PERMANENT DISINFLATIONARY EFFECTS ON UNEMPLOYMENT IN A SMALL OPEN ECONOMY: ITALY 1979-1995

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Abstract. The aim of this paper is to investigate the effects on the rate of unemployment of the disinflationary policies and other aggregate demand shocks which affected the Italian economy during the period 1979-1995. To this end, a structural cointegrated VAR model is built and the structural disturbances are recovered by imposing a set of short-run, contemporary restrictions. The results show that both short-run and long-run movements in unemployment are influenced by disturbances to aggregate demand, as well as by supply shocks. This evidence seems to be at odds with the predictions of "natural-rate" theories.
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1. Introduction

This paper shows that disinflationary policies and other adverse shocks to aggregate demand caused a permanent increase in Italian unemployment in the 1980s and early 1990s. These results are at odds with the prediction of "natural rate" theories, according to which tight monetary policies provoke only a rise in cyclical unemployment, since the long-run equilibrium unemployment is independent of monetary policy and aggregate demand. The picture which emerges from this paper is different: both short-run and long-run movements in unemployment are influenced by monetary policy and other shocks to aggregate demand, as well as by shocks on the supply side.

These results support hysteresis theories (cf. Blanchard and Summers, 1986). In fact, a central prediction of these models is that a disinflationary process causes a rise in cyclical unemployment and this provokes a rise in the long-run trend, the so-called non-accelerating inflation rate of unemployment (NAIRU).

It is worth stressing that the possible presence of persistent aggregate demand shocks could also be accomodated within a conventional model with long-run monetary neutrality. After all, a building block of "natural rate" models rests on the idea that negative shocks on the demand side, in particular those originating from monetary policy tightening, might cause a temporary increase of unemployment in the presence of errors in expectations. Thus, persistent shocks on the demand side are compatible with a vertical long-run Phillips curve. Nevertheless, in this paper we find that, as far as the selected period in the Italian economy is concerned, the existence of a negative long-run equilibrium relation between inflation and unemployment cannot be rejected and hence a long-run non-vertical Phillips curve seems to characterize the Italian economy in the sample period considered.

It is important to point out that in 1979, the starting year of our investigation, the world economy was affected by three major events: (1) the Iranian revolution and the connected second oil shock which caused an increase both in unemployment and inflation in the industrialized countries; (2) Italy and some other European countries joined the fixed exchange rate mechanism of the European Monetary System (EMS); (3) The reaction of main central Banks to inflation consisted in a sharp increase of short-term interest rates. Hence, in 1979 we observe both a peak in inflation and the beginning of the disinflation era. In the early 1980s, as a consequence of disinflationary monetary policies, Italy and most OECD countries experienced recessions and the rate of unemployment rose to levels unknown since the Great Depression. Moreover, in Italy, as in other European countries, the increase in unemployment turned out to be strongly

persistent. Furthermore, in the early 1990s, there was a new episode of tightening monetary conditions in Italy since exchange rate goals and anti-inflation policy induced another sharp increase in short-term interest rates. The recession of 1992-93 followed and in the period 1991-1995 the rate of unemployment rose three percentage points to twelve percent.

In two recent papers Ball (1997, 1999) criticizes the prevailing explanation of the rise in European unemployment in the eighties, founded on imperfections in the labour market. Such imperfections induced by a set of rules, regulations and labor market institutions, would make the labor market too inflexible. Ball argues that this "conventional wisdom" fails to consider the role of monetary policy and aggregate demand in the rise of long-run unemployment.

In this paper we try to address the questions raised by Ball and other authors by investigating the interactions among inflation, unemployment and monetary policy that characterize the Italian economy. To this end, a simple structural cointegrated VAR model, with quarterly data spanning the period 1979-1995, is built. We recover the structural shocks by imposing a set of identifying restrictions which aim to capture some features of a small open economy like Italy. Moreover, we avoid neutrality restrictions capable of obscuring potential permanent effects on unemployment of aggregate demand shocks and monetary policy intervention.

A widely held view maintains that in the 1980s and early 1990s Germany, the country that was the anchor of the EMS, was the 'conductor of the European orchestra'[1], and hence identifying the monetary policy rule for a small open economy like Italy necessarily requires the consideration of German variables. In line with the recent literature on monetary policy rules (e.g. Taylor,1999) it is assumed that the central bank uses a short-term interest rate as its instrument.

In a first stage we identify the long-run relationships which are suggested by cointegration analysis and theoretical arguments. The first important conclusion is that the Italian economy is characterized by a long-run tradeoff between inflation and unemployment. In a second stage we investigate the dynamic effects at different horizons on inflation and unemployment of three different kinds of structural disturbances: monetary policy shocks, demand shocks and supply shocks. Since we want to detect the potential presence of long-run effects of monetary policy and other demand shocks on unemployment, we do not impose *a-priori* low frequency restrictions, and identification is achieved by imposing

[1] 'conductor of the international orchestra' is the famous expression that Keynes used in order to characterize the leading role of the UK during the classic gold standard and the asymmetrical working of this system.

a set of contemporaneous, short-run restrictions on the cointegrated VAR. The second interesting conclusion we draw from the innovations accounting, is that although an important role is played by supply shocks, movements in the rate of unemployment, both at the business cycle frequencies and in the long run, are explained by all the three shocks.

