcker announced that the Federal Reserve would have abandoned any form of interest rates control and adopted

[5] «Historically, an individual central bank's policy was mainly guided by the desire to protect its own reserves (consisting of gold and universally acceptable reserve-currency holdings) - it lowered its rediscount rate in times of rising reserves and raised them in times of falling reserves. It was generally found (before the First World War, and to a somewhat lesser extent also in recent times) that, except in periods of 'crisis', a small rise in the central bank's own rediscount rate (relative to the corresponding rates in other financial centers) was sufficient to stop a drain on its reserves, or vice versa. This traditional policy implied that the 'money supply' was a passive element, which varied automatically with changes in the demand for credit (or the availability of credit-worthy borrowers) so long as such changes were not inconsistent with the primary aim of protecting the central bank's reserves» (Kaldor, 1985, p. xiii).

[6] See, for instance, Kaldor (1982) and Moore (1988).

a fixed target in terms of monetary aggregates in order to reduce the inflationary trend[7]. Thus if the central bank wishes to restore its original reserve ratio it must shrink the volume of monetary circulation. Interest rates can fluctuate freely, but in this case money supply is exogenously determined and therefore the reserve ratio stability is not a relevant objective any more. Only the denominator of this ratio can be steadily controlled, while reserves may fluctuate following interest rates movements.

Issues such as the role of money in the reaction function of the central bank, or as the effectiveness of control on monetary aggregates, or as interest rates and/or monetary aggregates volatility are not taken into account here. Anyway, it has to be noted that between the end of the Seventies and the beginning of the Eighties, some industrial countries changed their monetary policies for a twofold reason: 1) in order to adopt monetarist principles; 2) because the rise in US interest rates compelled them to follow such a policy in order to avoid a widening in interest rate differentials and, in this way, to defend the bank reserves.

The alternative between "traditional" and "new" monetary policy approaches is tackled here. We make the hypothesis that in 1979 a significant change occurred in central bank policy. The first step is to verify if there are symptoms of such a change, i.e. the abandon of the "old" scheme of central bank policy, and the adoption of both a new target and new tools. These two alternatives paradigms can be discerned through the analysis of causation between phenomena: when a "traditional" behaviour is adopted, changes occurred in the reserve ratio cause changes in interest rates; conversely, when the "new" behaviour is chosen, the direction of causality is reversed and adjustments in reserve ratio result from changes occurred in interest rates.

Moreover, the European Monetary System starts off on March 13th 1979 implying a greater coordination between economic and monetary policies within the European countries members of the Community.

Changes in Banca d'Italia and Italian Treasury monetary policies since 1979-1980 can be seen as responding to the new paradigm.

In this work we take two variables: 1) a reserve ratio (*R*), calculated as the ratio between the level of net reserves minus the balance of the Banca d'Italia at the Fecom and minus gold in vaults and total monetary circulation, 2) the spread (*S*) between the Bank of Italy discount rate and the short-term yield on US Federal funds. Dataset is built on monthly data from January 1961 to December 1990[8]. Furthermore, we have considered a different data definition in order to evaluate the robustness of results obtained with data

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[7] See the memories of Volcker on this decision in Volcker - Gyohten (1992), pp. 166-170, and also Campbell - Dougan (1986). We note that, although the economic and financial conditions in Italy and US are different, the influence of the Fed policy should had been pervasive: by using the words of Keynes (1930, p. 274), referring to the role of the Bank of England during the classical gold standard, «could almost have claimed to be the conductor of the international orchestra».

