Modelling Italian Inflation, 1970-2006

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Abstract

In this paper a model for the dynamics of inflation in Italy is proposed. It is shown that both in the short and long run the inflation patterns can not be explained by a single cause and that many theories contribute to determine the mechanism of price formation in Italy. 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-samples and modelling the dynamics of inflation differently for each of the periods. Moreover, a robustness analysis rejects the hypothesis of a structural break associated with the institutional changes occurred in 1999, with the adhesion to the EMU and the adoption of the euro.

1   Introduction

Price stability is a 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 the treaty explicitly says that "the primary objective of the European System of Central Banks shall be to maintain price stability". 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 became a weak currency. The great efforts of high-inflation countries such as France and Italy to approach the German levels have been however a strong economical and political signal in favor of what 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 could 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 points of view. This paper concentrates on the dynamics of inflation in Italy before and after the EMU.

The pattern of inflation in Italy during the period 1970-2006 might be described by indicating four different phases. The '70s are characterized by a strong increase of the inflation rate while the subsequent 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. The last phase starts with entry into the EMU and is characterized by a low and stable level of inflation.

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 monetarist 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 can not 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[1].

All these papers, however, have addressed at each causes of inflation separately. The effort, in the present paper, is to collect all possible determinants in a single framework and try to explain the marginal contribution to the dynamics of the Italian inflation, both in the short and long run. In a previous paper Acconcia (1994) proposed a similar approach and investigated the contribution of disequilibria in the money market, labour market and foreign market in explaining the Italian inflation over the period 1973-1991. Our approach is an extension, in several directions, of the one proposed by Acconcia (1994).

First of all, following Hendry (2001), we do not exclude *a priori* any theoretical explanation for the Italian inflation and include in our model indicators from both demand and supply sides of the economy. In particular, we observe how inflation reacts to disequilibria from 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 multivariate structural model for the inflation dynamics, differently from Acconcia (1994) who considered only a univariate equation for the Italian inflation. The methodology thus consists of a two-step procedure where, in the first one, we estimate the equilibrium relations through multivariate cointegration models, and in the second we include all the disequilibria in a model for the Italian inflation.

The third extension, instead, concerns the investigation sample, which has been enlarged by

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[1]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.

considering the four decades from 1970 to 2006. Over this four decades, substantial changes in many sectors of the Italian economy occurred during the first years of the '80s, as well as the transition from the national to the common monetary policy pursued by the ECB at the end of the '90s. These considerations suggest the possibility of changes in the equilibrium relations and in the dynamic evolution of the variables.

If the beginning of the '80s have been characterized by numerous changes in many sectors of the Italian economy, the launch of the stage Three of the EMU can not be considered of minor importance when the attention of the study is fastened on one of the primary objectives of the reform. Among the primary objectives, in fact, there is the desire to build an area of monetary stability and to reinforce the EU single market by eliminating any differences in the units of account, and hence making the price system more efficient and transparent. This suggests that the central objective behind the creation of the euro was to change something in the way prices are determined. Angeloni et al. (2006), using micro data on consumer prices and sectorial inflation rates from six euro area countries, find no evidence that anything has changed around 1999. Whether or not the beginning of the EMU represented a structural change seems to be still an argument for further research. What is clear, however, is that many factors, such as input costs or product markets harmonization, which might play a relevant role in the determination of prices in the short run, could be influenced by the EMU, although the consequences on prices are not direct and immediate.

Another current of the recent literature, instead, concentrates on the inflation differences that seem to persist even some years after the launch of the euro. After converging sharply in the 1990s, national inflation rates started to diverge again around 1999. Although recently the differentials have closed somewhat, stylized facts show that inflation differentials are larger and more persistent than, for example, in the United States (see, among many others, Angeloni and Ehrmann, 2004).

In both streams of research, hence, understanding the determinants of inflation is of extremely importance in order to determining which policy intervention might better perform in the realignment of inflation rates in the EU. This is exactly the aim of the present paper.

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 have a role in explaining the dynamics of the Italian inflation. Section 4 presents the general model and discusses the process of
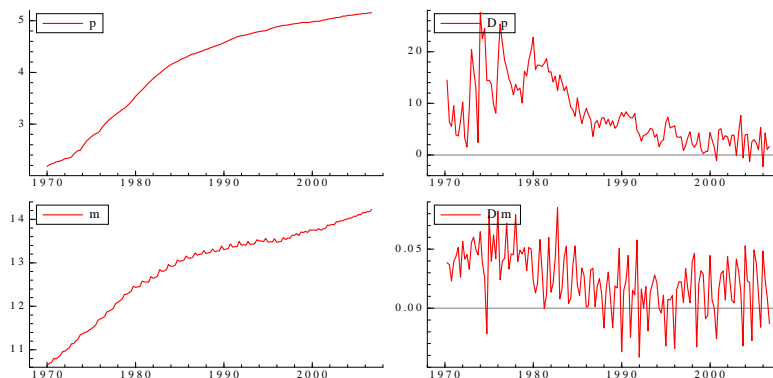
Figure 1: price indicator and money supply, in levels and first differences.

reduction to a simple and interpretable model for the Italian inflation. Some policy implications can also be found in Section 4, while Section 5 concludes.

2   Historical Perspective and Descriptive Analysis

The sample data are quarterly observations covering the period 1970:1 to 2006:4. As already introduced above, many sectors of the Italian economy have experienced substantial structural changes over the investigated period. 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 and during the first years of the EMU. This is clear by observing Figure 1, where the inflation rate Δp_t is measured as first differences of the log 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.

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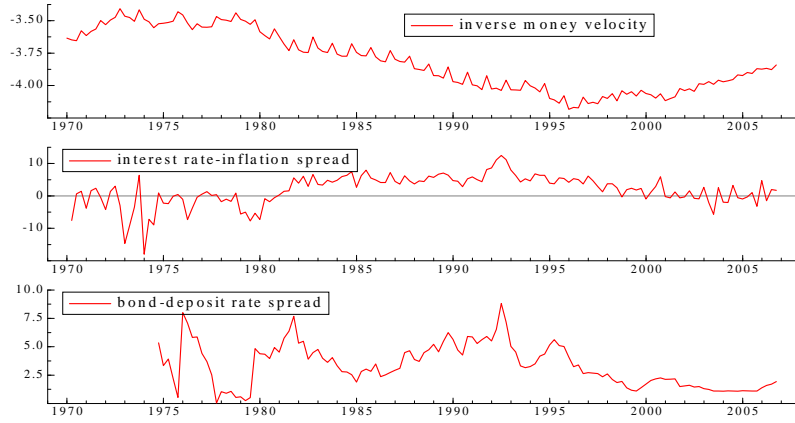
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Figure 2: liquidity ratio, interest rate-inflation and bond-deposit rate.

inflation rate spread remains almost constant on three different values: a negative real interest rate before 1982, a positive one before the entry in the EMU, and around zero during the EMU.

