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Modelling Italian Inflation, 1970-1998*

Emanuele Bacchiocchi†

December 2003

Abstract

In this paper a model for the dynamics of inflation in Italy is proposed. Changes in monetary and credit markets, along with substantial changes in many sectors of the Italian economy suggest to split the sample period into two sub-sample and modelling the dynamics of inflation differently for each of the periods. Disequilibria from both demand and supply sides of the economy strongly contribute to the determination of inflation consistently with each of the mainly theoretical explanations. Equilibrium-correction terms are developed for all sectors of the economy for each of the two sub-samples. The different responses of the inflation growth rate to the different equilibrium relations found in the two periods strongly support the separate investigation pursued in the empirical analysis. Moreover, the empirical analysis confirms that no single cause can explanain the pattern of the Italian inflation.

Keywords: Inflation dynamics, Disequilibria, Structural breaks, Equilibrium correction model.

J.E.L. Classification: C32, E00, E31.

1 Introduction

Price stability represented one of the key goal of the Maastricht treaty in 1992, when the Member States of the European Community decided to converge to a unified monetary policy and payment system based on a new European currency, the Euro. Article 105 of that treaty explicitly says that "the primary objective of the European System of Central Banks shall be to maintain price stability".

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Even once the European Monetary Union (EMU) and the adoption of the Euro have been reached, on January 1999, the mission of the European Central Bank (ECB) continues to be the control of price stability and the dynamics of inflation in the Euro Area, see ECB Monthly Bulletin (1999).

Moreover, even before the Maastricht treaty, low-inflation countries such as Germany wanted assurance that their EMU partners had learned to prefer an environment of low inflation to avoid that the Euro might be a weak currency. The great efforts of high-inflation countries such as France and Italy to approach the German levels has been however a strong economical and political signal in favor of that that Obstfeld called the "Europe's Gamble" (Obstfeld, 1997). Deciding to peg their exchange rates pursuing a common currency but experiencing different and higher inflation levels might have twisted effects; first for the potential loss in competitivity and second for the difficulties of these countries at curbing inflation after the loss of their monetary policy autonomy.

The debate on sources and nature of inflation for the countries of the Euro Area has revealed many interesting, but often controversial, results from both theoretical and empirical point of view. This paper is a further contribution in this area and, particularly, concentrates on the dynamics of inflation in Italy before the EMU. The purpose of the paper is to investigate how the inflation rate reacted to disequilibria generated from demand and supply side of the economy.

The pattern of inflation in Italy during the period 1970-98 might be described by indicating three different phases. The '70s are characterized by a strong increase of the inflation rate while the other two phases, separated by the exchange rate crises in September 1992, when the Italian lira was heavily devalued and forced to leave the European Monetary System, correspond to the two stages of the process of curbing inflation during the '80s and the '90s.

At first glance, the dynamics of inflation in Italy over the three decades preceding the EMU seem to confirm the validity of monetarist theories, see e.g. Fratianni and Spinelli (2001). The high inflation rates in the '70s could be explained by the expansionist monetary policy adopted to minimize the costs to finance the growing public debt. Furthermore, it would appear reasonable to consider the curbing of inflation in the '80s and '90s as the result of the tight monetary policy adopted by the authorities to pursue the objective of price stability.

Bertocco (2002), however, criticizes the monetary interpretation. In fact, in order for the monetarist view to be effective, the policy instrument should be a (totally exogenous) supply of money, and disequilibria in the money market will only be reflected in prices through changes in aggregate demand. Bertocco argues that all these assumptions are questionable for the present sample. The wide recourse to the cost-push explanations by all the Governors in the investigated period is also an argument in favor of the idea that inflation dynamics cannot be explained by monetary phenomena only.

Within this line, several authors have recently postulated a long-run (negative) relation between inflation and the markup, see Banerjee et al. (2001) and

reference therein. Even in the long run high levels of inflation may represent a cost for firms either because they lead to greater competition reducing the markup, or because of the difficulties for price-setting firms to adjust prices in an inflationary environment with incomplete information. Banerjee and Russell (2001) employ cointegration techniques to investigate such empirical issue in the G7 economies while Banerjee et al. (2001) concentrate on the case of Australia. Bertocco et al. (2002) apply the same tools on Italian quarterly data over the period 1970-98. Despite very different monetary regimes occurred within the whole sample period, they find a stable long-run relation connecting the Italian price index, unit labor costs and import prices. The connection between the markup and inflation sheds some light on the importance of the supply-side effects on price dynamics. Juselius (2001) also presents evidence of cost-push effects on inflation, as a consequence of higher cost of capital due to an increase of the interest rate by the monetary authorities as an instrument for curbing inflation. This finding is clearly at variance with the monetarist interpretation which attributes the pattern of inflation only to monetary phenomena.

Following Hendry (2001), we do not exclude *a priori* any theoretical explanation for the Italian inflation and include indicators from both demand and supply sides of the economy. In particular, we observe how inflation reacts to disequilibria from all the main sectors of the economy: money and credit markets, goods and services market, labour market, wage and price formation, import prices, exchange rate and productivity effects. Equilibrium-correction terms have been proposed for all of these sectors. Because of the high dimensionality of the information set, the analysis of each sector has been conducted separately, while all the disequilibrium terms have been reported in a univariate stationary model for inflation dynamics.

Furthermore, substantial changes in many sectors of the Italian economy occurred during the first years of the '80s, suggest the possibility of changes in the equilibrium relations and in the dynamic evolution of the variables which seems to be supported by the empirical analysis. With the exception of the markup model, as the one proposed in Bertocco et al. (2002), which seems to be stable over the entire sample, all the empirical analysis have been conducted separately for the two sub-sample: 1970-1982 and 1983-1998. Moreover, for different reasons it has been very difficult to find stable and economic interpretable relations over the '70s, especially for the credit and money sectors (see, among many others, Juselius, 2001, Marcellino and Mizon, 2001, Fanelli and Paruolo, 1999, Bagliano and Favero, 1992, Angelini et al., 1994). Consequently, the dynamics of inflation has been modelled separately over the two sub-samples, with strong evidence of different responses to the disequilibria in the two periods.

The paper is organized as follows. In Section 2 we discuss the data series to be analyzed and highlight some important features of the Italian economy over the investigated period. In Section 3 we present the equilibrium relations which might cover an interesting role in explaining the dynamics of the Italian inflation.

Section 4 presents the general model and discusses the process of reduction to a simple and interpretable model for the Italian inflation over the two sample periods. Some policy implication can also be found in Section 4 while Section 5 concludes.

2 Historical Perspective

The sample data are quarterly observations covering the period 1970:1 to 1998:2. As already introduced above, many sectors of the Italian economy have experienced substantial structural changes over the three decades preceding the Euro. In this section we briefly discuss the main economic features that characterized the sample period under investigation.

The pattern of inflation over the sample period is characterized by first increasing and then persistent high levels over the '70s, decreasing levels over the '80s while low and quite stable levels over the '90s. This is clear by observing Figure 1, where the inflation rate Δp_t is measured as first differences of the price indicator, p_t. In Figure 1, the price indicator and the inflation rate are compared with level and growth rate of the money supply (m_t and Δm_t, respectively). The very similar path between growth rates of p_t and m_t over the whole sample represents the basis of the monetarist interpretation of the Italian inflation provided by Fratianni and Spinelli (2001). According to this interpretation, the expansionist monetary policy adopted to minimize the costs to finance the growing public debt is the cause of the high inflation during the '70s, while the subsequent restrictive monetary policies acted in the '80s and '90s completely joined the objective of price stability. As already said however, this interpretation has been strongly criticized.

In spite of an almost constant opportunity cost of holding money, as shown in Figure 2, the money liquidity ratio (the inverse money velocity) grew rapidly over the first '70s and remained to the highest levels until the end of the decade. The declining process of the liquidity ratio during the transition period to the EMS (European Monetary System) is however characterized by two accelerating period consisting of the two-three years following the ERM (Exchange Rate Mechanism), in 1979, and the ratification of the Maastricht Treaty in 1992. The increase at the end of the periods might be ascribed to the consistent decrease in the opportunity cost of holding money. Figure 2 also shows the bond and inflation rate spread. Despite some turbulent periods corresponding to the two oil shocks and the speculative attack to the Italian Lira, the bond and inflation rate spread remains almost constant on two different values: a negative real interest rate before 1982 while a positive one for the rest of the sample period.