The paper is organized as follows: Section 2 outlines the strategy followed in order to achieve the identification of the structural disturbances; section 3 proceeds to the estimation of the empirical model, selection of the cointegration rank and identification of the long-run relations; in section 4 we recover the structural parameters by imposing a set of contemporary restrictions on the estimated vector error-correction model and show the dynamic response of inflation and unemployment to structural disturbances. In the final part of the section we present a forecast-error variance decomposition in order to investigate the relative importance of the three shocks in composing the variability of the unemployment rate at different horizons; section 5 concludes.

2. The Approach of the Paper

Let us consider a vector X_t (5 x 1) of I(1) series including, respectively, three Italian variables, the rate of unemployment (U), the short-term interest rate (Int), the rate of inflation (Inf), and two German variables, the short-term interest rate (Intg), and the rate of inflation (Infg). Under the hypothesis of existence of long-run equilibrium relationships, i.e. cointegration, among the variables, the structural model has the following representation:

$$A\Gamma(L)\Delta X_t = A\mu - A\gamma^*\alpha^{*'}X_{t-1} + Ce_t \tag{1}$$

where Δ is the difference operator, L is the lag operator and μ is a constant vector. In general, considering a n-dimensional dynamic linear system, the rank, $r < n$, of the autoregressive total multipliers matrix $A(1) = \gamma\alpha'$, is given by the number of independent long-run relations. Moreover, γ is a (n x r) matrix of loadings and α is a (n x r) matrix of cointegrating vectors. It is well known that it is possible to offer a structural interpretation of these relations only by imposing some meaningful identifying restrictions. It is shown that exact identification of α^* is achieved by imposing r normalizations, one for each vector, and $r-1$

restrictions for each row, i.e. a total of r^2 independent restrictions. A and C are matrices of full rank, e_t is the vector of structural disturbances with $E(e_t) = 0$ and contains orthonormal variables, i.e. $E(e_t e_t') = I$.

Contemporaneous effects of innovations on the observable variables included in the vector X_t are described by the matrix C, whereas instantaneous interactions among endogenous variables are captured by the matrix A.

The reduced form associated with the structural model (1) is given by:

$$\Gamma(L)\Delta X_t = \mu - \gamma\alpha' X_{t-1} + \epsilon_t \tag{2}$$

where ϵ_t is the (5×1) vector of disturbances such that $E(\epsilon_t) = 0$ and $E(\epsilon_t \epsilon_t') = \Sigma_\epsilon$. Johansen (1991) has shown that the reduced-form Wold representation of (2) is given by:

$$\Delta X_t = \rho + B(L)\epsilon_t \tag{3}$$

where: (i) $\rho = B(1)\mu$ (ii) $B(1) = \alpha_\perp \Phi \gamma_\perp'$. $\gamma_\perp$ and $\alpha_\perp$ are, respectively, the orthogonal complements to the matrix of error correction coefficients and the matrix of cointegration vectors, i.e. $\alpha'\alpha_\perp = 0$, $\gamma'\gamma_\perp = 0$; (iii) $\Phi = (\gamma_\perp' \Psi \alpha_\perp)^{-1}$, where Ψ is the derivative of $\Psi(z)$, the characteristic polynomial of model (2), for $z = 1$.

The structural Vector Moving Average representation is:

$$\Delta X_t = \rho + H(L)e_t \tag{4}$$

where: $H(0) = A^{-1}C$, and $H(L) = B(L)A^{-1}C$.

Equations (1) and (2) imply the following set of linear relations linking ϵ_t, the vector of error terms, and e_t, the vector of structural innovations:

$$A\epsilon_t = Ce_t \tag{5}$$

From (5) we obtain:

$$A\epsilon_t\epsilon_t'A' = Ce_te_t'C' \tag{6}$$

and, by taking expectations, we have:

$$A\Sigma_\epsilon A' = CC' \tag{7}$$

This equation implies a set of $n(n+1)/2$ non-linear restrictions on the parameters of the A and C matrices. Since identification requires $n^2 + n^2$ restrictions, there are $2n^2 - n(n+1)/2$ free elements.

Notice that this kind of structural VAR allows the instantaneous interaction among the endogenous variables to be modelled and, at the same time, it makes it possible to model the impact effect of the orthonormal disturbances affecting the system. As stressed by Amisano and Giannini (1997) this represents the most general parameterisation since it is usual, in the structural VAR framework, to choose A to be the identity matrix or C to be a diagonal matrix.