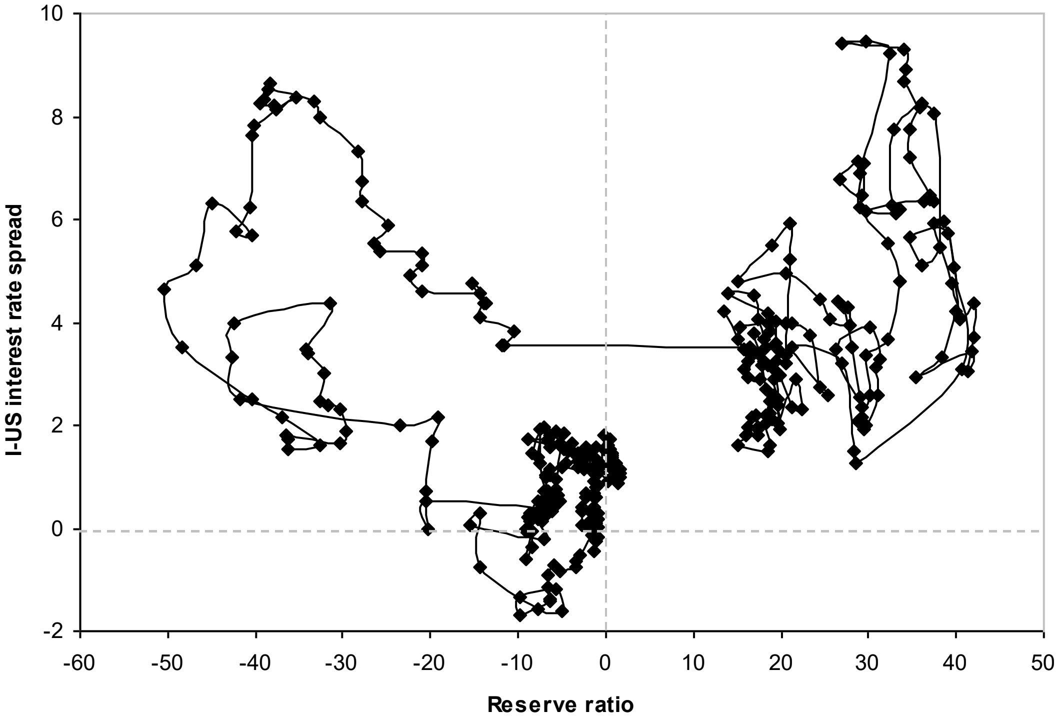
[8] Our data set is taken from Servizio Ragioneria della Banca d'Italia (1993) and from *Monthly Financial Statistics* of OECD.

as defined above[9]. Since the results are qualitatively similar to those obtained with the former variables definition, therefore we present in next section the empirical analysis concerning only variables *S* and *R* as defined above.

We recall that the reserve ratio is a proxy for the shocks originated by the external constraint which in the Italian case "has always been the main factor considered in monetary policy decisions (Gaiotti, 1999, p. 14).

The following chart depicts the scatter of these two variables.

Fig. 1 – Monthly reserve ratio and interest rates spread in Italy, 1961-1990 (in percent)



Source and note: see text.

Fig. 1 shows a complicate pattern during the whole period. Italian interest rate is almost always higher than those on US federal funds. Banca d'Italia net position in currency reserves is almost always negative until February 1979, and always positive afterwards. A greater regularity is showed till the end of the 1960s when observations are clustered on the left part of fig. 1 where reserve ratio is negative or close to

9 The different data definitions are the following: 1) the reserves ratio includes at the numerator the net currency position of Ufficio Italiano dei Cambi, too; 2) the spread is calculated as differential between the yield on Italian short-term public bonds and the yield on US Federal Funds. In this case, although yields on Italian monetary market show a higher variance, they are closely dependent on the Bank of Italy discount rate. As far as the second variable is concerned, it also includes the country's total currency reserves. Moreover, we have also considered as the anchor country Germany, rather than US, by using the yield on German short term public bonds.

zero, and spread is very low. In these years dispersion is narrower: between –10 and +2 per cent in the reserves ratio, and between –2 and +2 per cent in the spread. After the first Seventies, observations are scattered towards north-west (in the second quadrant). The reserves ratio falls from –7.5 to –20.5 per cent from February to March 1974. In the last quarter of 1974, after the first oil shock and the floating of the Dollar, Italian interest rates spread becomes larger and more volatile than before. During the 1976 crisis the reserves ratio reaches the minimum and the spread increases. From February 1979 points "jump" to the first quadrant, going from –11.7 to +16.5 per cent in March. Thereafter the path is hectic and come back at the end of the period in the proximity of the initial years, both in terms of reserves ratio and interest rates spreads.

The structural break of March 1979 is confirmed also by cluster analysis and some other statistical tests on these series[10].