The simple graphical inspection of the main characteristics of the Italian money market highlights the possibility of a structural break occurred around the beginning of the '80s, as a consequence of the fundamental changes associ-

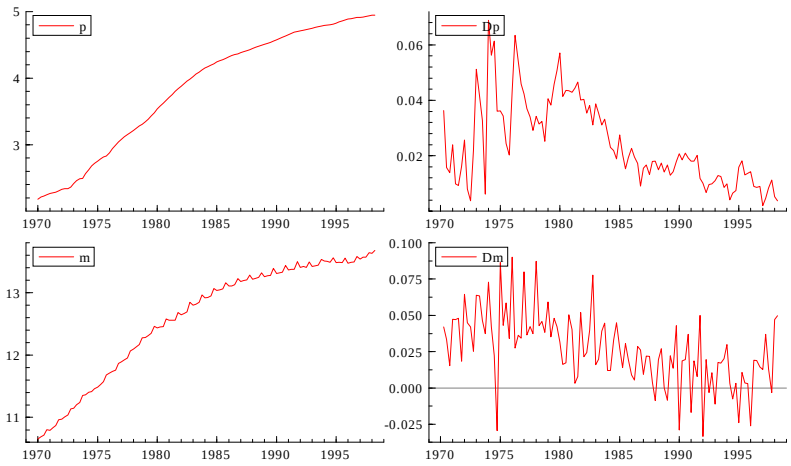

Figure 1: price indicator and money supply, in levels and first differences.

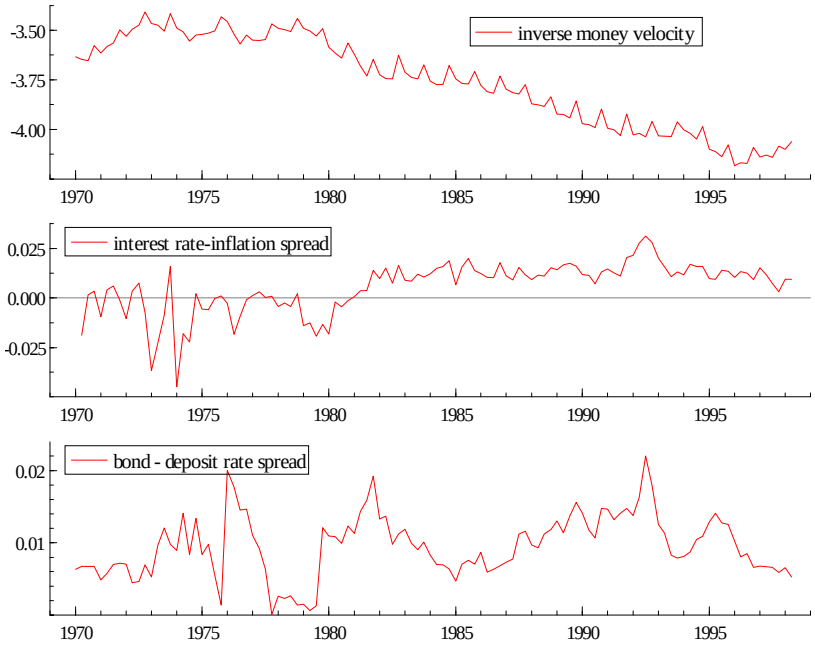

Figure 2: liquidity ratio, interest rate-inflation and bond-deposit rate.

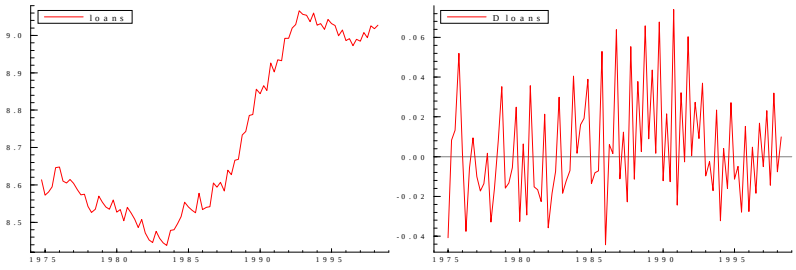

Figure 3: quantity of real loans in levels and first differences.

ated to the role and the instruments used by the central bank, the relationships between the central bank and the government and the increased economic integration within Europe. The independence of the Banca d'Italia from the Treasury was formally announced in 1981, even if it became really effective after a transition period of approximately two years. At the same time, the EMS, started in 1979, necessitated a further agreement in March 1983, in order to stop the frequent realignments and join an almost fixed exchange rate zone.

Juselius (2001) analyses the Italian monetary transmission mechanism by dividing the sample period into two parts approximately corresponding to the two regimes: 1974-1982 and 1983-1994. Moreover, previous empirical studies of Italian money demand find substantial difficulties in estimating stable relations over the entire sample period (Bagliano and Favero 1992; Angelini et al. 1994).

The different objectives of the Italian Central Bank pursued before and after the first years of the '80s is a further possible cause of the presence of a structural break around these years. In fact, during the '60s and the '70s the monetary authorities were mainly concentrated at preventing disequilibria in the balance of payments, and the quantity of credit, rather than the quantity of money, was regarded as the intermediate target of monetary policy[1]. In this context, an administrative ceiling on the expansion of credit and a security investment constraint were imposed to the banking system from 1973 to 1983. From the mid '80s, however, the high inflation rate, the increasing public deficit and the adhesion of the Italian lira to the ERM moved the interest of the Central Bank and the quantity of money became the intermediate target of monetary policy. Since 1984, an annual target for the expansion of M2 was officially declared, even if not completely respected (see Bertocco, 2002), while the removal of credit ceiling increased competitiveness among banks, inducing a very large reduction of bank holdings of government bonds from the second half of the '80s. In Figure 3, the quantity of loans strongly highlights the expansionist behavior of banks after the removal of the credit ceiling.

Structural changes however, do not involve monetary transmission mechanism

[1] See e.g. Bertocco (1997) and Cotula and Micossi (1977).

only, but characterize many other sectors of the Italian economy. Marcellino and Mizon (2000, 2001), in modelling real wages, prices, productivity and unemployment in Italy for the period 1970-1994, find strong empirical evidence of a structural change around the beginning of the '80s.

The wage indexation law "Scala Mobile", introduced in 1975 and reformulated many times before being abolished in 1992, and the decline in union power during the post-1980 period might be possible explanations to the different behavior of the labour market before and post the first '80s[2].

All these considerations seem to strongly confirm the presence of a structural break in many sectors of the Italian economy which has to be considered in empirical works such us those concerning the dynamics of the Italian inflation.

3 Modelling disequilibria from demand and supply side of the economy

The idea of the paper is that many theories could potentially contribute to a joint explanation of inflation in Italy. This is in the spirit of Hendry's (2001) view that no single-cause explanation is sufficient to describe inflation dynamics in the UK over the last century. In this section we first briefly introduce the most relevant theories and then we discuss and construct the empirical measures incorporated into the inflation model presented in the next section.

Fratianni and Spinelli (2001) assert that the Italian inflation experience represents a significant confirmation of the validity of the monetarist theory, in the earlier version of Friedmand (1956, 1969) and Friedmand and Schwartz (1963). In accordance with this theory the high inflation rate in the '70s is the consequence of the expansionist monetary policy adopted with the purpose of minimizing the costs borne to finance the growing public debt. The pattern of the Italian inflation over the subsequent two decades is the result of the commitment of the monetary authorities to pursue the objective of price stability. The excess money supply with respect to the demand of the economy is the only responsible for the high inflation levels in the '70s; the "simple" control of monetary aggregates pursued by the central bank obtains the result of realigning the inflation level to those of the other industrialized countries. In other words, besides a medium-run common trend between money and price growth rates, which seems to be confirmed, or at least not rejected, by the inspection analysis of the data in the previous section, disequilibria from the long-medium-run money demand relation are the main contributions of the price dynamics over the sample period.