Let us now summarize the method followed in this paper in order to identify the structural model. The first step of the approach consists in the estimation of reduced form (2). The second step, given a selected cointegration rank, attains the identification of the long-run relationships. The final step consists in the specification of a set of identifying restrictions on A and C, and in the characterization of the dynamic effects of structural shocks.

It is important to notice that, although we recover the structural disturbances affecting the economic system by considering cointegrating relationships, we do not impose *a-priori* long-run neutrality effects of some shocks. Instead, we impose a set of contemporaneous restrictions essentially based on the idea that, within the quarter, changes in the endogenous variables do not have effects on inflation and unemployment. As emphasized by Mankiw (2001) there is a wide agreement about the fact that demand shocks have a gradual and delayed effect on inflation. Moreover, it is well known that unemployment and labor market variables lag with respect to economic activity and, in general, show a slow reaction to a change in the economic conditions. As far as the monetary policy shock is concerned, we take into account that for a small open economy it is not possible to conduct a completely independent monetary policy. Hence, we

assume that the central bank set the short-term interest rate after observing the current German short-term interest rate.

The approach based on contemporaneous restrictions in VAR models was pioneered by Bernanke (1986), Blanchard and Watson (1986) and Sims (1986). It represents an important point of departure with respect to the recursive scheme, based on Cholesky decomposition[2] as in Sims (1980). Another important application of this methodology has been proposed in Blanchard (1989). Blanchard and Quah (1989) proposed, instead, an alternative identification strategy. They assumed a difference-stationary process for real output and imposed restrictions at frequency zero advocating a class of economic models which suggest long-run neutrality. In particular, they assume that demand disturbances have only a transitory effect on the level of output. King, Plosser, Stock and Watson (1991) extended the Blanchard-Quah model to the cointegration case[3]. A recent survey of methods that identify permanent and transitory shocks in cointegrated systems is provided by Levtchenkova, Pagan and Robertson (1998).

3. Estimation

The period of estimation, with quarterly data, is 1979:1-1995:4. We specify a five-dimensional VAR with $X_t = [U, Int, Inf, Intg, Infg]$ where U, Int and Inf are, respectively, the Italian unemployment rate, the short-term interest rate and the annualized rate of inflation measured by the consumer price index. Intg and Infg are, respectively, the German short-term interest rate and the annualized rate of inflation[4].

The individual series included in X_t behave as if they were I(1) processes[5]. In particular, we interpret the potential presence of a unit root in the rate of

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[2] The Cholesky decomposition is usual labelled as "atheoretical identification" whereas the approach based on contemporaneous restrictions is labelled as "structural VAR". In our opinion, this distinction is misleading since both procedures enable the structural disturbances to be recovered by advocating some more or less plausible economic scheme, whether recursive or not.

[3] A systematic framework for analyzing the different types of models proposed in structural VAR literature is developed in Amisano and Giannini (1997).

[4] The data are from OECD, Main Economic Indicators. As for short-term interest rates, int is the three month interbank rate and intg is the three month Frankfurt Interbank Offered Rate. Infg, the German annualized rate of inflation, is measured by the consumer price index and U is the standardized unemployment rate.

[5] Of course, the usual battery of unit root tests was conducted and the results (not reported) show that all series can be represented as difference-stationary processes. Nevertheless, it is well known that any such test has arbitrarily low power as against a sufficiently close alternative.

unemployment as due to economic mechanisms underlying the dynamic process of unemployment which lead to highly persistent effects of demand and supply shocks.

For cointegrated systems, Reimers (1993) suggests using the Hannan–Quinn criterion for the selection of lag length. Accordingly, a VAR model was specified with one lag. Moreover, on the basis of Johansen's (1992) trace test, at the 2.5 percent level, a cointegration rank of two was selected. Hence, two independent long-run relations were identified.

Insert Table 1 about here

In a first stage we impose two restrictions on each cointegrating vector, i.e. we start with a just identified long-run structure. The matrix of cointegrating vectors, α_0', has the form:

$$\alpha_0' = \begin{pmatrix} 1 & 0 & \alpha_{13} & \alpha_{14} & \alpha_{15} \\ 0 & 1 & \alpha_{23} & \alpha_{24} & \alpha_{25} \end{pmatrix}$$

As for the first cointegrating vector, since our aim is to investigate a possible long-run relationship between inflation and unemployment, we impose two additional restrictions: $\alpha_{14} = \alpha_{15} = 0$. If we test for such overidentifying restrictions, the hypothesis of a long-run Phillips tradeoff may not be rejected (see table 2).