The simple graphical inspection of the main characteristics of the Italian money market highlights the possibility of two structural breaks. The first one occurred around the beginning of the '80s, as a consequence of the fundamental changes associated 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[2]. The second structural break, instead, could be ascribed to the entry to the EMU and the abandonment of the national monetary authority.

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 mainly aimed at preventing disequilibria in the balance of payments. The quantity of credit, rather than the quantity of money, was regarded as the intermediate target of monetary policy[3]. 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 participation of the Italian lira to the ERM

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[2]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.

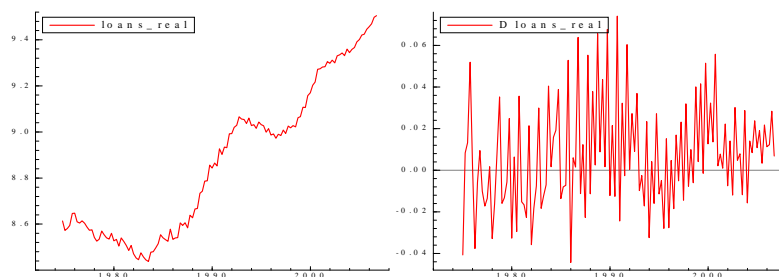[3]See e.g. Bertocco (1997) and Cotula and Micossi (1977).

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

changed the objective 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 only, but characterize many other sectors of the Italian economy. Marcellino and Mizon (2001a, 2001b), 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[4]. All these considerations seem to strongly confirm the presence of a structural break in many sectors of the Italian economy, at the beginning of the '80s.

Another fundamental step of the Italian economy, as well known, is represented by the decision to join the EMU with the first group of countries in 1999. Such a decision, in some sense, obliged the Italian economic authorities to make enormous efforts in order to approach the most virtuous countries and respect the economics constraints as postulated by the Maastricht treaty in 1993.

Thinking at the 1999 as a structural break, thus, could be a simplified representation of the reality, in that structural changes could have occurred well before the birth of the euro. This

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[4]See e.g. Erickson and Ichino (1994) and Bertola and Ichino (1995) for the impact of the "Scala Mobile" on the Italian economy.

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point is still the object of an animated debate in the literature, which seems to confirm that, at list for the mechanism of price formation, nothing has changed around 1999 for many euro area countries[5].

In Table 1 we report the correlations between inflation and a set of possible explanatory variables. The correlations have been calculated both for the entire period and for some sub-periods, in line with the discussion above. What emerges, at first glance, is that all the variables taken in consideration, at least for a single sub-period, present relevant unconditional correlations with the inflation rate. Moreover, some of these correlations are completely different among the sub-periods, providing a further partial evidence of the presence of structural changes characterizing the Italian economic framework over the last four decades.

In the next two sections we propose theoretical and empirical evidences of the relations between all these variables and the inflation dynamics, both in the long and short run.

	$\Delta^2 p$				
	1970-82	1983-98	1999-2006	1983-2006	1970-2006
$\Delta^2 m$	0.17	-0.30	0.04	-0.12	0.02
Δy	0.25	0.13	-0.05	0.04	0.19
$\Delta^2 pm$	0.56	-0.11	-0.27	-0.16	0.34
$\Delta^2 ulc$	0.05	-0.11	0.66	0.40	0.17
$\Delta^2 w$	0.20	0.00	0.78	0.55	0.31
Δu	0.09	0.00	0.30	0.06	0.08
$\Delta^2 debt$	-0.45	-0.22	0.19	0.08	-0.26
Δi_b	0.22	0.09	-0.03	0.04	0.17
Δi_d	0.23	0.04	-0.03	0.01	0.18
Δr		-0.10	-0.30	-0.10	-0.08
$\Delta loand$		-0.15	-0.26	-0.16	-0.08
$\Delta \rho$		0.18	0.02	-0.10	0.27

Table 1: correlations between inflation and other variables. All variables have been appropriately differenced in order to become stationary.

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[5]See, e.g. Angeloni et al. (2006).

3 The Inflation Dynamics in the Long Run

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 is strong evidence in favor of the monetarist theory, in the earlier version of Friedman (1956, 1969) and Friedman and Schwartz (1963). This interpretation, however has raised many relevant issues letting researchers to asking whether the pure monetary interpretation was the most appropriate for the Italian case.

The narrative approach in Bertocco (2002), the explanations proposed by all the Governors in the Bank of Italy yearly reports in the period as well as the empirical analysis in Bertocco et al. (2002), emphasize the importance of supply side effects in price dynamics. Other important contributions in this sense can be found in relations for wage determination which depend on unemployment, productivity, taxes and policy interventions.

During the last few years, some researchers have focused on 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[6]. 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, such as the output gap, can be useful in explaining and forecasting inflation.

The empirical analysis, in this paper, is based on a two step procedure. In the first step we investigate separately all the different aspects of the Italian economy through cointegrated

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[6]Fanelli and Paruolo (2003), Bagliano and Favero (1997) and Buttiglione and Ferri (1994) find that the credit channel effectively operates since 1983, which corresponds to the abolition of the credit ceiling, till the entry of Italy to the EMU.

VAR models which appropriately exploit the time series properties of the variables involved. In the second step, we include all disequilibria from the mentioned equilibrium relations in a structural error correcting model for explaining the Italian inflation. The choice of a two step procedure is mainly due to the dimensionality of the information set which would make a single cointegration analysis clearly infeasible.

Here below, we present the separate cointegration analyses for the relevant economic sectors: money, credit, fiscal policy, final demand, markup, wages and unemployment. In Section 4, instead, we present a structural model for the Italian inflation which collects all the aspects discussed in the present section[7].

3.1   Money and Credit

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.

Before the EMU, the monetary transmission mechanism has experienced many structural changes, especially around the first '80s. From the point of view of the money channel, the common result seems to be that a stable money demand relation can be estimated only for the period 1982-98[8]. After the entry into the EMU, instead, it seems not very realistic to talk about a demand for money when the measured quantity of money is only an indirect consequence of the effective monetary policy. About the credit channel, all empirical contributions concentrate 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.

Based on the theoretical framework proposed by Bernanke and Blinder (1988) we expect at least three equilibrium relations in the money and credit markets: a money demand equation, a loans demand equation, and a relation for the interest rate on loans. Moreover, over this sample period we expect a stable real interest rate, as shown in Figure 2.