These interpretation, however has opened many relevant questions letting

[2] See e.g. Erickson and Ichino (1994) and Bertola and Ichino (1995) for the impact of the "Scala Mobile" on the Italian economy. Bertola and Ichino (1995) discuss also the role of the union trade in the dynamics of Italian unemployment.

researchers to asking whether the pure monetary interpretation was the most appropriate for the Italian case.

The narrative approach in Bertocco (2002) and the explanations proposed by all the Governors in the Bank of Italy yearly reports in the period gave evidence that, first, some assumptions of the monetarist theory are questionable for the period investigated and, second, that monetary policy affects inflation also through factors that influence production costs. Bertocco et al. (2002) emphasize the importance of supply side effects in price dynamics, both in the short run and in the long run. They find a stable relation connecting markup and inflation and, moreover, inflation error-corrects towards this equilibrium. Other important contributions from the supply-side of the economy might be found in relations for wage determination which depend on unemployment, productivity, taxes and policy interventions.

During the last few years, some researchers have devoted the attention to the question of the relevance of banks' credit as a channel for the transmission of monetary policy. In fact, the limited development of financial markets with respect to other developed countries and the consequent strong dependence of the production sector on bank loans make Italy as an interesting case study to test for the existence of an additional channel for the transmission of monetary policy. Fanelli and Paruolo (2003), Bagliano and Favero (1997) and Buttiglione and Ferri (1994) find that the credit channel effectively operates since 1983, which correspond to the abolition of the credit ceiling, till the entry of Italy to the EMU. Alongside the traditional money channel, thus, the credit channel could play a further and important role in the explanation of the Italian inflation path, particularly after the abolition of the credit ceilings.

However, as argued by Hendry (2001), the most natural explanation of price behavior is the role played by final demand which rises prices to "ration" goods to those most willing to pay. Measures of the excess demand of goods and services with respect to the sustainable production can be useful in explaining and forecasting inflation.

In Section 4 all these possible sources are included in an error-correcting model for the Italian inflation. Before discussing such a model all the disequilibria from the mentioned equilibrium relations are analyzed in a cointegration framework exploiting the time series properties of the variable involved. Because of the dimensionality of the information set, a single cointegration analysis proved infeasible. Consequently, all the relevant aspects discussed above have been analyzed separately and, when necessary, by splitting the sample period to take into account the structural breaks already emphasized in the historical review of the three decades under investigation.

Here below, we present the separate cointegration analysis for the relevant economic sectors: money, credit, final demand, markup, wages and unemployment.

3.1 Money, Credit and Interest Rates

As already mentioned, the aggregate demand transmission channel can be seen as the resultant of two channels: a money and a credit channel, see e.g. Bernanke and Blinder (1988), Gertler and Gilchrist (1993), Bernanke and Gertler (1995). In this work we consider both transmission channels as possible determinants of inflation dynamics.

The monetary transmission mechanism has experienced many structural changes, especially around the first '80s. From the point of view of the money channel, previous empirical works found difficulties in estimating a stable money demand relation over the entire sample period (see, e.g. Juselius 2001, Fanelli and Paruolo 1999, Angelini et al. 1994). The common result however, seems to be that a stable money demand relation can be estimated only for the second part of the sample, i.e. from around 1982 to 1998. About the credit channel, all empirical contributions concentrates on the period following the abolition of the credit ceilings in 1983. Consequently, the analysis of both transmission channels focuses on the period 1983-98, and has been conducted through the $I(1)$ cointegration procedure proposed by Johansen (see Johansen, 1995 for a detailed discussion on such procedure).[3] The information set consists of seven variables: the real stock of money $(m_t - p_t)$, the real GDP y_t, the average interest rate on Treasury Bills at different maturity (3, 6, 12 months) i_{bt}, the nominal interest rate on deposits i_{dt}, the inflation rate Δp_t, the quantity of loans in real terms $loan_t$, the nominal interest rate on loans ρ_t, the stock of total reserves held by commercial banks at the Central Bank b_t. All variables are expressed in logarithmic terms, except the interest rates. A restricted trend is also included in the statistical model. Among the five cointegrating relations suggested by the trace test, three of these directly refers to the money and credit channels: the money demand relation, the demand for loans relation and the interest rate on loans relation.

The money demand relation connects the inverse log velocity of money $(m_t - p_t - y_t)$ to the opportunity cost measured as the spread between the interest rates determined by the market i_{bt}, and the deposit interest rate i_{dt}. The estimated excess-demand relation is:

$$\widehat{e}_{mt} = (m_t - p_t - y_t) + \underset{(0.28)}{0.53}\,(i_{bt} - i_{mt}) + \underset{(0.0002)}{0.0084}t + const \qquad (1)$$

where standard errors of coefficients are reported in parentheses, as in all other estimated relations hereafter in the paper.

[3] All variables seem to behave as $I(1)$ processes with the exeption of real loans which is likely to be $I(2)$. The test procedure proposed by Rahbek et al. (1999), in fact, suggests the presence of one $I(2)$ common trends but the difficulties in giving plausible economic interpretation of this phenomenon makes preferable to treat the system as integrated of order one, paying, however, particular attention on the interpretation of the results. See Fanelli and Paruolo (1999) for similar conclusions.

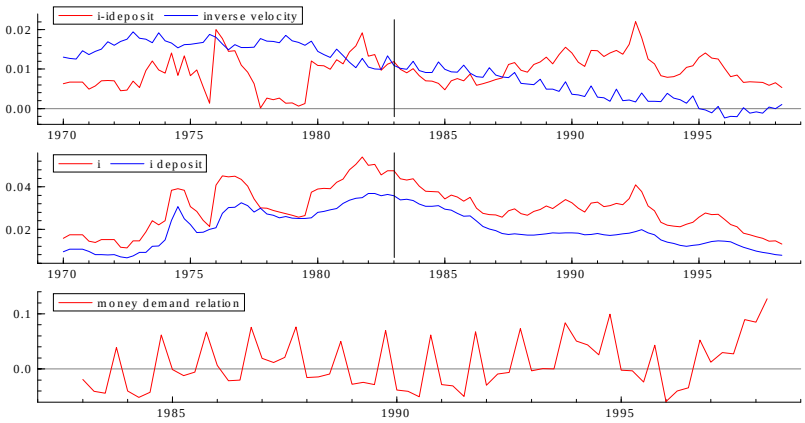

Figure 4: inverse money velocity, interest rate on bonds and deposits and money demand relation over the period 1983-98.

Regarding the credit market, the long-run relationships we found are directly inspired by Bernanke and Blinder (1988). The first of the two equilibrium relations concerns the interest rate on loans. Suppose that the banking system fixes the price of credit as a function of the two other interest rates included in the model, i_{dt} and i_{bt}, and the real GDP, y_t. The inclusion of i_{Dt} as a determinant of ρ_t tries to capture the markup behavior of commercial banks, which regards the level of the deposit interest rate as the lower threshold of the financial intermediation activity. The stock of reserves r_t is also included in that, owing to reserve requirement and its influence on excess reserves, monetary policy affects the interest rate on loans. The estimated disequilibria are

$$\widehat{e}_{\rho t} = \rho_t - i_{bt} - \underset{(0.04)}{0.37} i_{Dt} - \underset{(0.0035)}{0.028} (y_t - r_t) + const \tag{2}$$

The quantity $(y_t - r_t)$ can be interpreted as the "velocity" of reserves.

As in the conventional money demand framework, the inverse of the "velocity of credit" $(loan_t - y_t)$ is modelled as a function of the price of credit and of the price of alternative financing means for the private sector. The estimated excess demand for credit is

$$\widehat{e}_{lt} = (loan_t - y_t) + \underset{(1.13)}{7.5}\, \rho_t - \underset{(1.14)}{15.1} i_{bt} - \underset{(0.001)}{0.014} t + const \tag{3}$$

The relationships (2) and (3) describe the credit market in a very simple way; this implies that the stock of loans observed in the credit market is demand-determined, in the sense that, in equilibrium, the Banking System supplies whatever amount of credit the Private Sector demands at the pre-set value of ρ_t.