As far as the second relation is concerned, economic theory suggests that, in the long run, discrepancies in national and foreign nominal interest rates should reflect differentials in the respective rates of inflation. This conclusion is an implication of the relative Purchasing Power Parity (PPP) or, more precisely, it descends from the joint consideration of PPP and Uncovered Interest Parity (UIP). Hence, we also tested the following restrictions: $\alpha_{23} = \alpha_{24} = -1; \alpha_{25} = 1$. These restrictions are clearly rejected by data and the final long-run identified structure (see table 3) is expressed by the following matrix of cointegrating vectors:

$$\alpha' * = \begin{pmatrix} 1 & 0 & \alpha_{13} & 0 & 0 \\ 0 & 1 & -1 & \alpha_{24} & \alpha_{25} \end{pmatrix}$$

It is important to notice that these results, as a whole, are consistent with

the idea that nominal shocks have very persistent effects on real variables. This clearly shows up in the first long-run relationship which establishes a long-run tradeoff between inflation and unemployment. But, if monetary and other nominal shocks have long-lasting effects on the real side, then it follows that PPP (or UIP) does not hold.

Our findings are thus consistent with the existence of a non-vertical long-run Phillips curve. Weber (1994), building on a previous work by King and Watson (1992), estimates a bivariate VAR model including changes in inflation and unemployment and, after imposing a set of identifying restrictions, concludes that for six of the G7 economies the hypothesis of a vertical long-run Phillips curve cannot be rejected. The exception is represented by Italy where, in effect, this hypothesis is rejected. In his comment on Weber's paper, Canova (1994) points out that (i) in general, a bivariate framework raises questions since useful information is thrown away unless the underlying economic system is recursive and inflation and unemployment are in the upper part of the recursive system; (ii) once the variables are assumed to be I(1), a natural way of investigating long-run relations is to test for cointegration. Moreover, Canova observes that the tests presented by Weber are inefficient in the presence of cointegration.

It should be added that the bivariate approach, employed by Weber, fails to consider the nature of a small open economy for countries like Italy.

The set of overidentifying restrictions imposed on the second cointegrating vector was clearly rejected (see table 2). Note that it is not possible to assess whether this rejection is due to failure of PPP or UIP (or both). A recent survey of the literature on testing PPP is offered in Rogoff (1996). According to the author, one possible explanation for the purchasing power parity puzzle rests on the persistence of monetary shocks on the real economy in the presence of sticky nominal wages and prices[6]. Giovannini (1995) has emphasized that during the period 1979-1992 PPP did not materialize in Europe since data show a clear trend in nominal exchange rates of France, Italy and Spain with respect to Germany despite the process of convergence of inflation differentials[7]. Moreover, as the author stresses, Italy maintained restrictions on capital account transactions for the first part of the 1980s and these restrictions were gradually removed only start-

[6] Rogoff draws attention to the fact that consensus estimates show a tendency to convergence toward PPP in the very long run. Hence, our rejection of this hypothesis could depend on the sample selected, which spans a period of about 20 years. It is no accident that the terms "persistent" and "permanent" are used interchangeably throughout this paper.

[7] Indeed, as regards the Italian inflation differential, it decreased from a peak of 16 percent reached in 1980 to virtually zero in 1983. Yet convergence slowed at the end of 1980s when the inflation differential, relative to consumer price index, seemed to stabilize around 4 percent.

ing from 1987. In particular, the liberalization of all major financial transactions was achieved in 1990. Of course, from the point of view of our investigation, this adds another possible reason for the failure of convergence of Italian and German interest rates we found in the data.

Given the selected long-run structure, one might wonder if alternative and economically plausible long-run equilibria could have been recovered. Hence, in order to investigate the robustness of our conclusions, we tested for the possibility that other long-run equilibrium relations were contained in the cointegration space and, as a consequence, could have legitimately been selected. In particular, we evaluated two additional relations:

(i) Since Italy is a small open economy, it should not be *a-priori* excluded the existence of a relation between German and Italian real variables. Thus, given the initial just-identified structure, we then tested the restrictions: $\alpha_{14} = -\alpha_{15}$ and $\alpha_{13} = 0$. This amounts to testing for the presence of a long-run equilibrium relation between Italian unemployment and the German real interest rate. As shown in table 4, at the conventional level, this set of restrictions may be rejected.

(ii) We also explored the possibility of a long-run equilibrium relation linking the short-term domestic nominal interest rate to domestic inflation and to German real rate. More precisely, by restricting: $\alpha_{24} = -1$ and $\alpha_{25} = 1$, we aimed to testing for the possibility of a long-run behaviour of Italian monetary policy influenced by the German variables and, moreover, oriented to a tight control of domestic inflation[8]. The results show that also this equilibrium relation is not contained in the cointegration space (see table 4).

Thus, we conclude that while the rejection of the hypothesis of long-run monetary neutrality is the main result of this section, the identified long-run structure seems to obtain some support in robustness.