3. Empirical Results: Methodology and tests

As already stated, variables used for the present analysis are i) the differential or spread between Italian official interest rate and US federal funds yield; ii) the reserves ratio. Firstly, we investigated the whole period (1961:1-1990:12); then we analysed both historically significant subperiods (1961:1-1979:2 and 1979:3-1990:12). Since our question involves the causal relation between changes in interest rates differential and reserves ratios, adoption of the first differences variables is the natural choice. It is easy to show that such differenced variables are stationary or integrated I(0)[11]. When both series are deemed I(0), a traditional bivariate model or alternatively a VAR model is used[12]. Both methods provide the same qualitative results. We present results of the traditional methodology to test Granger causality[13] in a

[10]Both Chow test and Perron test evidenced a structural break in 1979:3.

[11] As usual, we precede tests by standard procedures to determine stationarity properties of each time series, thereby eliminating spurious regression results owing to non-stationarity of the considered time series. We apply Dickey and Fuller (DF) (1979) and Augmented Dickey-Fuller (ADF) (1981) unit root tests. Empirical findings show that while never rejecting the null hypothesis of a unit root in the levels, which indicate that both series are non-stationary, the null hypothesis is always rejected, as expected, for the first differenced series, which suggest that both series contain a single unit root, i.e. they are integrated of order one, I(1). However, conducting ADF type tests for a unit root when there is a break in the trend function – as it is likely in the present series – would need a proper procedure (see Vogelsang - Perron, 1998).

[12] The cointegration test of Engle-Granger rejected the hypothesis of cointegration for the two series investigated here, so that we have not adopted the vector error correction model.

[13]In the literature on the subject of causality various tests are developed using the principle originally suggested by Granger (1969). Two of the most widely used are known as Granger test and Sims (1972) test. We use the first of these tests, which contains only lagged values of variables. Sims test exploit the feature of the general concept of causality that the feature cannot cause the present containing leading values of variables. Although which of these two tests are better has not been accurately ascertained, Guilkey–Salemi (1982) argue that the Granger test is superior. Obviously, due to the necessity of leading variables, Sims test is less parsimonious in terms of loss of both number of observation and degrees of freedom (for sake of precision Charemza-Deadman (1992, p.194) argue that «because of different philosophical background of the tests, it seems advisable to use both rather than to choose one of them»).

bivariate model (see Appendix)[14]. In addition to the F-test of zero restrictions, the FPE can be used as an additional *indication* of causality, i.e. if FPE (p^*, q^*) < FPE(p^*)[15], it implies Y Granger-causes X (or ΔY Granger causes ΔX in the case of first differenced variables), see Giles *et al*. (1993) for more details. Both criteria are used in this section. We estimate proper VAR models for our two subperiods, too: such estimations provide, through the impulse response functions for instance, a further tool for investigation of causality effects. To confirm the reliability of test procedures, we also perform tests for the presence of serial correlation, heteroschedasticity and autoregressive conditional heteroschedasticity (ARCH) in the residuals of equations of the bivariate model. In order to perform the Granger causality test between two variables, the selection of optimal lag lengths is essential. To determine optimal lag lengths of the dependent and independent variables, p and q respectively, we opt for the following usual strategy: 1) we first estimate the model using different lag lengths for the lagged dependent variable, for a preset maximum number of lags equal to six. Hsiao (1981) argues that lag length investigated should be from one to four. We then select the lag length that minimises a set of standard statistics of selection of the model: AIC (Akaike (1974) criterion), FPE, HQ (Hannan-Quinn, 1979), Schwarz's (1978) information criterion (SIC). We do not need to have any rule for choice among different criteria because all four indexes are always converging, indicating the same model specification. 2) Then, we include lagged values of the independent variable, and again utilising the four statistics mentioned above, we examine whether these variables have any explanatory power or not. Let's define s as the change in the rates spread (e.g. $\Delta S = S_t - S_{t-1}$) and r the change in the reserves ratio (e.g. $\Delta R = R_t - R_{t-1}$). When the dependent variable is s, the optimal lag length, which is chosen by the method described above, is $p=1$, $q=2$. When the dependent variable is r, there exists the following optimal lag lengths: $p=1$, $q=3$. Causality test results are summarized in Table 1. Findings provide very little evidence for the existence of causality in each direction when the entire period is considered (both F-statistics and FPE criteria suggest the "independence" between changes in reserves and rates spread); this fact may not be surprising considering the existence of evident different patterns during such a period. In particular, we identify a structural break in the first part of 1979 which appears to be important for at least two reasons, one theoretical, the other institutional: i) on that very year the monetarist view consolidated itself, and ii) the EMS experiment began. Therefore we re-estimate the relation between s and r for the two subperiods mentioned above. Test results for the 1961:1-1979:2 period show that there exists a causal relationship from the reserves ratio to the rate spread, but not vice versa. In the second period the causality is