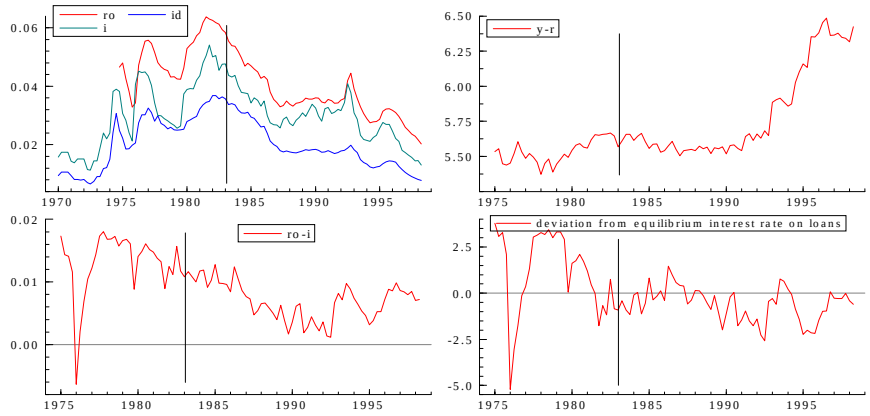

Figure 5: interest rates on loans, deposit and bonds, velocity of reserves, loans-bond spread and disequilibria from the stable interest rate on loans.

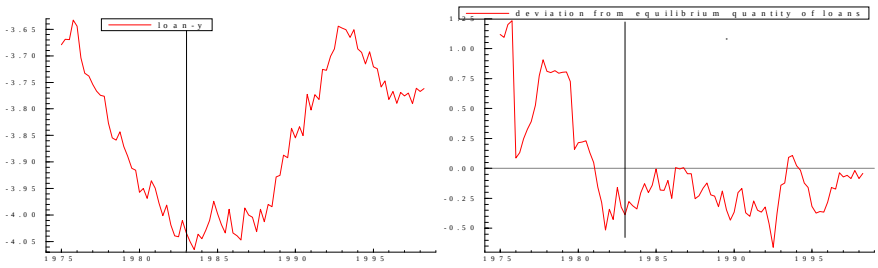

Figure 6: inverse loan velocity and disequilibria from the stable quantity of loans.

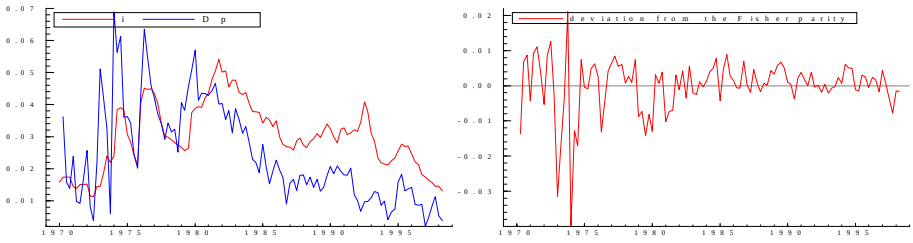

Figure 7: interest rate on bonds, inflation rate and deviation from the Fisher parity

The other two equilibrium relation estimated in the cointegration analysis might also be extremely useful in explaining the dynamics of Italian inflation. The two cointegration relations, a particular version of the CC curve in a Bernanke and Blinder-type theoretical model and the real bond interest rate, however, merit a particular attention in that can be examined for the entire period, and not for the more recent years of the sample only.

In particular, the bond real interest rate is investigated in a bivariate cointegrated VAR model for the bond interest rate and the inflation rate for the whole sample. As already mentioned, the real interest rate shows a stable path over two different levels, consistent with the structural break characterizing the Italian monetary transmission mechanism. A step dummy variable $Ds83$ (switching regime in 1983:1) restricted to lie in the cointegration space thus, has been included in the information set. A dummy variable $Ds92$ aiming at modelling the devaluation of the Italian lira in 1992 is also included in the model, restricted to lie in the cointegration space. Disequilibria from the real interest rate in the two regimes become

$$\widehat{e}_{it} = i_t - \Delta p_t - \underset{(0.0013)}{0.016}\, Ds83 - \underset{(0.001)}{0.006} Ds92 + const.$$

3.2 Aggregate demand and the output gap

Excess final demand is generally measured by the so called "output gap", which represents the deviation from output to its "natural rate". Such indicator plays a central role in many macroeconomic theoretical schemes but being a latent variable is difficult to be measured. Several measures have been proposed in the empirical literature which, however, strongly depend on many factors such as the sample period under investigation and the availability of data.

The present approach uses the notion of potential capacity, i.e. the potential output y_t consistent with the available amounts of labour l_t, stock of capital k_t, and technical progress. As quarterly observations are not available for real capital

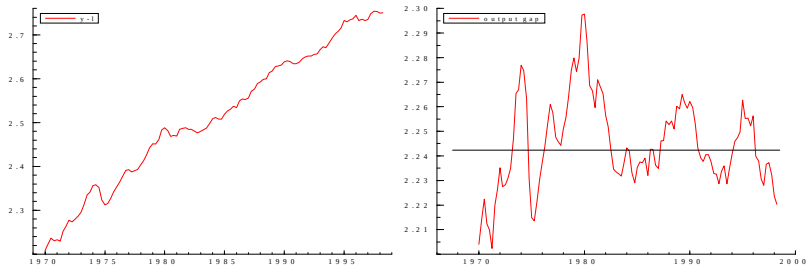

Figure 8: output per worker and output gap.

stock, one possible solution is to measure the output gap as trend adjusted log output per capita, in which the deterministic trend is a proxy of capital per capita and technical progress.

Both univariate and multivariate approaches confirm the following relation as a measure of the output gap

$$\widehat{e}_{yt} = y_t - l_t - \underset{(0.0002)}{0.005}\, t + const \tag{4}$$

even if the stationarity of $\widehat{e}_{yt}$ seems to be controversial[4].

3.3 Markup, Labour Costs and Import Prices

High levels of inflation may represent a cost for firms either because they lead to greater competition reducing the markup, or because of the difficulties for price-setting firms to adjust prices in an inflationary environment with incomplete information. Empirically, many studies apply cointegration techniques to investigate such empirical issue even in the long run. All results seem to confirm the existence of a long-run (negative) relation between inflation and the markup, see Banerjee et al. (2001) and reference therein. The model proposed in this section directly refers to that proposed by Bertocco et al. (2002), who apply the same tools on Italian quarterly data over the three decades preceding the EMU. The starting point is a modified version of the markup model[5], where substantial differences are opportunely introduced. The relationship among the markup and the inflation rate is opportunely taken into account in order to explain the long run behavior of the domestic general price level in an open economy framework. In the long run, the domestic general price level is determined by the markup over total unit costs net of the cost of inflation. Under these hypothesis, Bertocco et al.

[4] The VAR approach, with $X_t = (y_t, l_t)'$ and a restricted deterministic trend, does not show evidence for a cointegrating relation; the trace test does not reject the null $r = 0$, although the restricted cointegrating relation (4) is strongly accepted by the data with a $p - value = 0.50$.

[5] See Franz and Gordon (1993) for a revision of the literature of the markup model considered in this analysis.

(2002) propose a long run relation which, under the linear homogeneity assumption, links the price level to its determinants. This relation can be formulated as follows:

$$z_t = p_t - \gamma ulc_t - \delta pm_t - \eta \Delta p_t = q_t - \eta \Delta p_t \tag{5}$$

where z_t is the retail markup over costs at time t net of the costs of inflation while q_t is the 'gross' markup; ulc_t is a measure of nominal unit labour costs, pm_t is the nominal import price index and Δp_t is the inflation rate. Following Bertocco et al. (2002) and Banerjee and Russel (2001), the coefficients $\gamma \geq 0$, $\delta \geq 0$, which can be interpreted as the elasticities of the price level with respect to unit labor costs and import costs, satisfy the homogeneity restriction $\gamma + \delta = 1$. The coefficient $\eta \geq 0$, instead, can be interpreted as a measure of the impact that inflation exerts on firms' markup.