Insert Table 2 about here

Insert Table 3 about here

Insert Table 4 about here

[8] In this context we avoided imposing restrictions on the domestic inflation coefficient, α_{23}. The estimation of the long-run parameters shows a value for the coefficient α_{23} less than one. This result might reveal that the conduct of Italian monetary policy was characterized by overreactions in the presence of undesidered movements in inflation. Yet notice that, as a whole, the existence of a long-run monetary policy relation is rejected.

4. Identification of Structural Disturbances and Simulation Analysis

This section is devoted to specifying the identifying restrictions which allow the structural disturbances to be recovered. After recovering these disturbances, we proceed with the simulation analysis and show the dynamic effects of the structural shocks on inflation and unemployment.

Recall that ϵ_t, the vector of error terms, and e_t, the vector of structural innovations, are related by: $A\epsilon_t = Ce_t$. We selected the following contemporaneous structure:

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & a_{23} & a_{24} & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & a_{45} \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \epsilon_u \\ \epsilon_{int} \\ \epsilon_{inf} \\ \epsilon_{intg} \\ \epsilon_{infg} \end{pmatrix} = \begin{pmatrix} c_{11} & c_{12} & 0 & 0 & 0 \\ 0 & c_{22} & 0 & 0 & 0 \\ c_{31} & 0 & c_{33} & 0 & 0 \\ 0 & 0 & 0 & c_{44} & 0 \\ 0 & 0 & 0 & 0 & c_{55} \end{pmatrix} \begin{pmatrix} e_d \\ e_{mp} \\ e_s \\ e_{mpg} \\ e_{dg} \end{pmatrix} \tag{8}$$

The demand shock is identified by assuming that unemployment is contemporaneously exogenous to other variables. Note that a direct effect of monetary policy shocks on unemployment is allowed for. It is worth pointing out that these short-run restrictions leave room for the possibility of long-run effects on unemployment of monetary policy and other demand shocks.

There has recently been a certain convergence among researchers on the fact that the central bank pursues monetary policy by using as its instrument the short-term interest rate (e.g. Taylor, 1999). In accordance with this view, we assume that the short-term interest rate measures the stance of monetary policy. The reaction function of the Italian monetary authority is built on the assumption that the interest rate is set in relation to the current value of inflation and the German short-term interest rate. That is, the central bank of a small open economy like Italy, given the possibility of capital account transactions, cannot conduct an independent monetary policy. As far as the German short-term interest rate is concerned, we assume that it is set after observing the current value of domestic inflation. Moreover, we assume that Italian variables do not contemporaneously affect both the German variables.

Innovations in the rate of inflation are attributed to supply innovations. Nevertheless, we allow a direct effect on inflation of demand innovations.

Thus we assume that: (i) within the quarter the endogenous variables do not exert effects on the macro variables, *i.e.* on inflation and unemployment;

(ii) the exogenous policy shock may have a contemporaneous effect on unemployment. Indeed, although the assumption of no contemporaneous interaction between monetary policy variables and macro variables is widely adopted in the literature, as stressed by Bernanke and Mihov (1998) it is more difficult to justify the identifying assumption of no contemporaneous feedback from policy variables to the economic system at the quarterly frequency.

In table 5 estimates of the A and C parameters are reported together with the associated standard errors. All the estimated coefficients are significant at the conventional level, excepting c_{31}.

Insert Table 5 about here

Figures 1-6 plot the impulse-response functions of inflation and unemployment to the supply, monetary policy and demand shocks with the 90 per cent confidence bounds[9]. The dynamic effects of supply innovations show that unemployment increases in the current quarter and thereafter the size of this increase reduces. Such an adverse effect of a positive supply shock turns out to be permanent, since unemployment does not return to its initial value. As emphasized by Blanchard (1989), some models predict that an increase in productivity might provoke an increase in unemployment in the short run, owing to shortage of aggregate demand in relation to the pace of technological change[10]. The long-run effects rest on the various channels studied by the literature on hysteresis and discussed at length in Blanchard and Katz (1997). A potentially interesting one is the following: if a productivity shock maintains unemployment high for many quarters this provokes an increase in the proportion of long-term unemployed who may lose skills. As a consequence, their effect on bargaining decreases and the unemployment rate does not show any tendency to converge to the previous level.

As expected, inflation moves in the opposite direction to supply shocks. Notice that, although the contemporaneous effect is insignificant it tends to increase over time and induces a permanent decrease in the rate of inflation.

A monetary policy shock, i.e. an unexpected movement in the short-term interest rate, provokes a movement of unemployment in the same direction and

[9] These asymptotic confidence bounds were obtained by following the analytical formulae developed in Amisano and Giannini (1997).