In the money market, thus, we expect a standard money demand relation, where the real quantity of money is a function of the opportunity cost of holding money. In the credit market, instead, we suppose that the banking system fixes the price of credit by following the markup

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[7]Calculations were performed in PcGive 10.0, see Doornik and Hendry (2001).

[8]See, e.g. Juselius (2001), Fanelli and Paruolo (1999), Angelini et al. (1994), Bagliano and Favero (1992).

rule, where the lower threshold of the financial intermediation activity is represented by the deposit interest rate. The price of credit, thus, will be a function of the levels of interest rates in the market and an indicator of the business cycle. On the other side, the demand for loans can be modelled as a standard demand function, where the quantity of loans is a function of the GDP, the cost of credit, and the level of interest rates in the market, indicating an alternative way of financing.

The information set consists of eight variables: the real stock of money $(m_t - p_t)$, the real GDP y_t, the average interest rate on Treasury Bills at different maturities (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 r_t. All variables are expressed in logarithmic terms, except the interest rates. A restricted trend is included in the statistical model, as well as unrestricted centered seasonal dummies in order to account for the strong seasonality of the money aggregate[9]. The analysis has been conducted through the $I(1)$ cointegration procedure proposed by Johansen (see Johansen, 1996 for a detailed discussion on such procedure). Among the five cointegrating relations suggested by the trace test, as expected three of these directly refers to the money and credit channels.

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:

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

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

Regarding the credit market, the long-run relationships for the interest rate on loans is

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

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[9]All variables seem to behave as $I(1)$ processes although the test procedure proposed by Rahbek et al. (1999) suggests the presence of one $I(2)$ common trend. A simple graphical inspection of the series would suggest the real loans to be approximated by an $I(2)$ process although 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 (2003) for similar conclusions.
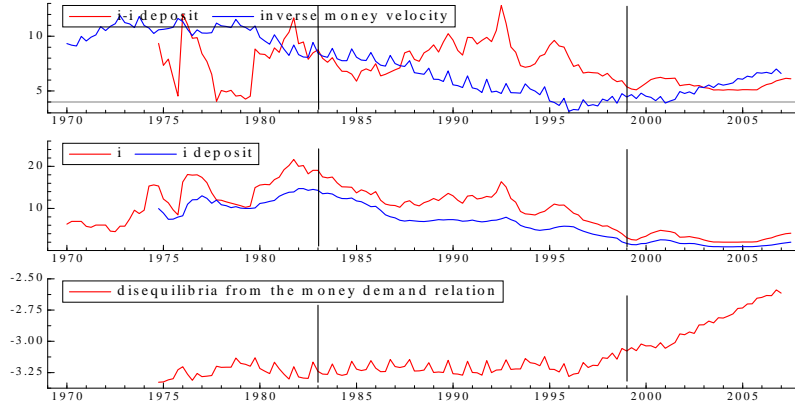
Figure 4: inverse money velocity, interest rates on bonds and deposits, and money demand relation over the period 1983-98.
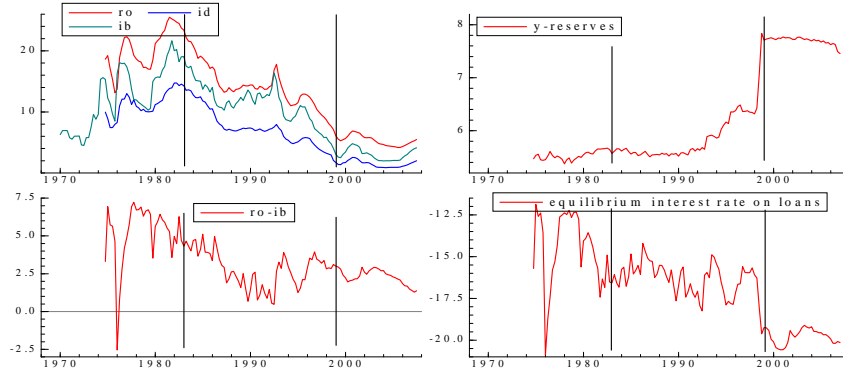

Figure 5: interest rates on loans, deposits and bonds, velocity of reserves, loans-bonds spread and disequilibria from the stable interest rate on loans.

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

The estimated excess demand for credit, instead, is

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

where $(loan_t - y_t)$ represents the inverse of the "velocity of credit". 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.
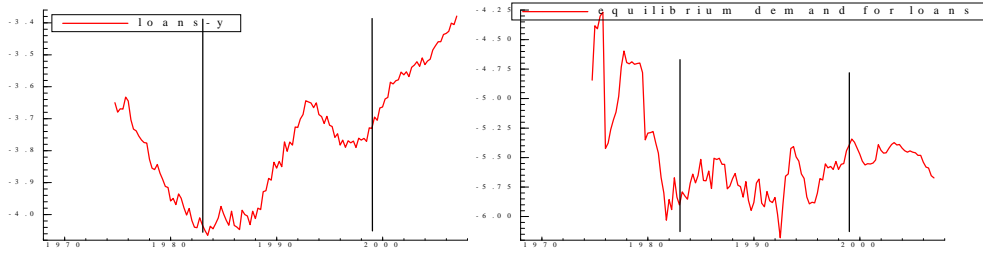
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Figure 6: inverse loan velocity and disequilibria from the stable quantity of loans.

As shown in Figures 5 and 6, even after the start of the EMU, the two relations for the credit market continue to be quite stable, but on a different value with respect to the previous period. Such different means could be explained with the realignment of the reserve coefficients with the other European countries, which caused an enormous reduction in the reserves held by commercial banks at the Central Bank[10].

Concerning the loading coefficients, reported in the Appendix B, it is interesting to note that the inflation rate responds significantly to excess of money and credit, while credit interest rates higher than the equilibrium level contribute at reducing inflation. All the other coefficients show the expected signs.

3.2 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. Empirical 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[11]. 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 the linear homogeneity assumption, this relation can be formulated as follows:

$$z_t = p_t - \gamma ulc_t - \delta pm_t - \eta \Delta p_t = q_t - \eta \Delta p_t \tag{4}$$

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[10]The reserve coefficient for the Italian banks has been reduced at 9% in June 1998, at 6% in August and subsequently at 2.5% in December of the same year. Since January 1999, the reserve coefficient is at 2% for all european banks.