The long run implications of the markup relation can be easily derived by exploiting the homogeneity condition, which makes it possible to express the relation (5) as

$$z_t = \gamma (p_t - ulc_t) + \delta (p_t - pm_t) - \eta \Delta p_t. \tag{6}$$

Thus, the empirical formulation of the retail markup model (6) can be rewritten as

$$(p_t - \gamma ulc_t) + \beta_1 (p_t - pm_t) + \beta_2 \Delta p_t = e_{zt} \tag{7}$$

where $\beta_1 = \delta/\gamma$, $\beta_2 = -\eta/\gamma$ and $e_{zt} = z_t/\gamma$ is stationary for the markup relation to hold in the long run[6]

Disequilibria from the long-run markup relation (7) have been estimated as:

$$\widehat{e_{zt}} = (p_t - ulc_t) + \underset{(0.11)}{0.43} (p_t - pm_t) - \underset{(2.21)}{12.74} \Delta p_t + const, \tag{8}$$

which are very similar to the estimates proposed in Bertocco et al. (2002).

The strong significance of the import price component in the markup relation needs to be further discussed. If we re-write the price of imports in the following way

$$pm_t = ex_t + pm_t^f$$

where ex_t is the log of an effective exchange rate (i.e., trade weighted exchange rate) and pm_t^f is the price of imports in foreign currencies (logged), the relation (6) describes the influence of the exchange rates on prices. More precisely, the quantity

$$pm_t - p_t = ex_t + pm_t^f - p_t$$

can be seen as a measure of the real exchange rate, which might play an important role for the dynamics of prices in a turbulent environment such as the post-Bretton Woods period, characterized by many international crisis.

[6] In this paper, the same normalization proposed by Bertocco et al. (2002) is used, simply in order to make the results comparable; different normalization could be applied.

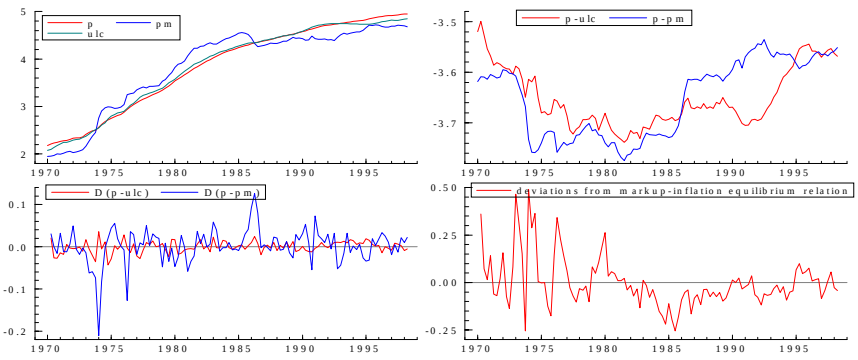

Figure 9: GDP deflator, import prices and unit labour costs in levels; markup over labour costs and over imports in levels and first differences; deviations from the markup-inflation equilibrium relation. All series are in log terms.

3.4 Wages, Productivity and Unemployment

The debate whether inflation and labour market are connected for developed economies, started with the well known contribution by Phillips (1958), is still open from both theoretical and empirical point of view (see, Ball and Mankiw 2002, and Galĭ et al. 2001). Such relation seems to be confirmed by the European experience, which, in accordance with ERM priorities switched from high-employment policies to restrictive monetary policies in order to reduce inflation and stabilize exchange rates.

The Italian economy, particularly, offers an interesting case study in that, in addition to the changes following the growing European integration process, experienced several idiosyncratic features such as the wage indexation (Scala Mobile), operative until the beginning of the '90s.

As already mentioned in previous sections, many sectors of the Italian economy have experienced structural changes around the first years of the '80s. Marcellino and Mizon (2001), in analyzing Italian labour market and wage-price formation, indicate the 1980 as the breaking point between the two stable periods. However, even more strong evidence of structural changes can be seen when the empirical analysis is conducted in parallel with the monetary transmission mechanism changes, which fixes the 1982 as the switching year. In fact, splitting the sample between 1970-82 and 1983-98, as shown below, enforces the evidence of such changes, highlighting differences even in the number of equilibrium relations, rather than simple different coefficients between the two periods found by Marcellino and Mizon (2001).

The empirical analysis, thus, has been conducted through the cointegrated VAR approach for the split samples 1970-82 and 1983-93; see Appendix B for further details on the empirical analysis. The variables included in the VAR

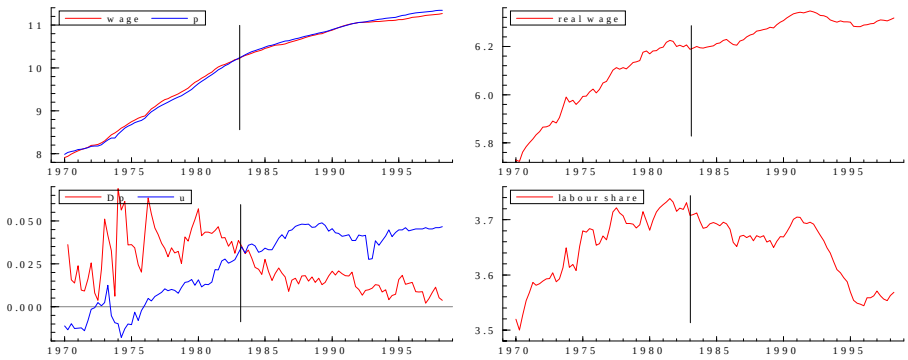

Figure 10: price and wage, real wage, unamployment and inflation, and labour share.

model are those proposed by Marcellino and Mizon (2001)[7], even if with different real GDP and price indicators, in order to be coherent with the other economic sectors investigated in this analysis;

$$X_t = (w_t - p_t, y_t - l_t, u_t, \Delta p_t)'$$

where $w_t - p_t$ is the log of real wages, $y_t - l_t$ is a simple measure of productivity in log terms, u_t is the log of the percentage of unemployment rate and Δp_t is the usual inflation rate. A restricted trend t is also included, together with unrestricted intervention dummies. All variables appear to be non stationary and in particular, while y_t, l_t, u_t, and Δp_t are integrated of order one, w_t and p_t are likely to be integrated of order two. A linear combination of the two $(w_t - p_t)$, however, cointegrates from $I(2)$ to $I(1)$ letting the whole system X_t to be integrated of order one, and allowing the empirical analysis to be computed through the well known $I(1)$ cointegration techniques[8].

The empirical results for the two sub-periods highlight two equilibrium relations for the first period and only one for the second period. Although there is no clear cut evidence, the choice of two cointegration relation in the first period seems to be the most plausible one, after a joint analysis of the trace test and the observation of the characteristic roots under the restricted and unrestricted models. The non rejected cointegration relations, with a $p - value = 0.23$, are

$$\begin{aligned} \widehat{e}_{wt} &= (w_t - p_t) + \underset{(0.05)}{0.08} u_t - \underset{(0.11)}{1.71} (y_t - la_t) + const \\ &= s_t + 0.08 u_t - 0.71 (y_t - l_t) + const \end{aligned}$$

[7] Golinelli (1997) provides similar empirical analysis of this sector of the Italian economy.

[8] This can still be seen as a "nominal-to-real transformation" in the sense of Kongsted (1998) and Kongsted (2002).

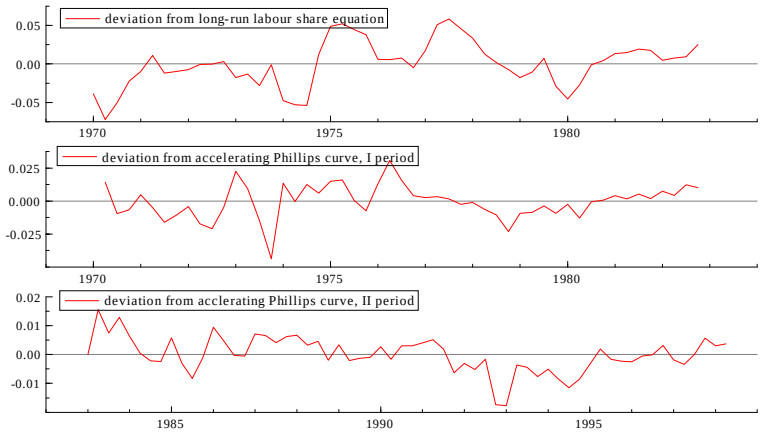

Figure 11: deviations from long-run equilibria in the labour market for the first and second period.

where $s_t = (w_t - p_t) - (y_t - l_t)$ is the log of the labour share, and

$$\widehat{e}_{pcIt} = \Delta p_t + \underset{(0.01)}{0.02} u_t - \underset{(0.1)}{0.55} (y_t - l_t - 0.005t) + const$$

where $(y_t - l_t - 0.005t)$ is a measure of the output gap, as discussed above. The first long-run relation indicates that labour share decreases with unemployment and increases with per capita output.