[14] The equations have been estimated with the presence of an intercept. Adjustments for seasonality and time trend did not alter the qualitative results and then they have been omitted.
[15] p and q are the lag lengths of the dependent and independent variables in the bivariate model.

unidirectional from the rate spread to the reserves ratio.[16] At the same time, there is no evidence of reverse causality from *r* to *s*. Such a reversion of the causality nexus may be also shown by investigating the relationship between s and r through the impulse response functions (IRF)[17]. Response of *r* when *s* is the shocked variable is shown in Figs. 2a and 2b for the two subperiods, respectively. Figs. 3a and 3b show the response of *s* when *r* is the shocked variable, for the two subperiods, respectively. Comparison of Figs. 2a and 2b evidences that the response of reserves changes to a differential rates shock is positive in the first period, while it is negative in the second one. Conversely, comparison of Figs. 3a and 3b, shows that the response of the change in the rates spread to a shock in the variation of the reserves ratio is negative in the first period, while it is positive in the second one. This phenomenon is in line with the hypothesis of a change in monetary policy between the two periods. The non-rejection of the hypothesis that *r* causes *s* in the first period – while the converse causation is strongly rejected – and that *s* causes *r* in the second period – while the converse causation is strongly rejected, provide strong support for the claim of a behavioural change in monetary policy[18]. In all cases a shock causes a quick adjustment during four-five periods.

Tab. 1 – Summary of the Causality analysis between *s* and *r*

Direction Causality	Lags leng s and	F-valu	Critical F-value a 10%, 5%, 1%	FPE (p	FPE (p	Decision (F criteria)	Decision (F criteria)
Sample period: 1961:1 – 1990:12							
s → r	2,2	1.8	F(2,351)= 2.32, 3 4.67	7.705	7.70	Reject	s and r are "independe
r → s	1,1	0.79	=	0.206	0.20	Reject	

[16] For sake of precision in the second period the null hypothesis of causality is not rejected at the limit of the 7%. However we accept the conclusion of unidirectional causality, mainly stressing the economic significance of the evident symptoms of the inversion of causality with respect to the previous period. Such symptoms are even more evident in the other models with higher lag lengths which we have estimated (not presented here for economy of space), where the causality may be accepted with high level of significance. By passing, we recall that the bivariate causality nexus may be affected by possible correlations of *s* and *r* with omitted variables such as money and exchange rates. The extension of the empirical investigation to a multivariate model is beyond of the scope of this paper and it will be object of further research.

[17] As known, another method of analysing the short run dynamics of a VAR model is by employing impulse response analysis. Impulse response functions trace the response of each variable in a particular VAR system to a one standard error shock in an individual variable. The sensitivity of the results to the ordering of the two variables has been examined by using the different ordering in the impulse response functions. The results does not appear qualitatively different between them. As regards the optimal order of the lags in the VAR models, estimated with the same lag lengths for both variables, the same criteria mentioned in the main text indicated as optimal $p = q = 1$ for both sub-periods.

[18] However we should note some statistical caveats. In fact in some cases the residuals of the OLS estimates of the single equations (1)-(4) show symptoms of autocorrelation and sometimes of heteroschedasticity; however estimating equations with methods (e.g Cochrane-Orcutt and WLS estimations) correcting such drawbacks produces recalculated test statistics only marginally changed, so that the shown results may be considered sufficiently robust. In any case the usual caveats on the robustness of the conclusions drawn by the Granger analysis may apply here as well.