[11]See also Franz and Gordon (1993) for a revision of the literature of the markup model considered in this analysis.
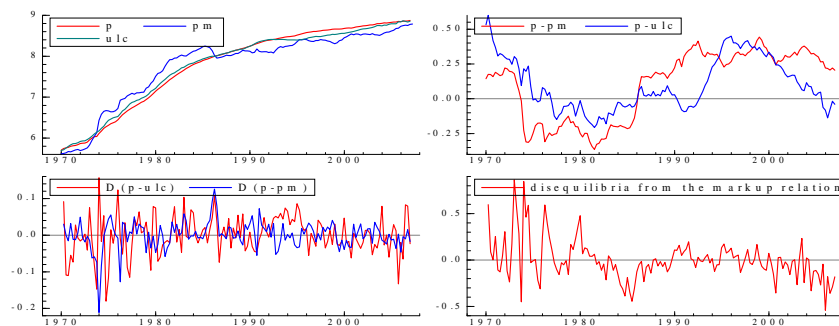
Figure 7: GDP deflator, import prices and unit labour costs in levels; markup over labour costs and over imports in levels and first differences; deviations from the markup-inflation equilibrium relation. All series are in log terms.

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.

After some simple algebra, the empirical formulation of the retail markup model (4) can be rewritten as

$$(p_t - ulc_t) + \beta_1 (p_t - pm_t) + \beta_2 \Delta p_t = e_{zt} \tag{5}$$

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. Thus, when considering the information set $X_t = (p_t - ulc_t, p_t - pm_t, \Delta p_t)$, we expect one cointegration relation that involves the variables as explained in the theoretical model above.

Disequilibria from the long-run markup relation (5) have been estimated, for the period 1970-2006, as:

$$\widehat{e}_{zt} = (p_t - ulc_t) + \underset{(0.11)}{0.43} (p_t - pm_t) - \underset{(2.21)}{12.74} \Delta p_t + const. \tag{6}$$

The estimated adjustment coefficients, reported in the Appendix B, show that all the variables react to the disequilibria in the markup relation[12]. However, as it can be expected for the inflation rate and the markup over labour costs, it seems quite strange for the markup over import prices. However, this is not so unrealistic if we re-write the price of imports in the

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[12] A LR test rejects the null hypothesis that $(pm_t - p_t)$ does not react to disequilibria in the murkup relation.

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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 adjustment towards the equilibrium thus can happen either through the domestic price level p_t or thorough the exchange rate ex_t (or a combination of the two). Moreover, the relation (5) 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.

3.3   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 Galǐ et al. 2001). Such relation seems to be confirmed by the European experience, which, in accordance with the 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 (2001a), 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 1983-2006, enforces the evidence of such changes.

The empirical analysis, thus, has been conducted through the cointegrated VAR approach for the split samples 1970-82 and 1983-2006; see Appendix B for further details on the empirical
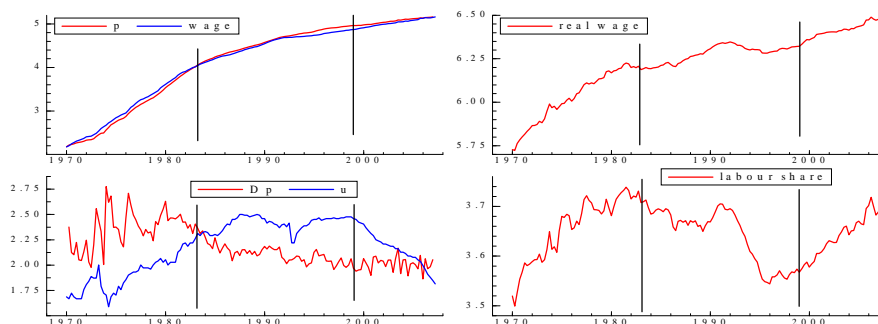
Figure 8: prices and wages, real wages, unamployment and inflation, and labour share.

analysis. The variables included in the VAR model are:

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

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[13]. Considering this information set we expect at least one cointegrating relation in both periods, involving inflation rate and unemployment, as in a standard Phillips curve.

The empirical results for the two sub-periods highlight two equilibrium relations for both the first and second period. Although there is no clear cut evidence, the choice of two cointegrating relations 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 cointegrating relations, with a $p-value = 0.23$, are

$$
\begin{aligned}
\widehat{e}_{st} &= (w_t - p_t) + \underset{(0.057)}{0.081} u_t - \underset{(0.119)}{1.705} (y_t - l_t) + const \\
&= s_t + 0.081 u_t - 0.705 (y_t - l_t) + const
\end{aligned}
$$

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

$$\widehat{e}_{pcIt} = \Delta p_t + \underset{(0.013)}{0.022} u_t - \underset{(0.099)}{0.554} (y_t - l_t - 0.005t) + const$$

---

[13] 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. This can still be seen as a "nominal-to-real transformation" in the sense of Kongsted (2003, 2005).
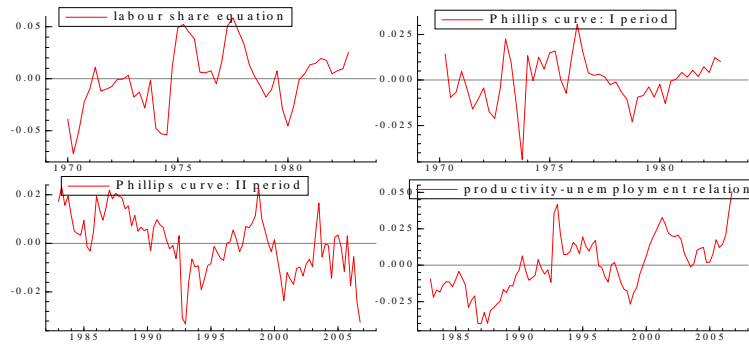
Figure 9: deviations from long-run equilibria in the labour market for the first and second period.

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

Figure 9 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 cointegrating relation indicates that inflation decreases with an increase in unemployment, but increases with positive output gap. This relation thus can be interpreted as an augmented Phillips curve.

For the second period the trace test indicates, in a quite clear way, the presence of two cointegrating relations. The first one is a relation which connects productivity and unemployment:

$$\widehat{e}_{put} = (y - l) - \underset{(0.021)}{0.255}u - \underset{(0.004)}{0.003}t + const.$$

The second relation highlights that the accelerating Phillips curve continues to hold, but with different long-run elasticities. In particular, the relation becomes

$$\widehat{e}_{pcIIt} = \Delta p_t + \underset{(0.016)}{0.184}u_t - \underset{(0.041)}{0.679}\left(y_t - l_t - 0.004t\right) + const$$

with higher parameters both for unemployment and the output gap with respect to the previous period. The overidentifying restrictions can not be rejected by a $\chi^2(4) = 1.84$, with a $p-value = 0.40$.