Figure 10 indicates an unusual increase of the labour share during the '70s, which is not consistent with a Cobb-Douglas technology and not typical for a wider historical perspective. Labour share increasing with output per capita can be interpreted as a signal of the strong power of employed labour. In fact, an increase in output per capita is associated with a more than proportional increase in real wages. This might be a consequence of the wage indexation system operative during the second half of this period. The negative effect of unemployment on labour share can be interpreted as weak demand for labour, as in Sargan (1964).

The second cointegration relation indicates that inflation decreases with an increase unemployment, but increases with positive output gap. This relation thus can be interpreted as an augmented Phillips curve.

For the second period, a combination of trace test and observation of characteristic roots for the unrestricted and restricted VAR model helps to choose the adoption of only one cointegrating relation. Moreover, the non rejected overidentifing restrictions, with a $p - value = 0.81$, highlights that only the accelerating Phillips curve relation continues to hold, but with different long-run elasticities.

In particular, the relation becomes

$$\widehat{e}_{pcIIt} = \Delta p_t + \underset{(0.01)}{0.09} u_t - \underset{(0.10)}{0.40} (y_t - l_t - 0.005t) + const$$

with a higher parameter for unemployment and a lower one for the output gap with respect to the previous period.

4 A model for the Italian Inflation

In this section we propose a univariate model for the Italian inflation. According to all considerations about the plausibility of a structural break, the analysis has been conducted by splitting the model into two sub-models, one for each sub-sample.

In order to account for the statistical properties of all the series, the dependent variable refers to the price acceleration rate, which behave as a stationary process in both periods. One period lagged first differences of real variable and interest rates (which behave as $I(1)$ processes), and one period lagged second differences of nominal variables included in the analysis of all sectors of the Italian economy have been included in the model as regressors as well as all the intervention dummies (the variables related to the credit market have been included only in the second period relation because of not available for most part of the first period).

The main contribution however, rests on the response analysis that prices accelerating rate exerts on disequilibria stemming from all the related sectors of the Italian economy. The adjustment behavior in each of the two periods, thus, appears as an equilibrium correction model as originally introduced by Davidson et al. (1978).

Following a "general-to-specific" approach, significant tests of each regressor and LR tests for overidentifying restrictions help us to reduce the initial model to a more simple and interpretable form[9]. All empirical results for each of the two periods, together with economic interpretation and policy considerations are reported in the next sub-sections.

4.1 The fiscal dominance and the high inflation period: 1970-82

According to Fratianni and Spinelli (2001), the 70s' can be considered as "an unprecedent inflationary process in peace time in terms of level and persistence". During this decade, monetary policy has been more accommodating than fiscal policy and such behavior created a vicious circle in the sense that favored the

[9] See Hendry (1995), Hendry and Mizon (1993) and Juselius (1994) for detailed discussions of the "general-to-specific" approach.

expansion of indebtness compelling monetary authorities to further expand the creation of money. According to the monetarist interpretation, excess money supply is the main cause of the high and persistent growth rate of prices over those years.

The model proposed in this work, however, analyze the monetary interpretation jointly with other possible explanation of the Italian inflation. All disequilibria discussed above, along with all variables included in the cointegrating analyses (lagged one period and opportunely differentiated do be stationary), have been included in an error-correcting model which, after a reduction process of insignificant determinants, can be written as:

$$\begin{aligned}\Delta^2 p_t &= \underset{(0.11)}{-0.15} + \underset{(0.12)}{0.31}\Delta p^2_{t-1} + \underset{(0.09)}{0.21}\Delta p^2_{t-2} - \underset{(0.01)}{0.05}\widehat{e}_{zt-1} + \\ &+ \underset{(0.05)}{0.07}\widehat{e}_{yt-1} - \underset{(0.05)}{0.10}\widehat{e}_{sIt-1} + \underset{(0.03)}{0.09}\Delta\left(m_{t-1} - p_{t-1}\right) + \\ &- \underset{(0.11)}{0.21}\Delta y_{t-1} + \underset{(0.07)}{0.10}\Delta^2 w_{t-1} + \underset{(0.008)}{0.02}\, D7301 + \\ &+ \underset{(0.007)}{0.05}\, D7401 + \underset{(0.005)}{0.02}\, D7601 + \varepsilon_{1t}\end{aligned} \tag{9}$$

$R^2 = 0.84$	$\sigma = 0.0066$	$RSS = 0.0016$
LR test of overidentifying restriction		$\chi^2(6) = 4.04\,[0.67]$
AR 1-4 test:	$F(4, 32) = 1.04$	[0.40]
ARCH 1-4	$F(4, 28) = 1.62$	[0.20]
Normality test	$\chi^2(2) = 1.24$	[0.54]
hetero test	$F(19, 16) = 0.58$	[0.87]
RESET test	$F(1, 35) = 1.36$	[0.25]

The reduction process is strongly accepted by the data; the LR test of six overindentifying restriction does not reject the null with a $p - value = 0.67$ while all the diagnostic tests are insignificant. The graphs of actual and fitted data, residuals, correlogram and density are reported in Figure 13.

As already said, a stable money demand can not be estimated for these years but the significant coefficient associated to the growth rate of the real money supply seems to be consistent to the monetary interpretation. Other components however seem to play a relevant role such as the cost-push effects and the disequilibria on the labour market. As expected, the intervention dummies included in the model to account for the instabilities of the first oil crisis are strongly significant.

4.2 The process of disinflation: 1983-98

During the first years of the 80s' monetary authorities acquired a greater independence from the Treasury and, even as a consequence of the adhesion to the

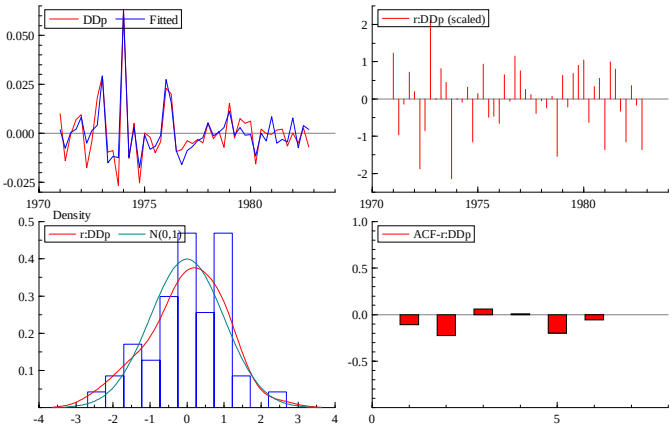

Figure 12: actual and fitted data, residuals, correlogram and density for the period 1970-82.

EMS, the monetary policy recorded positive changes. The direct control of monetary aggregates and the stabilization of the exchange rate in line with the ERM pursued during the '80s, however, have not been sufficient to reach a low level of inflation compared to other developed countries such as Germany and the US, and led to an overvaluation of the lira exchange rate which caused the crisis of 1992. After that crisis, however, the inflation curbing process continued and led to the respect of the Maastricht criteria to joining the euro with the first group of countries in 1999. During the process of curbing inflation, however, policy interventions in different sectors of the economy took place and contributed to the reduction first, and elimination thereafter, of the inflation differential with the most virtuous European countries.