Sub-sample period: 1961:1 – 1979:2

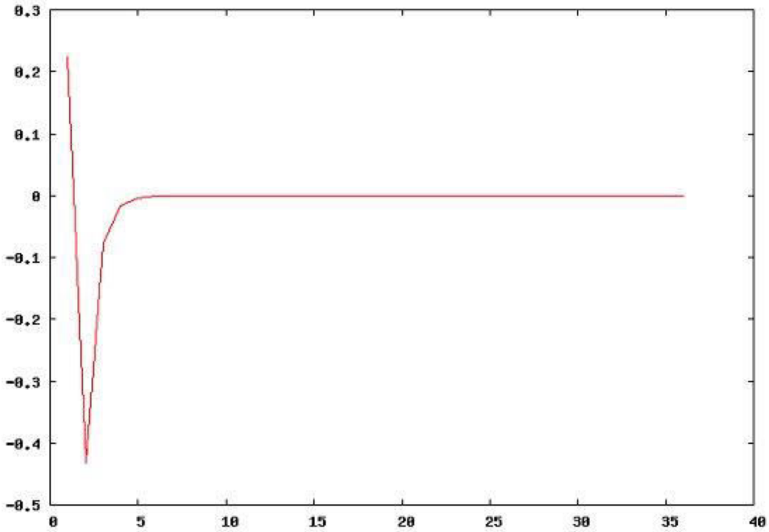
s → r	1,3	0.0237	F(3,212) =2.11, : 3.88	5.40'	5.4:	Reject	s "do not cau:
r → s	1,2	10.9:	F(2,212)= 2.33, : 4.71	0.102	0.0:	Do not reject a than 1%	r "causes"

Sub-sample period: 1979:3 – 1990:12

s → r	1,1	3.41	F(1,139) 2.74- 3. 6.82	42.7:	42.:	Don't Reject a 7%	s "causes"
r → s	2,1	1.06	F(2,139) 2.35- 3. 4.77	0.94(	0.9:	Reject	r "don't cause

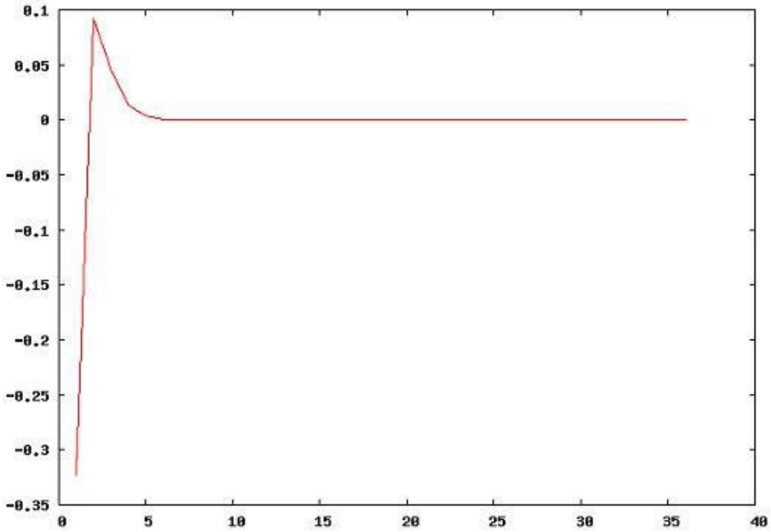
Note: The same results are obtained testing Granger causality in the VAR frame, and so for brevity such results are not presented here.

Fig. 2a – Impulse response function of *r* to one standard-error shock in the interest rate spread in the period 1961:1–1979:2



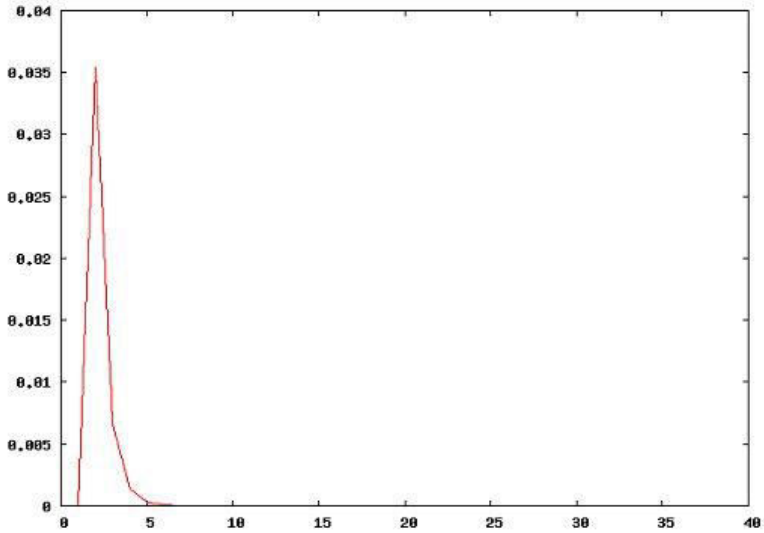
Note: IRF are produced by VAR (1,1)