17

Concerning the adjustment coefficients, reported in Appendix B, it is interesting to note that the unemployment rate is weakly exogenous for the long-run coefficients in the first period, while helps reaching the equilibrium in both the long-run relations in the second period. The inflation rate, instead, reacts to disequilibria in both long-run relations, in the two subsamples. This result highlights, as will be discussed in the next section, the notable role played by productivity and labour market in determining the inflation dynamics.

4   A model for the Italian Inflation

In this section we propose a structural model for the Italian inflation. The idea is to model the national economy by means of an aggregate supply and an aggregate demand equation. The aggregate supply is specified as a sort of "hybrid" Phillips curve where, however, we do not explicitly model the expected future inflation rate[14]. The aggregate demand is modelled by an equation for the growth rate of the GDP, which we expect to react to the real interest rate and the real effective exchange rate, which, in our case, is incorporated in the import price index. The model is completed by an equation for the determination of the interest rate, interpretable as a Taylor rule equation.

The modelling strategy consists in the specification of a multivariate reduced form model for the stationary vector $(\Delta^2 p_t, \Delta y_t, \Delta i_{bt})$ and, following the "*general to specific*" approach, we arrive to a structural form which can not be rejected by the data but, at the same time, can help us in investigating which theoretical explanation mainly contributed to explain the Italian inflation[15]. Among the regressors we include one period lagged first differences of real variables 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[16]. Moreover

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[14]The inclusion of expectations in the empirical versions of the price determination models requires some restrictions in order to separately identify the effects of expected future variables. If the model is specified with unconstrained leads and legs, it will be difficult for the data to distinguish between the leads, which solve out as restricted combinations of lag variables, and unrestricted lags. Such restrictions might become quite complicated when, as in our case, one thinks of a combination of causes as the most plausible explanation for the dynamics of prices. In our case, in addition, we enrich the dynamics by the inclusion of error correction terms and the restrictions for the identification of the contribution of expected and past inflation become nearly intractable.

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

[16]The variables related to the credit market have been included only since 1983 because unavailable for most

we include the Hodrick-Prescott measure of the output gap (gap_t) and the second difference of the nominal public debt ($debt_t$). Some variables, in particular the second difference of nominal wages $\Delta^2 w_t$, the second difference of the import prices $\Delta^2 p_{mt}$, and the first difference of the european interest rate Δi_{eut} (only for the post-EMU period), are considered as exogenously determined and are allowed to enter simultaneously in the model in order to catch up possible contemporaneous relations with the inflation rate. All the variables, thus, have been opportunely differentiated in order to estimate equations which are composed only by stationary variables.

The main contribution of the paper, however, rests on the response analysis that prices accelerating rate exerts on disequilibria stemming from all the main sectors of the Italian economy. In the following sub-sections, for each historical phase, we report only the inflation equation, leaving the details for the other two equations in Appendix C. Economic interpretation and policy considerations are reported in Section 4.3.

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 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, analyzes the monetary interpretation jointly with other possible explanations of the Italian inflation. All disequilibria discussed above, along with all variables included in the cointegration analyses, have been included in a structural error-correcting model which, after a reduction process of insignificant determinants, can be written as:

$$
\begin{aligned}
\Delta^2 p_t \;=\; & \underset{(0.001)}{0.002} + \underset{(0.124)}{0.325}\Delta^2 p_{t-1} + \underset{(0.094)}{0.226}\Delta^2 p_{t-2} + \underset{(0.064)}{0.263}\Delta^2 w_t + \underset{(0.066)}{0.166}\Delta^2 w_{t-1} + \\
& \underset{(0.025)}{0.105}\Delta\left(m_{t-1} - p_{t-1}\right) + \underset{(0.070)}{0.147}gap_{t-1} - \underset{(0.007)}{0.033}\widehat{e}_{zt-1} + \underset{(0.008)}{0.044}D7401 + \underset{(0.007)}{0.012}D7601 + \varepsilon_{1t}
\end{aligned}
\tag{7}
$$

The reduction process is strongly accepted by the data; the LR test of thirty overidentifying

part of the first period.

restrictions (for all the three equations) does not reject the null with a $p-value = 0.17$ while all the diagnostic tests are insignificant[17]. The graphs of actual and fitted data are reported in Figure 10 (left panel).

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 with the monetary interpretation. Other components however seem to play a relevant role such as the cost-push effects and the dynamics of nominal wages[18]. In particular, the growth rate of the real money supply explains the 20% of the variability of the inflation growth rate, while the cost push effects account for the 41% (23% for the markup error correction term and 18% for the contemporaneous and lagged wages). The output gap, instead, explains the 16% of the variability. 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 and the EMU Period: 1983-2006

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 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.

Although the debate whether the euro area does satisfy the Optimum Currency Area conditions still continues, one unquestionable result is that the rate of inflation, for most part of the

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[17]$R^2 = 0.81$, AR 1-4 test: $F(4, 25) = 0.63$ ($p-value = 0.93$); ARCH 1-4 $F(4, 31) = 0.59$ ($p-value = 0.67$); Normality test: $\chi^2(2) = 1.10$ ($p-value = 0.58$).

[18]The disequilibria from the long-run Phillips curve and the labour-share relation, which entered significantly in the inflation equation as reported in Section 3.3, in equation (8) becomes not significant when including the disequilibria from the markup relation. In other words, the cost-push effects are more strongly captured by the markup relation rather than the disequilibria from the labour market and productivity.
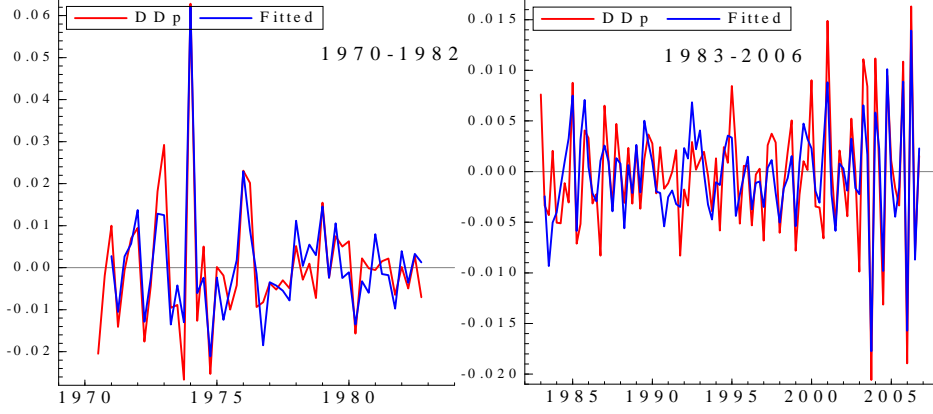
Figure 10: Actual and fitted values for the two periods: 1970-1982 (left panel), 1983-2006 (right panel)

participating countries, remained quite stable over the low levels reached in 1999. Of course, some differences still exist, but such differentials can not be compared to the past situation.