[10] For the US economy in the period 1965-1986, Blanchard (1989) shows that unemployment is higher than normal for 6 quarters in response to a positive supply shock and returns slowly to its normal level.

the effect of this adverse monetary shock, however small in amplitude, does not show any tendency to revert over time. As for inflation, recall that our identifying restrictions impose the absence of contemporaneous effects of monetary policy shocks. The impulse-response function shows that inflation reduces after a monetary tightening and, in our opinion, this is undoubtedly an important result. For, although largely expected on an *a-priori* ground, it gives additional plausibility to the identification scheme adopted in this paper. It is well known that a common finding of many VAR studies published in the late 1980s and early 1990s was the temporary increase of inflation in response to a monetary tightening. Of course, this puzzling result represented an unattractive feature of the VAR approach. In order to avoid this paradoxical result, Sims (1992) suggested the inclusion of present and past values of the commodity price index[11] in the information set of the policy makers, since this variable is a leading indicator of future inflation. Nevertheless, the results obtained in this paper seem to show that the price puzzle can be avoided through the inclusion in the information set of the policy makers of variables, such as the foreign interest rate, which allow us to take into account the impossibility to conduct an independent monetary policy in the context of small open economies.

As far as demand shocks are concerned, we observe a reduction of unemployment, both in the short and long run. After 7-8 quarters the reduction in unemployment reaches a floor and thereafter persists over time. The demand shock has a permanent effect on the rate of inflation. An increase in the aggregate demand induces its major effect on inflation in the first year and thereafter the effect steadily decreases.

Insert Figures 1-6 about here

The picture shown by the impulse-response functions gives reasonable support to an interpretation of the evolution of the Italian economy in the period 1979-1995 as driven by a mixture of shocks, on the supply and demand side, which had permanent effects on the rate of unemployment. Our results allow a natural-rate model for Italian unemployment to be rejected. They also jeopardize an interpretation excessively skewed towards rigidity in the labour market since we find that monetary policy and other adverse shocks to aggregate demand contributed to the rise of the unemployment rate.

[11] A different strategy has recently been proposed by Uhlig (2005). It consists in imposing sign restrictions on the impulse response functions consistent with the traditional view on the effects of monetary policy

We complete the innovations accounting by presenting (see table 6) the variance decomposition, at different horizons, concerning the rate of unemployment. This is an important complement to impulse-response analysis since it allows the relative importance of the different identified shocks to be evaluated.

Although with declining importance approaching low frequencies, the supply shock plays a preminent role at each horizon. Notice that it explains almost all of variability at high frequencies, but it is worth recalling that this is mainly due to the assumption that unemployment is contemporaneously exogenous to the other variables. Demand shocks and monetary policy shocks explain about 25 percent of variability of the unemployment rate both at business cycle frequencies and in the long run. Undoubtedly, unexpected changes in monetary policy seem to have a less important role[12].

Insert Table 6 about here

In a recent study, by using dynamic panel data models, Karanassou *et al.* (2003) find that for a panel of EU countries there is a long-run inflation-unemployment tradeoff. The authors argue that both theoretical and empirical investigations call for an extensive rethinking of the role of monetary policy. In particular, they present a theoretical model of the Phillips curve in which the interaction between money supply growth and nominal frictions leads to a downward sloping long-run Phillips curve.

In the remainder of this section we briefly discuss the results obtained by some other studies which have investigated the fluctuations in the Italian rate of unemployment by using structural VARs. In a recent study Balmaseda, Dolado and Lopez-Salido (2000) estimate, for a sample of 16 OECD countries, a three variable system including output growth, real wage growth and the unemployment rate. They impose a set of long-run identifying restrictions stemming from an insider-outsider framework and recover three structural shocks hitting the labour market: productivity, labor supply and aggregate demand shocks. Their main findings are that demand shocks reveal persistent effects on unemployment in most countries and that an approach based on the partial hysteresis interpretation, i.e. unemployment taken as an I(0) process, yields reasonable results. Moreover, they find that unemployment fluctuations are dominated by demand

[12] Nevertheless, as emphasized by some studies (*e.g.* Christiano *et al.* (1999)), attributing a small part of variation in unemployment to monetary policy shocks does not automatically lead one to conclude that such a limited role is also played by the systematic component of monetary policy in explaining the evolution of unemployment.

shocks at the business cycle frequencies whereas labour supply and productivity shocks dominate at lower frequencies. The authors observe that in some economies like Italy and Spain, which they label as "sclerotic economies", demand shocks have long-run effects on unemployment. The methodology adopted by Balmaseda *et al.* does not contemplate the possibility of long-run equilibrium relationships among the variables.

The latter were considered in Giannini *et al.* (1995) who applied the traditional "Keynesian" setting (cf. Blanchard, 1989) to the Italian economy for the period 1970-1990. The authors impose a set of contemporaneous restrictions on a cointegrated VAR model and find that demand shocks dominate output fluctuations in the short run but lead only to temporary decrease in the unemployment rate. As for real supply shocks, they exhibit small effects on nominal variable fluctuations. In this sense, the structural shocks identified produce results that are consistent with a traditional Keynesian description of economic fluctuations. Consistently with this traditional description, the estimated impulse-response functions do not display permanent effects of aggregate demand shocks. Moreover, it is worth noticing that the analysis is conducted in a closed economy framework.