Fig. 2b – Impulse response function of *r* to one standard-error shock in the interest rate spread in the period 1979:3–1990:12



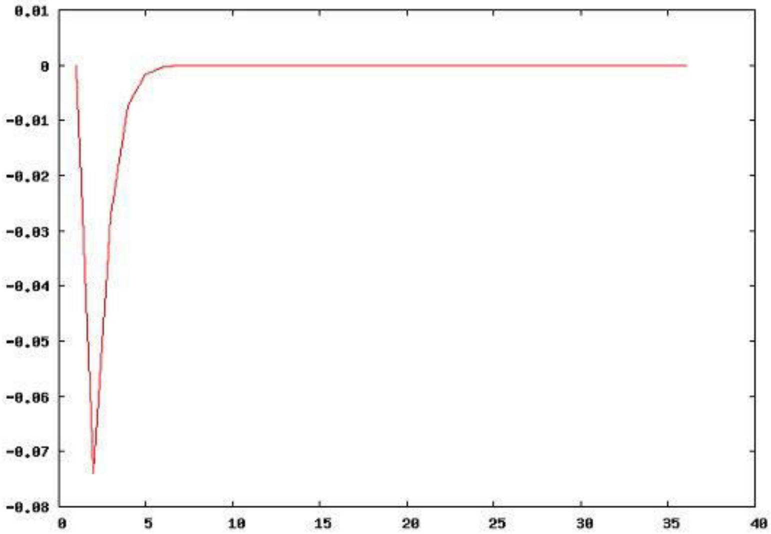
Note: IRF are produced by VAR (1,1)

Fig. 3a – Impulse response function of the interest rate spread to one standard-error shock in the reserve ratio in the period 1961:1–1979:2



Note: IRF are produced by VAR (1,1)

Fig. 3b – Impulse response function of *r* to one standard-error shock in the interest rate spread in the period 1979:3–1990:12



Note: IRF are produced by VAR (1,1)

4. Conclusions

This paper examines the linkages between the reserves ratio and the spread of interest rates in Italy in order to verify if the monetary authorities followed the "traditional" or a "new" behaviour during the 1961-1990 period. Our approach analyses causal interactions between such variables. In fact, in the "traditional" view in which money supply is endogenously determined, the central banker modifies the discount rate in order to restore the desired level of currency reserve. In this way Italian domestic interest rates may result higher or lower than those prevailing in the US monetary market. In the "traditional" approach, the central bank monitors its reserves and changes its interest rate policy regardless to the fact that the fall (rise) in the reserves ratio is due to money demand or to variations in external interest rates. In contrast with the "traditional" approach, in the "new" one the central bank aims to control the money supply and allows for free movements in interest rates.

Granger causality tests are employed to determine whether *s* and *r* possess predictive power in relationship to one another in the short run. During the whole period Granger test results show that the two variables are independent. However, in this case the length of the period considered could have hidden different causality nexus in sub-periods. We analyse causality in two sub-periods divided by a structural break in data series as well as by historical monetary policy changes. In the first subperiod, from 1961 to March 1979, test results show that there exists a unidirectional causal relationship from the reserves ratio to the interest rate spread. This could be interpreted as an adhesion to the "traditional rule". Thus before 1979 the results suggest that the central bank aimed to keep a relative stability in reserve ratio in order to obtain credit stability, regardless to the general conditions in international financial markets.

In the second sub-period (1979:3-1990:12) the causality is unidirectional from the interest rate spread to reserves ratio. At the same time, there is not evidence of reverse causality from *s* to *r*. This would confirm the break in monetary targeting adopted by the Italian central bank at the end of the Seventies when it allows for free fluctuations of interest rates (and of their spread) in order to pursue an anti-inflationary policy. Results of this paper, although partial, suggest that monetary policy in Italy might have been influenced by the new course inaugurated by the Federal Reserve as well as by the introduction of Ems.