The inflation equation, after the reduction process, becomes

$$
\begin{aligned}
\Delta^2 p_t = & \underset{(0.000)}{-0.001} - \underset{(0.111)}{0.002}\Delta^2 p_{t-1} - \underset{(0.092)}{0.125}\Delta^2 p_{t-2} + \underset{(0.043)}{0.218}\Delta^2 w_t - \underset{(0.004)}{0.012}\widehat{e}_{zt-1} \\
& + \underset{(0.048)}{0.098}gap_{t-1} - \underset{(0.000)}{0.001}\widehat{e}_{\rho t-1} + \underset{(0.012)}{0.026}\widehat{e}_{loant-1} - \underset{(0.075)}{0.267}\widehat{e}_{put-1} - \underset{(0.113)}{0.445}\widehat{e}_{pcIIt-1} + \varepsilon_{2t}.
\end{aligned}
\tag{8}
$$

The overidentifying restrictions for all the three equations can not be rejected with a $p-value = 0.92$ while all the diagnostic tests are insignificant[19]. The growth rate of inflation during the period 1983-2006 is influenced only marginally by its past values but strongly depends on the dynamics of wages. As for the previous period, cost-push effects continuous to play an important role, while the quantity of money seems to be irrelevant. The monetary policy seems to enter through the credit markets. The dynamics of wages accounts for almost 30% of the variability, while the disequilibria on the labour market and productivity explain the 33% of the variability jointly. Although less than in the previous period, the markup error-correction term explains approximately the same share of the inflation dynamics than the monetary and credit variables (11% and 12% respectively). Actual and fitted data are reported in Figure 10 (right panel).

In Figure 11 we report the sequential Chow tests for the presence of a structural break at time t, where t belongs to the interval 1990-2006. The figure shows that for each equation and

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[19] $R^2 = 0.62$, AR 1-5 test: $F(6,59) = 1.93$ $(p-value = 0.09)$; ARCH 1-4: $F(4,75) = 0.18$ $(p-value = 0.95)$; Normality test: $\chi^2(2) = 1.18$ $(p-value = 0.56)$.
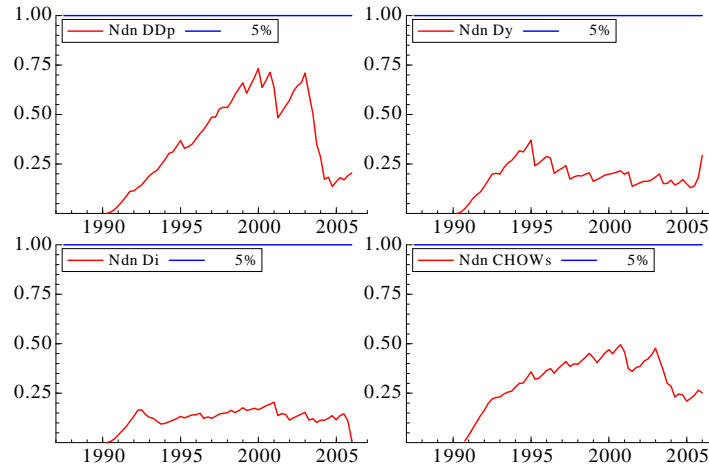
Figure 11: Sequential Chow tests for the presence of structural breaks

for the system as a whole the null hypothesis of no structural break cannot be rejected for any t in the sample[20].

A further confirmation of the absence of a structural break is that the same overidentifying restrictions imposed in the model for the period 1983-2006 cannot be rejected both for the period 1983-1998 (with a $p - value = 0.89$) and for the period 1999-2006 (with a $p - value = 0.14$).

Moreover, significant tests for the equality of the coefficients in the two sub-periods do never reject the null. However, by observing the unconditional correlations reported in Section 2, relaxing the constraint on the nominal wages $\Delta^2 w_t$ we obtain that over the pre-EMU period the inflation rate does not depend on the dynamics of nominal wages while during the EMU the coefficient becomes positive and strongly significant.

4.3 Model interpretation and policy considerations

The empirical analysis presented in this work suggests interesting considerations about a) the policies pursued by the Italian economic authorities in order to curbing inflation during the three decades preceding the Euro, and b) the determinants of the price dynamics once the monetary authority changed toward the ECB's monetary policy strategy.

The first consideration is that excess money supply can not account for all the variability observed in the price acceleration rate over the whole sample. Variables and disequilibria from

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[20]This is true for any conventional significant level and not simply for the 5% as reported for semplicity in the figure.

the 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, seems to be partially contradicted by the empirical evidence.

The importance of cost-push effects 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 3.2. 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. The importance of the exchange rate channel is confirmed by the significant impact provided by the import prices in the interest rate and growth equations, particularly during the second period[21].

During the four decades 1970-2006, 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 productivity-unemployment long-run relation and towards the accelerating Phillips curve in the 1983-2006 period confirm this statement. Moreover, the inclusion of the wage accelerating rate in the first period highlights the role of the vicious circle exerted by the wage indexation "Scala mobile", operative since the second half of the '70s. The dynamics of wages, in addition, reveals to be extremely important during second period too.

Although not directly included in the model, the contribution of expectations in the mechanism of price formation might be deduced from the strong significance of the wages in both periods. Price expectations, in fact, directly affect wages, which feed back to the GDP deflator and to the consumer prices. Our results are consistent with those of Gaiotti et al. (1998), although they consider only the period 1985-96[22].

As already mentioned, monetary aggregates play a relevant role. During the first period in fact, real money growth rate enters significantly the relation. During the '80s and the '90s,

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[21] In order to better understand the impact of the exchange rate and other international variables, one possibility could be to consider a Global VAR (GVAR) model as in the spirit of Pesaran et al. (2004) and Dees et al. (2007). In this context it would be possible to explore the international likages of the Italian economy, including trade and financial relationships. This is however an interesting argument for future research.

[22] However, Gaiotti et al. (1998) estimate a VAR model where both wages and price expectations are included in the information set.

however, the restrictive interventions operated by monetary authorities have been conducted through interest rates rather than money supply. Neither the amount of money, nor the disequilibria from the money demand relation do enter significantly in the inflation equation. This result is at odds with the common wisdom that excess money supply directly affects prices. Moreover, 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 adjustments 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 can not be discussed separately (see, e.g. Bernanke and Gertler, 1995).