The model, after reduction, is the following:

$$\begin{aligned}\Delta^2 p_t \;=\; & \underset{(0.09)}{-0.19} - \underset{(0.006)}{0.02}\,\widehat{e}_{zt-1} + \underset{(0.04)}{0.08}\widehat{e}_{yt-1} + \\ & \underset{(0.07)}{-0.14}\widehat{e}_{pcIIt-1} + \underset{(0.01)}{0.03}\widehat{e}_{mt-1} - \underset{(0.0005)}{0.001}\,\widehat{e}_{\rho t-1} + \varepsilon_{2t}\end{aligned} \tag{10}$$

$R^2 = 0.39$	$\sigma = 0.0032$	$RSS = 0.0006$
LR test of overidentifying restriction		$\chi^2(17) = 14.93\,[0.60]$
AR 1-4 test:	$F(4, 51) = 1.22$	$[0.31]$
ARCH 1-4	$F(4, 47) = 1.29$	$[0.29]$
Normality test	$\chi^2(2) = 1.10$	$[0.58]$
hetero test	$F(10, 44) = 1.03$	$[0.44]$
RESET test	$F(1, 54) = 0.77$	$[0.39]$

As for the analysis of the first period, the model is the resultant of a coherent reduction process. The LR test of six overindentifying restriction does support

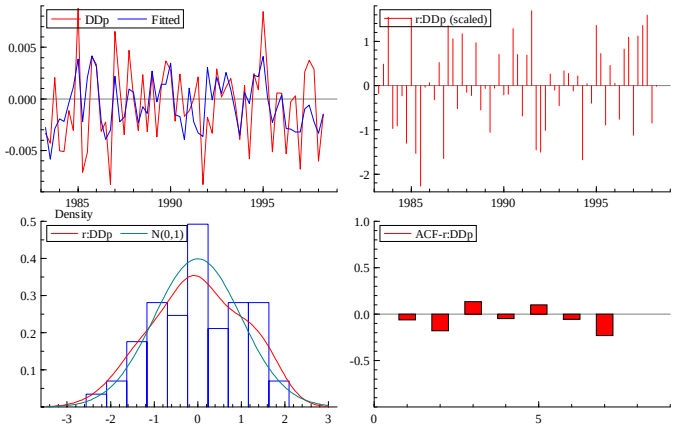

Figure 13: actual and fitted data, residuals, correlogram and density for the period 1983-98.

the null with a $p-value = 0.67$ while all the diagnostic tests does not signal any particular departure from the usual hypothesis on the error terms. The graphs of actual and fitted data, residuals, correlogram and density are reported in Figure 14.

The model proposed for analyzing the price behavior over the disinflation period, confirm what found for the previous period. Disequilibria from both monetary and credit market play an important role which, however, account only for a part of price dynamics. Labour market disequilibria and cost-push effects continue to play a determinant role. No intervention dummy helps substantially explaining unexpected turbulences.

4.3 Models interpretation and policy considerations

The empirical analysis presented in this work suggests interesting considerations about the policies pursued by economic authorities in order to curbing inflation during the three decades preceding the Euro.

The first consideration concerns the fact that the empirical results for both the first and second period confirm that excess supply of money can not account for all the variability observed in price acceleration rate over these years. Variables and disequilibria from other sectors of the Italian economy enter the relation with correct signs and significant coefficients.

The idea that the two digit inflation during the '70s was a consequence of the high growth rate of the money supply and that once controlled for that, the inflation reached more reasonable values, as argued by Fratianni and Spinelli (2001), seems to be partially contradicted by the empirical evidence presented above.

The growth rate of inflation appear to be strongly persistent during the first period as confirmed by the positive and significant coefficients of its lagged values up to order two. The monetary interpretation is partially explained by the dependence on the growth rate of real money but it is also clear that this can not be considered as the unique theoretical explanation.

The importance of cost-push effects on inflation is confirmed by the fact that prices significantly error-correct in both sub-samples towards the stable long-run relation between inflation and the markup found in Section 3.3. It is important to note, however, that such long-run relation includes also the exchange rate effects, and the higher error-correction coefficient observed in the first period has likely to be ascribed to the international market shocks due to the oil crisis of the '70s. Such different adjustment is a further point in favor of the split-sample analysis of the Italian inflation.

During the three decades 1970-98, the labour market has experienced many structural and institutional changes which, as expected, can not be considered as completely independent to the inflation dynamics. In fact, the significant adjustments towards the labour share long-run relation in the first period and towards the accelerating Phillips curve in the second period confirm this statement. Moreover, the inclusion of the wage accelerating rate in the first period (even if not strongly significant), highlights the role of the vicious circle exerted by the wage indexation "Scala mobile", operative since the second half of the '70s.

As already mentioned, however, monetary aggregates plays a relevant role. During the first period in fact real money growth enters significantly the relation. The existence of a stable money demand relation for the second period and the significant error-correcting coefficient confirms the common wisdom that excess money supply directly affects prices. However, during the '80s and the '90s, the restrictive interventions operated by monetary authorities have been conducted through interest rates rather than money supply. Interest rate maneuvers might have more direct effects on price of loans rather than to the quantity of money. This could be one of the possible explanations of the significant adjustment towards disequilibria on the credit market, especially the interest rate of loans.

In this context, the interest rate of loans could be seen as the most indicative interest rate through which monetary policy interventions affect aggregate demand. This statement is not a point in favor of the presence of a credit channel, but rather a remark that monetary and credit channels cannot be discussed separately (see, e.g. Bernanke and Gertler, 1995). Moreover, interest rate interventions could have the standard transmission mechanism effect (independently whether through a money channel, a credit channel, or both) but also the effect of increasing production costs. From the policy point of view, thus, it explains the failure of the economic policies aimed at curbing inflation during the '80s, based solely on controlling the money growth.

If the interest rate on loans does reflect the interest rate intervention of the monetary authorities, also the control of the quantity of loans could be effective

at reducing inflation. Bertocco (1997) has shown the difficulties of monetary authorities in controlling the monetary base, and consequently the quantity of loans, in a period of high inflation such as the '70s. During these years, monetary authorities decided to directly control the stock of loans by imposing administrative ceilings. These measures, however, allowed commercial banks to face restrictive monetary policies through changes of their assets composition. During the '80s and the first years of the '90s monetary squeezes have not been accompanied by a reduction of bank loans, with the exception of the one in 1992-93, when however, the reduction has to be attributed to a drop in demand rather than in supply of loans (see Bertocco, 1997). This failure in controlling the stock of loans could have reduced, thus, the effectiveness of restrictive monetary policies.

According to Bertocco et al. (2002) and Juselius (2001), monetary policy could affect the inflation rate through its influence on production costs. However, if it seems reasonable to believe that monetary policy could influence production costs through e.g. the cost of loans, it is also clear that many other factors can influence production costs. A restrictive monetary policy, combined with income and fiscal policies, in fact, has reached the most important results at curbing inflation during the three decades preceding the entry of Italy to the EMU. The strong manoeuvre aimed at reducing the public deficit/GDP in 1992 and the agreements reached by the government and trade unions in 1993 are a signal in this sense and can explain the more effectiveness of the economic policies during the '90s rather than during the '80s. In fact, while during the '80s economic policies were based on monetary instruments only, during the '90s they were also accompanied by income and fiscal policies as indicated above.

5 Concluding remarks

In this paper we investigate the determinants of inflation in Italy over the three decades preceding the EMU. Structural and institutional changes in many sectors of the Italian economy suggest to split the sample period into two sub-samples and modelling the dynamics of inflation differently for each of the periods.

The first conclusion is that the interpretation of inflation as a pure monetary phenomenon, which seems to be confirmed by a simple critical inspection of the data, is questionable. Several theories of inflation provide part of the empirical explanation for Italian inflation over the present sample but none of them plays is able to give a complete explanation of the inflation phenomenon.

Cost-push effects, which also include world price inflation and exchange rate instability, play a relevant role, both in the short and long-run. Labour market disequilibria and excess demand for goods and services also matter but the doubts over the stationarity of this latter indicator needs some caution in interpreting the results.

The common wisdom that excess money supply influences prices is confirmed

by the empirical results, even if, during the '80s and '90s the credit transmission mechanism needs to be considered. In particular, over these two decades the restrictive interventions operated by monetary authorities have been conducted through interest rates rather than money supply, and the interest rate on loans does reflect such interventions. This can explain the failure of the economic policies aimed at curbing inflation during the '80s, based solely on controlling the money growth.

The finding that several theories do matter in determining the Italian inflation explains why a combination of monetary, income and fiscal policies pursued after the exchange rate crisis in 1992, were more effective than in the '80s, only based on monetary instruments, and helped Italy to joining the euro in 1999.