The methodology poposed in King *et al.* (1991) has been applied to the Italian economy by Onofri, Paruolo and Salituro (1994). The authors build a model for the Italian economy founded on a natural-rate hypothesis and impose a set of long-run restrictions based on neutrality effects for real and nominal demand shocks. The main conclusion they draw is that the permanent supply shock makes the dominant contribution in explaining both the short-run and long-run movements in aggregate output.

We want to stress the main points of convergence as well as some important differences that characterize these researches on the Italian economy founded on structural VARs. The persistent effects of aggregate demand shocks on real variables and a dominant role which is attributed to supply shocks in explaining movements at low frequencies of real variables represent common conclusions of these investigations. Yet the results presented in this paper show the presence of short-run and long-run effects of monetary policy shocks in explaining unemployment which are often neglected. Furthermore, these structural disturbances are identified by taking into account the dominant role played by the German central bank in driving the monetary policy in Europe in the 1980s and early 1990s. We have also found, by using cointegration techniques, a long-run tradeoff between inflation and unemployment which contradicts the "natural-rate" of unemployment hypothesis underlying many econometric investigations. Finally, the impulse-response functions have shown that the long-run relationships present

bidirectional causality, in the sense that both demand and supply shocks affect the two variables at low frequencies.

5. Conclusions

The rate of unemployment rose in most OECD countries in the 1980s. As stressed by Ball (1997), countries which experienced larger decrease in inflation and longer disinflationary periods had larger increases in unemployment. Ball argues that the central cause of this rise in unemployement was the tight monetary policy undertaken in most OECD countries in order to reduce inflation.

In this paper we have investigated the nexus between inflation and unemployment in the context of the Italian economy during the period 1979-1995, i.e. a period of prolonged disinflation. The task was accomplished by estimating a cointegrated VAR model on which a set of over-identifying contemporary restrictions was imposed. In particular, a monetary policy shock has been identified on the assumption that the central bank throughout this period was mainly concerned with control of the inflation rate and, more important, had to take into account the decisions of the German central bank regarding the short-term interest rate. In effect, we have tried to incorporate in the structural model the idea that for a small open economy it is not possible to conduct an independent monetary policy - at least, not completely independent. Our findings can be summarized as follows. It is not possible to reject the hypothesis of a long-run tradeoff between inflation and unemployment. Moreover, aggregate demand shocks and monetary policy shocks exert effects on the rate of unemployment both in the short and the long run. As for supply shocks, such as change in productivity or in labor force, they also play an important and indeed pre-eminent role in explaining movements in unemployment and inflation at all frequencies. These results do not support 'natural-rate' based models for the Italian economy but seem consistent, at least partially consistent, with a hysteretical interpretation of unemployment dynamics. The specific channels through which demand shocks have propagated very persistent effects on the real variables were not investigated in this paper and should be an objective for a future extension of this research.

Finally, it would be tempting to assert that expansionary aggregate demand policies could permanently reduce the rate of unemployment and indeed this is an implication of our results. Nevertheless, we believe that this conclusion is to be taken *cum grano salis*. For, there is at the moment no convincing proof that hysteresis also works in the opposite direction and it is our conviction that the results obtained with linear structural models need to be corroborated by

further evidence. Furthermore, we emphasize that aggregate demand policies should not (and cannot) be undertaken at single country level. On the other side, looking at the Euro area, we should pay closer attention to the experience of the US economy in the 1980s, when the strong recovery which followed the 1982 recession was magnified by loosening monetary policy and increasing public spending.

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I would like to thank Mario Forni, Andrea Ginzburg, Marco Lippi and Barbara Pistoresi for helpful comments and suggestions. I am also grateful to Miur (Italian Ministry of Education) for financial support (Cofin 2004: Dynamic Models in Macroeconomic Analysis).

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Table 1
Johansen's Cointegration Rank Test (Trace test)

H_0: rank	Statistic	97,5% c.v.
$r = 0$	133.58	71.80
$r \leq 1$	68.78	50.35
$r \leq 2$	31.54	32.56
$r \leq 3$	5.79	17.52
$r \leq 4$	0.67	4.95

Notes: Results for the period 1979:1 1995:4 are based on a reduced form model which includes Italian CPI inflation, Italian unemployment rate, Italian short-term interest rate, German CPI inflation and the German short-term interest rate.

Table 2

H_0: The Cointegration space contains		significance level
Long-run Phillips tradeoff	$\chi^2_{(2)} = 4.68$	0.0962
Relative PPP-UIP	$\chi^2_{(3)} = 12.97$	0.0047
Long-run Phillips tradeoff and relative PPP-UIP	$\chi^2_{(5)} = 46.69$	00000

Notes: Johansen's likelihood ratio test of restrictions on the cointegrating vector is distributed as a chi-squared with degrees of freedom equal to the number of restrictions tested.