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. 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. This statement is confirmed by the empirical analysis. In fact, the high and persistent levels of public debt during the first period are captured by the monetary aggregates and the fiscal variables do not enter significantly the relation. During the second period conversely, both monetary and fiscal variables play a relevant role in explaining inflation. In fact, although the fiscal variables

do not enter directly the inflation equation, in the equation for the interest rate determination, it is shown as the monetary authorities take care about the debt dynamics when fixing the policy interest rate.

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 discussed above.

Another important point concerns the connections between the institutional changes following the adhesion to the EMU and the mechanism of price formation. The empirical evidence confirms, even from a macroeconomic point of view, the results in Angeloni et al. (2006) that almost nothing did change with the adoption of the euro, at least for the Italian case. The sequential Chow tests, reported in Figure 11, show that if something did change, although not significantly, it happened well before the 1999, probably due to the uncertainties associated with the fragile situation of the Italian economy around the ratification of the Maastricht Treaty.

5 Concluding remarks

In this paper we investigated the determinants of inflation in Italy since the beginning of the '70s till the first years after the launch of the EMU. Structural and institutional changes in many sectors of the Italian economy suggest to take into account the possibility of splitting the sample period into three sub-samples and modelling the dynamics of inflation differently for each of the periods. While this is the case for the first years of the '80s, an appropriate robustness analysis rejects the hypothesis of different mechanisms of price formation before and after the adhesion to the EMU in 1999.

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.

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 also offer a substantial contribution in explaining the dynamics of prices.

The common wisdom that excess money supply influences prices is confirmed by the empirical results, even if, since the beginning of the '80s the credit transmission mechanism needs to

be considered. In particular, over the '80s and the '90s the restrictive interventions operated by the Italian 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, has been more effective than in the '80s, only based on monetary instruments, and helped Italy to joining the euro in 1999.

During the first years of the EMU, as for the previous period, cost push effects, as well as disequilibria from the credit and labour sectors reveal to be the main drivers of the dynamics of prices. From a broader point of view, these conclusions are of extremely importance in acting at reducing the inflation differentials among euro area countries.

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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 maturities (Bank of Italy)

$loan_t$ =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)

i_{uet} =short term maturity european interest rate (from Favero and Giglio, 2006)

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)

i_{uet} =short-term european interest rate (from Favero and Giglio, 2006)

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:

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

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 1983:1-1998:4.

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 root in the restricted model is one more evidence of the presence of a common $I(2)$ stochastic trend[23].

The estimated cointegrating relations are reported in Table 2. 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 2: trace test in the restricted trend I(1) model; 1983:1-1998:2.

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[23]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.

Cointegrating relations

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

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

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

$$\widehat{e}_{yt} = y_t + \underset{(0.08)}{0.45}(i_{bt} - \Delta p_t) - \underset{(0.01)}{0.064}r_t - \underset{(0.0002)}{0.0069}t + const$$

$$\widehat{e}_{it} = i_t - \Delta p_t - \underset{(0.0025)}{0.029}D923 + const$$

Adjustment coefficients				
$\widehat{e}_{mt}$	$\widehat{e}_{\rho t}$	$\widehat{e}_{loant}$	$\widehat{e}_{yt}$	$\widehat{e}_{it}$

	$\widehat{e}_{mt}$	$\widehat{e}_{\rho t}$	$\widehat{e}_{loant}$	$\widehat{e}_{yt}$	$\widehat{e}_{it}$
$\Delta(m_t - p_t)$	-0.352 (0.146)	0.016 (0.008)	-0.038 (0.058)	-0.928 (0.322)	-0.163 (0.139)
Δy_t	-0.007 (0.048)	0.066 (0.027)	0.026 (0.019)	0.112 (0.107)	0.077 (0.046)
Δi_{bt}	0.042 (0.063)	-0.944 (0.356)	0.103 (0.025)	0.400 (0.139)	-0.277 (0.060)
Δi_{dt}	0.022 (0.021)	-0.283 (0.117)	0.015 (0.008)	0.022 (0.046)	-0.043 (0.020)
$\Delta^2 p_t$	0.425 (0.107)	-0.022 (0.006)	0.138 (0.043)	0.919 (0.236)	0.355 (0.101)
$\Delta \rho_t$	0.056 (0.033)	-0.953 (0.183)	0.060 (0.013)	0.276 (0.072)	-0.127 (0.030)
$\Delta loan_t$	-0.054 (0.108)	0.016 (0.006)	-0.070 (0.043)	0.106 (0.237)	-0.162 (0.102)
Δr_t	-1.467 (0.409)	-0.031 (0.023)	0.483 (0.163)	1.224 (0.900)	-0.449 (0.389)

Table 3: cointegrating relations and adjustment coefficients for the money and credit market; 1983:1-1998:2. Standard errors in parentheses.

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 1970:1-2006:4.

All variables appear to be integrated of order one and the trace test, reported in Table 3, strongly supports only one cointegrating relation with two $I(1)$ trends[24]. 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
$trace$ (p−value)	33.26 (0.018)	8.80 (0.391)	2.749 (0.097)

Table 4: trace test; 1970:1-2006:4.

Adjustment Coefficients		
$p_t - ulc_t$	$p_t - pm_t$	Δp_t
$\widehat{e_{zt}}$ −0.042 (0.011)	−0.049 (0.031)	−0.022 (0.007)

Table 5: Adjustment coefficients for the markup model; 1970:1-2006:4.

Wages, Productivity and Unemployment

As already mentioned in Section 3.3, 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

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

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[24]The $I(2)$ test in Paruolo (1996) has been performed and does exclude the presence of $I(2)$ components, confirming thus the nominal-to-real transformation in the sense of Kongsted (1998, 2002)

$r \leq j$		0	1	2	3
First period (1970-1982)	$trace$ ($p-value$)	72.29 (0.007)	38.68 (0.125)	10.90 (0.876)	3.77 (0.771)
Second Period (1983-2006)	$trace$ ($p-value$)	94.64 (0.000)	44.90 (0.029)	10.02 (0.918)	2.30 (0.930)

Table 6: trace test for the two periods.

	cointegrating relations	LR test
First period (1970-1982)	$\widehat{e}_{st} = (w_t - p_t) + \underset{(0.057)}{0.081}u_t - \underset{(0.119)}{1.705}(y_t - l_t) + const$	$\chi^2(2) = 3.05$ $p-value=0.22$
	$\widehat{e}_{pcIt} = \Delta p_t + \underset{(0.013)}{0.022}u_t - \underset{(0.099)}{0.554}(y_t - l_t - 0.005t) + const$	
Second Period (1983-2006)	$\widehat{e}_{put} = (y_t - l_t) - \underset{(0.021)}{0.250}u_t - \underset{(0.0003)}{0.004}t + const$	$\chi^2(4) = 1.84$ $p-value=0.40$
	$\widehat{e}_{pcIIt} = \Delta p_t + \underset{(0.016)}{0.180}u_t - \underset{(0.041)}{0.673}(y_t - l_t - 0.004t) + const$	

Table 7: cointegrating relations and LR tests for overidentyfing restrictions for the two periods. Standard errors in parentheses.