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Appendix A: The data

y_t	=log of real GDP,seasonally adjusted (ISTAT)
m_t	=log of stock of money measured as M2 less the stock of certificates of deposits of all maturityes (Bank of Italy)
$loans_t$	=log of deflated total amount of loans (Bank of Italy)
p_t	=log of implicit GDP deflator (ISTAT)
Δp_t	=inflation rate ($\Delta p_t = p_t - p_{t-1}$)
r_t	=log of deflated total amount of reserves held by banks at the central bank (Bank of Italy)
i_{bt}	=average interest rate on Treasury Bills with maturity 3, 6 and 12 months (BOT, Bank of Italy)
ρ_t	=average interest rate on loans (Bank of Italy)
i_{dt}	=average interest rate on deposits (Bank of Italy)
l_t	=log of total employment, seasonally adjusted (ISTAT)
w_t	=log of nominal average earnings, seasonally adjusted (ISTAT)
ulc_t	=log of nominal unit labour costs ($ulc_t = w_t - (y_t - l_t)$, ISTAT)
pm_t	=log of tariff-adjusted total import price index (including energy, ISTAT)
u_t	=log of unemployment rate, seasonally adjusted (ISTAT)

Appendix B: Cointegration analyses

In this appendix we sum up the results of the cointegration analyses performed to obtain the disequilibria from the main sectors of the Italian economy.

Money and credit markets

The cointegration analysis follows what proposed by Fanelli and Paruolo (2003). The VAR(2) model includes the following information set:

$$X_t = (m_t - p_t, y_t, i_{bt}, i_{dt}, \Delta p_t, \rho_t, loan_t, r_t)' .$$

A deterministic trend and a structural dummy D923, with a peak in 1992:3, have been included to lie in the cointegration space while centered quarterly dummies and a further dummy variable to account for occasional credit ceilings have been included unrestricted. The inclusion of the restricted dummy D923 aims to capture the effects of the exchange rate speculative attack against the lira observed around 1992. The model has been estimated over the period 1983:1-1998:2.

The trace test, as shown in Table 1, suggests the presence of either five or six cointegrating relations. As discussed in Fanelli and Paruolo (1999), however, a possible $I(2)$ common trend can characterize the series involved, even if difficult to be interpreted form the economic point of view. The choice of $rank = 5$, and

consequently three unit roots in the system, has to be preferred once observing for the roots of the characteristic polynomial in the restricted VAR model. However, the presence of a further potential unit roots in the restricted model is one more evidence of the presence of a common $I(2)$ stochastic trend[10].

The estimated cointegrating relation are reported in Table 2, where all coefficients are significant at the conventional levels and the LR test for the overidentifying restrictions, asymptotically distributed as a $\chi^2(14)$ under the null, is not significant with a p-value of $0,115$.

$r \leq j$	0	1	2	3	4	5	6	7
$trace$	283.7	201.3	153.7	112	73.28	46.18	21.91	7.35
$(p-value)$	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)	(0.021)	(0.145)	(0.319)

Table 1: trace test in the restricted trend I(1) model; 1983:1-1998:2.

Cointegrating relations
$\widehat{e}_{mt} = (m_t - p_t - y_t) + \underset{(0.28)}{0.53}(i_{bt} - i_{mt}) + \underset{(0.0002)}{0.0084}t + const$
$\widehat{e}_{\rho t} = \rho_t - i_{bt} - \underset{(0.04)}{0.37} i_{Dt} - \underset{(0.0035)}{0.028}(y_t - r_t) + const$
$\widehat{e}_{lt} = (loan_t - y_t) + \underset{(1.13)}{7.5}\rho_t - \underset{(1.14)}{15.1} i_{bt} - \underset{(0.001)}{0.014}t + const$
$\widehat{e}_{yt} = y_t + \underset{(0.08)}{0.45}(i_{bt} - \Delta p_t) - \underset{(0.01)}{0.064} r_t - \underset{(0.0002)}{0.0069}t + const$
$\widehat{e}_{it} = i_t - \Delta p_t - \underset{(0.0025)}{0.029} D923 + const$

Table 2: cointegration relations for the money and credit market; 1983:1-1998:2. Standard errors in parenthesis

Markup, Labour Costs and Import Prices

The markup-inflation relation is analyzed through a VAR(4) model for

$$X_t = (p_t - ulc_t, p_t - pm_t, \Delta p_t)'.$$

An impulse dummy D741 has been included in order to capture part of the instability caused by the first oil shock. The analysis is performed over the period 1970:1-1998:2.

[10] The test statistic proposed by Rahbek et al. (1999) for investigating the presence of $I(2)$ components does not reject the hypothesis of five cointegrating relation and one $I(2)$ common trend.

All variables appear to be integrated of order one and the trace test, reported in Table 3, strongly support only one cointegrating relation with two $I(1)$ trends[11]. The estimated cointegrating relation is

$$\widehat{e_{zt}} = (p_t - ulc_t) + \underset{(0.11)}{0.43}\,(p_t - pm_t) - \underset{(2.21)}{12.74}\Delta p_t + const$$

which is stable over the whole sample period.

$r \leq j$	0	1	2
$trace$	40.58	5.46	0.65
$(p-value)$	(0.002)	(0.759)	(0.422)

Table 3: trace test; 1970:1-1998:2.

Wages, Productivity and Unemployment

As already mentioned in Section (3.4), the cointegration analysis has been conducted by splitting the sample into two sub-samples in order to account for the structural changes discussed above. The information set is the same in both systems and consists of

$$X_t = (w_t - p_t, y_t - l_t, u_t, \Delta p_t)'.$$

A deterministic trend restricted to lie in the cointegration space and several unrestricted intervention dummies have been included to model instabilities due to the two oil shocks, changes in measures of the unemployment rate and the speculative attack to the lira around 1992. The two sub-samples correspond to 1970-82 and 1983-98; a VAR model with two lags has been estimated for both periods. All variable appear to be integrated of order one in both in each of the sub-samples and in the whole sample, making the standard $I(1)$ cointegration techniques the most suitable to perform the analysis.

For the first period, the trace test suggest only one cointegration techniques but, the low power of the test for small samples as the present one and a more accurate investigation of the roots of the characteristic polynomial in the restricted and unrestricted VAR(2) model suggest an overall preference for two cointegrating relation and two $I(1)$ common trends.

For the second period, there seems to be no evidence for cointegrating relation in between the variables in the system although a maximum of three roots appear to be close to unity. Thus, imposing three unit roots and only one cointegrating relation seems to be a more reasonable solution. The results of the trace tests and

[11] The $I(2)$ tests in Paruolo (1996) have been performed and do exclude the presence of $I(2)$ components, confirming thus the nominal-to-real transformation in the sense of Kongsted (1998, 2002)

the estimated cointegrating relation are reported in Table 4 and Table 5. The LR tests of the overidentifying restrictions for the two periods are also reported in Table 5.

	$r \leq j$	0	1	2	3
First period	$trace$	72.29	38.68	10.90	3.77
	$(p-value)$	(0.007)	(0.125)	(0.876)	(0.771)
Second Period	$trace$	57.46	29.21	11.15	2.34
	$(p-value)$	(0.154)	(0.555)	(0.862)	(0.930)

Table 4: trace test for the two periods.

	cointegrating relations	LR test
First period	$\widehat{e}_{wt} = (w_t - p_t) + \underset{(0.05)}{0.08} u_t - \underset{(0.11)}{1.71} (y_t - la_t) + const$	$\chi^2(2) = 3.05$ $_{p-value=0.22}$
	$\widehat{e}_{pcIt} = \Delta p_t + \underset{(0.01)}{0.02} u_t - \underset{(0.1)}{0.55} (y_t - l_t - 0.005t) + const$	
Second period	$\widehat{e}_{pcIIt} = \Delta p_t + \underset{(0.01)}{0.09} u_t - \underset{(0.10)}{0.40} (y_t - l_t - 0.005t) + const$	$\chi^2(2) = 0.41$ $_{p-value=0.81}$

Table 5: cointegration relations and LR tests for overidentyfing restrictions for the two periods. Standard errors in parenthesis