Further research should proceed as follows: 1) we may include a control variable such as other money market interest rates, some monetary aggregates and operational instruments of monetary policy and perform the Granger causality test in a multivariate frame, checking differences with present results; 2) besides the Granger causality test, other parametric tests such as Sims (1972) test, Geweke-Meese-Dent (Geweke 1984) test and non parametric tests such as the multiple rank F can also be performed and compared with results obtained in this paper; 3) comparison involving other countries, using the same kind of data set and methodologies would be of relevant interest, too.

Methodological Appendix

In the literature on the subject of causality various tests are developed using the principle originally suggested by Granger (1969). Two of the most widely used are known as Granger test and Sims (1972) test. We use the first of these tests, which contains only lagged values of variables. Sims test exploit the feature of the general concept of causality that the feature cannot cause the present containing leading values of variables. Although which of these two tests are better has not been accurately ascertained, Guilkey–Salemi (1982) argue that the Granger test is superior. Obviously, due to the necessity of leading variables, Sims test is less parsimonious in terms of loss of both number of observation and degrees of freedom.[19]

Granger causality relationship is expressed in two pairs of regression equations by simply twisting independent and dependent variables as follows

$$X_t = \beta_{1,1}X_{t-1}+\beta_{1,2}X_{t-2}+\ldots\ldots+\beta_{1,p}X_{t-p}+\beta_{2,1}Y_{t-1}+\beta_{2,2}Y_{t-2}+\ldots\ldots+\beta_{2,q}Y_{t-q}+u_{1,t} \qquad (1)$$

$$Y_t = \beta_{2,1}Y_{t-1}+\beta_{2,2}Y_{t-2}+\ldots+\beta_{2,q}Y_{t-q}+\beta_{1,1}X_{t-1}+\beta_{1,2}X_{t-2}+\ldots\ldots+\beta_{1,p}X_{t-p}+u_{2,t} \qquad (2)$$

$$X_t = \beta_{1,1}X_{t-1}+\beta_{1,2}X_{t-2}+\ldots+\beta_{1,p}X_{t-p}+u_{1,t} \qquad (3)$$

$$Y_t = \beta_{2,1}Y_{t-1}+\beta_{2,2}Y_{t-2}+\ldots+\beta_{2,q}Y_{t-q}+u_{2,t} \qquad (4)$$

Equations (1) and (2) are called unrestricted, (3) and (4) restricted.

According to Granger's definition of causal relationships:

Y does not cause X, if $\beta_{2,1} = \beta_{2,2} = \ldots\ldots = \beta_{2,q} = 0$ (5)

and

X does not cause Y, if $\beta_{1,1} = \beta_{1,2} = \ldots\ldots = \beta_{1,p} = 0$ (6)

[19] For sake of precision Charemza-Deadman (p.194) argue that " because of different philosophical background of the tests, it seems advisable to use both rather than to choose one of them".

In order to judge whether these conditions hold, the test employ the following *F*-statistic to be applied to equations (1) and (2) relative to equations (3) and (4):

$$F = [(RSSUR - RSSR) / p] / [(RSSUR) / (n-2p-1)] \qquad (7)$$

Where:
RSSUR = the unrestricted residual sum of square
RSSR = the restricted residual sum of square
n = the number of observations
p = the number of lags of the "causal" variable, which, for simplicity, is assumed to be equal for the two variables, $p=q$.

With Granger test, the direction of causality is judged as follows:

The result of F-test Direction of Causality

1) (5) holds, (6) does not hold :	*X* causes *Y* $(X \rightarrow Y)$
2) (5) does not hold, (6) holds :	*Y* causes *X* $(Y \rightarrow X)$
3) Both (5) and (6) hold :	Feedback between *X* and *Y* $(X \leftrightarrow Y)$
4) Neither (5) nor (6) holds :	*X* and *Y* are independent

References

H. AKAIKE (1969), "Fitting Autoregressive Models for Predictions". *Annals of Mathematical Statistics*, 40, pp. 243-47.

P. BAFFI - A. OCCHIUTO (1963), "La componente esterna della liquidità e le regole della condotta monetaria", in *Studi di economia finanza e statistica in onore di Gustavo Del Vecchio*, Cedam, Padova, Vol. I, pp. 63-81.