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 1983-2006; a VAR model with two lags has been estimated for both periods. All variables appear to be integrated of order one 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 suggests only one cointegrating relation 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 relations and two $I(1)$ common trends.

For the second period, there seems to be less doubts for the choice of two cointegrating relations. The results of the trace tests and the estimated cointegrating relations 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.

	Adjustment coefficients: 1970-1982			
	$\Delta(w_t - p_t)$	Δu_t	$\Delta(y_t - l_t)$	Δp_t
$\widehat{e}_{st}$	-0113 (0.081)	0	0.204 (0.042)	0.120 (0.063)
$\widehat{e}_{pcIt}$	0.297 (0.212)	0	-0.220 (0.111)	-0.858 (0.165)

Table 8: Adjustment coefficients for the labour market in the first period. Standard errors in parentheses.

	Adjustment coefficients: 1983-2006			
	$\Delta(w_t - p_t)$	Δu_t	$\Delta(y_t - l_t)$	Δp_t
$\widehat{e}_{st}$	-0.077 (0.041)	-1.072 (0.037)	-0.182 (0.037)	-0.515 (0.083)
$\widehat{e}_{pcIIt}$	0	-1.244 (0.606)	0	-0.925 (0.134)

Table 9: Adjustment coefficients for the labour market in the second period. Standard errors in parentheses.

Appendix C: Structural model for the Italian inflation

In this appendix we report, for each sub-sample, the estimated equations of the structural model discussed in Section 4.

First period: 1970-1982

$$\Delta^2 p_t = \underset{(0.001)}{0.002} + \underset{(0.124)}{0.325}\Delta^2 p_{t-1} + \underset{(0.094)}{0.226}\Delta^2 p_{t-2} + \underset{(0.064)}{0.263}\Delta^2 w_t + \underset{(0.066)}{0.166}\Delta^2 w_{t-1} +$$

$$\underset{(0.025)}{0.105}\Delta(m_{t-1} - p_{t-1}) + \underset{(0.070)}{0.147}gap_{t-1} - \underset{(0.007)}{0.033}\widehat{e}_{zt-1} + \underset{(0.008)}{0.044}D7401 + \underset{(0.007)}{0.012}D7601 + \varepsilon_{1t}$$

$$\Delta y_t = -\underset{(0.087)}{0.055}\Delta^2 p_{t-1} + \underset{(0.069)}{0.180}\Delta^2 p_{t-2} + \underset{(0.086)}{0.589}\Delta y_{t-1} - \underset{(0.410)}{0.590}\Delta i_{dt-1} + \underset{(0.059)}{0.261}\Delta^2 w_t$$

$$-\underset{(0.016)}{0.025}\Delta^2 pm_t + \underset{(0.030)}{0.041}\Delta^2 debt_t + \underset{(0.026)}{0.043}\Delta(m_{t-1} - p_{t-1}) - \underset{(0.079)}{0.170}gap_{t-1}$$

$$+\underset{(0.006)}{0.019}\widehat{e}_{zt-1} + \underset{(0.054)}{0.178}\widehat{e}_{st-1} - \underset{(0.124)}{0.220}\widehat{e}_{pcIt-1} + \underset{(0.007)}{0.014}D7401 + \varepsilon_{y1t}$$

$$\Delta i_{bt} = \underset{(0.030)}{0.122}\Delta^2 p_{t-1} + \underset{(0.027)}{0.055}\Delta^2 w_{t-1} + \underset{(0.024)}{0.073}gap_{t-1} + \underset{(0.003)}{0.022}D7601 + \varepsilon_{i1t}$$

Second period: 1983-2006

$$\Delta^2 p_t = -\underset{(0.000)}{0.001} - \underset{(0.111)}{0.002}\Delta^2 p_{t-1} - \underset{(0.092)}{0.125}\Delta^2 p_{t-2} + \underset{(0.043)}{0.218}\Delta^2 w_t - \underset{(0.004)}{0.012}\widehat{e}_{zt-1}$$

$$+\underset{(0.048)}{0.098}gap_{t-1} - \underset{(0.000)}{0.001}\widehat{e}_{\rho t-1} + \underset{(0.012)}{0.026}\widehat{e}_{loant-1} - \underset{(0.075)}{0.267}\widehat{e}_{put-1} - \underset{(0.113)}{0.445}\widehat{e}_{pcIIt-1} + \varepsilon_{2t}$$

$$\Delta y_t = \underset{(0.001)}{0.002} + \underset{(0.093)}{0.200}\Delta y_{t-1} + \underset{(0.100)}{0.174}\Delta y_{t-2} - \underset{(0.016)}{0.023}\Delta^2 pm_t + \underset{(0.016)}{0.021}\Delta^2 pm_{t-1} + \underset{(0.020)}{0.037}\Delta^2 debt_{t-1}$$

$$- \underset{(0.004)}{0.014}\widehat{e}_{\rho t-1} + \underset{(0.030)}{0.075}\widehat{e}_{loan t-1} - \underset{(0.057)}{0.238}gap_{t-1} - \underset{(0.030)}{0.093}\widehat{e}_{put-1} + \varepsilon_{y2t}$$

$$\Delta i_{bt} = \underset{(0.0002)}{-0.0003} + \underset{(0.114)}{0.342}\Delta i_{bt-1} - \underset{(0.004)}{0.006}\Delta\left(m_{t-1} - p_{t-1}\right) - \underset{(0.018)}{0.036}\Delta^2 w_t + \underset{(0.006)}{0.017}\Delta^2 pm_{t-1} + \underset{(0.008)}{0.013}\Delta^2 debt_t$$

$$+ \underset{(0.018)}{0.062}\widehat{e}_{loan t-1} - \underset{(0.001)}{0.001}\widehat{e}_{zt-1} + \underset{(0.023)}{0.084}gap_{t-1} + \varepsilon_{i2t}$$