Table 3
Identified long-run relationships (std.errors in brackets)

$$U_t = \underset{(0.0253)}{-0.304}\,Inf_t$$

$$Int_t = Inf_t + \underset{(0.99)}{7.56}\,Intg_t - \underset{(0.932)}{10.23}\,Infg_t$$

LR Test for over-identification :

$$\chi^2_{(3)} = 5.222, \text{ significance level} = 0.1562$$

Table 4
Robustness of the long-run identified structure: Testing for the presence of alternative long-run equilibrium relations.

H_0: The Cointegration space contains		significance level
Long-run relation between unemployment and German real rate	$\chi^2_{(2)} = 6.197$	0.045
Long-run monetary policy behaviour	$\chi^2_{(2)} = 10.95$	0.012

See notes to table 2.

Table 5

Contemporaneous coefficients in the structural model

	a_{23}	a_{24}	a_{45}	c_{11}	c_{12}
Coeff.	–0.159	-0.474	-0.134	0.296	0.082
S.E.	0.049	0.152	0.047	0.026	0.037

	c_{22}	c_{31}	c_{33}	c_{44}	c_{55}
Coeff.	0.956	0.095	2.406	0.702	1.855
S.E.	0.083	0.307	0.209	0.061	0.161

LR test for 5 over-identifying restrictions:
$\chi^2_{(5)} = 9.74974$, significance level = 0.08264

Table 6
Variance Decomposition: Unemployment Rate

Horizon: Quarters	Supply Shock	Demand Shock	Monetary Policy Shock
1	92	0	8
4	71	11	7
8	61	16	8
12	60	17	9
30	58	17	10

Notes. This table reports the decomposition of the variance of the forecast error of unemployment rate. For each identified shock are reported the share of the variance at different horizons which is ascrivible to the three shocks. See table 5 for details on the identifying restrictions imposed on the estimated VECM.

Impulse-Response Functions

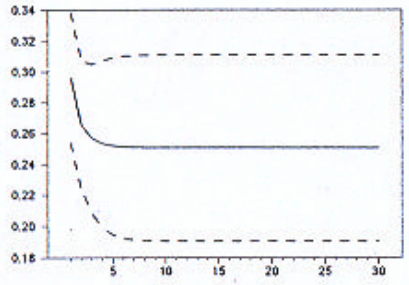

Figure 1. Response of U to a supply shock.

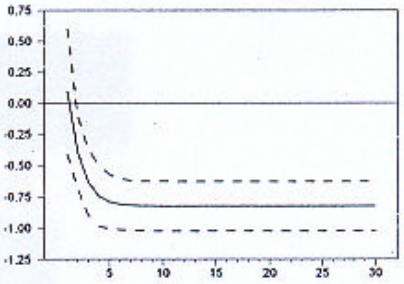

Figure 2. Response of Inf to a supply shock.

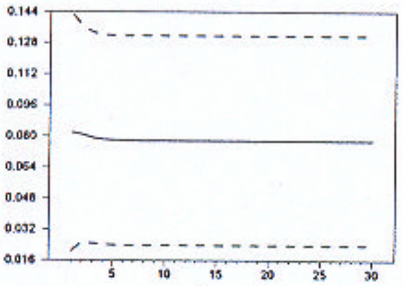

Figure 3. Response of U to a monetary policy shock.

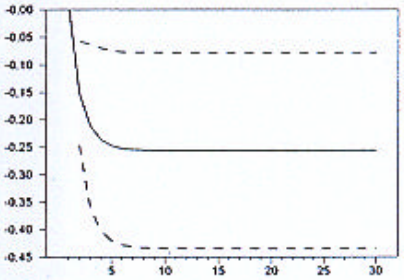

Figure 4. Response of Inf to a monetary policy shock.

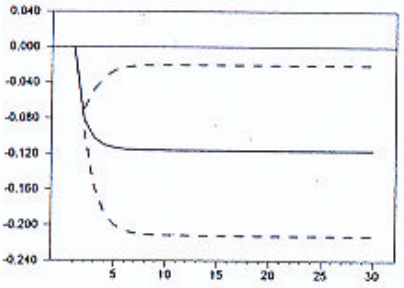

Figure 5. Response of U to a demand shock.

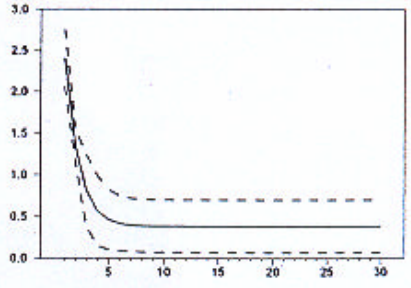

Figure 6. Response of Inf to a demand shock.