L. BUTTIGLIONE - G. FERRI (1994), "Monetary Policy Transmission via Lending Rates in Italy: Any Lessons from the Recent Experience?". Banca d'Italia, *Temi di discussione*, n. 224.

C. C. CAMPBELL - W. P. DOUGAN (1986), *Alternative Monetary Regimes*, John Hopkins University Press, Baltimore.

W. W. CHAREMZA - D. F. DEADMAN (1992), *New Directions in Econometric Practice*, Edward Elgar, Aldershot.

G. DE ARCANGELIS - G. DI GIORGIO (1998), "In Search of a Monetary Policy Measure: the Case of Italy in the 90s". *Giornale degli Economisti e Annali di Economia*, 57, pp. 167-204.

D. A. DICKEY - W. A. FULLER (1979), "Distribution of the Estimators for Autoregressive Time-Series with a Unit Root". *Journal of the American Statistical Association*, 74, pp. 427-31.

———————— (1981), "Likelihood Ratio Statistics for Autoregressive Time-Series with a Unit Root". *Econometrica*, 49, pp. 1057-72.

R. F. ENGLE - C. W. J. GRANGER (1987), "Cointegration and error correction: representation, estimation and testing". *Econometrica*, 55, pp. 251-76.

E. GAIOTTI (1999), “The Transmission of Monetary Policy Shocks in Italy, 1967-1997”. Banca d’Italia, *Temi di discussione*, n. 363.

J. GEWEKE (1984), “Inference and causality in economic time series models”, in Z. Griliches and M. D. Intriligator (eds), *Handbook of Econometrics*, Vol. 2, North-Holland, Amsterdam.

D. E. A. GILES - J. A. GILES - E. McCANN (1993), “Causality, unit roots and export-led growth: the New Zealand experience”. *Journal of International Trade and Economic Development*, 1, pp. 195-218.

C. W. J. GRANGER (1969), “Investigating causal relations by econometric models and cross-spectral methods”. *Econometrica*, 37, pp. 424-38.

D. K. GUILKEY - M. K. SALEMI (1982), “Small sample properties of three tests for Granger-causal ordering in a bivariate stochastic system”. *Review of Economics and Statistics*, 64, pp. 668-80.

E. HANNAN - B. QUINN (1979), “The Determination of the Order of an Autoregression”. *Journal of Royal Statistical Society*, 41, pp. 190-95.

R. G. HAWTREY (1938), *A Century of Bank Rate*, Frank Cass & Co. Ltd., London, 1962 (first edition: Longmans, Green & Co.).

C. HSIAO (1981), “Autoregressive modelling and money-income causality detection”. *Journal of Monetary Economics,* 7, pp. 85-106.

N. KALDOR (1985), *The Scourge of Monetarism*, Oxford University Press, Oxford (first ed. 1982).

J. M. KEYNES (1930), *A Treatise on Money*, in *The Collected Writings of J.M.K.*, Macmillan, London - Basingstoke, 1971, Vol. VI.

B. J. MOORE (1988), *Horizontalists and Verticalists*, Cambridge University Press, Cambridge.

OECD, *Monthly Financial Statistics*, OECD, Paris (various years).

T. PADOA SCHIOPPA (1987), “Reshaping Monetary Policy”, in R. Dornbusch, S. Fischer and J. Bossons (eds), *Macroeconomics and Finance: Essays in Honor of Franco Modigliani*, MIT Press, Cambridge, Mass., pp. 265-86.

G. SCHWARZ (1978), “Estimating the Dimension of a Model”. *Annals of Statistics*, 6, pp. 461-64.

SERVIZIO RAGIONERIA DELLA BANCA D’ITALIA [M. CARON - L. DI COSMO] (1993), *I bilanci degli istituti di emissione in Italia 1894-1990*, Laterza, Roma-Bari.

C. SIMS (1972), “Money, Income and Causality”. *American Economic Review*, 62, pp. 540-53.

T. J. VOGELSANG - P. PERRON (1998), “Additional tests for a unit root allowing for a break in the trend function at an unknown time”. *International Economic Review*, 39 (4), pp. 1073-100.

P. VOLCKER - T. GYOHTEN (1992), *Changing Fortunes. The World’s Money and the Threat to American Leadership*, Random House, Inc., New York.