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Macroeconomic Implications of Near Rational Behavior: an Application to the Italian Phillips Curve

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Abstract - New-Keynesian macroeconomic models typically conclude that longrun unemployment gravitates around the NAIRU, regardless of the nominal inflation rate. Contrastingly, the model of Akerlof, Dickens and Perry (2000) (ADP) predicts that excessively low inflation may result in a situation where unemployment is high relative to the social optimum. This paper investigates whether ADP-type short- and long-run Phillips Curves may suit the Italian economy. Firstly we estimated a short-run non accelerationist Phillips curve (i.e. where the expected inflation coefficient depends on inflation and it is generally less than unit) on Italian post-war data. Based on these results, we then simulated the long-run Phillips Curve and ran robustness checks by using a rival cointegration approach. We have two main results. First, the Italian short-run Phillips curve is actually non-accelerationist. Second, our estimates indicate that in Italy a long-run trade-o¤ between inflation and unemployment cannot be ruled out at low and moderate inflation rates.

Keywords: Near-rationality; Non-accelerationist Phillips Curve; Natural rate of unemployment.

JEL classification: E24, E31, J41

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1 Introduction

The existing debate about the long-run Phillips Curve is essentially a debate about money non-neutrality. Macroeconomic theorists have always had great difficulties in admitting the existence of long-run money non-neutrality to core macroeconomics theory, even though the data generally suggest that monetary shocks leave a permanent scar on real variables (Mankiw, 2001). Here we want to show that such scars can be found also in Italian data.

In this work, we first perform a simple quantitative exercise: we estimate the model of Akerlof, Dickens, Perry (2000) (henceforth ADP) with Italian data, presenting our evidence for a short-run non-accelerationist Phillips Curve. As a further step and following Wyplosz (2001), we adopt a rival methodology to assess the presence of nonlinearities in the Italian long-run Phillips curve. Finally we compare the results of the two approaches and we draw our conclusions.

ADP's (2000) model assumes that as long as inflation is low, firms ignore or underweight inflation in setting efficiency wages. Furthermore, their Near Rational inattentiveness does not vanish in time but fades only with rising inflation. *Near Rationality*[1] of their behavior implies that even though the individual losses implied by this kind of behavior are only second order, the aggregate consequences are extremely relevant.The model has two main implications. First, the combination of near rational behavior and efficiency wages, results in a non-accelerationist short-run Phillips Curve, i.e. a Phillips Curve where the expected inflation coefficient is generally less than unity and it depends on inflation. Second, the long-run Phillips Curve is non vertical and becomes backward-bending at an intermediate inflation rate.

From the theoretical standpoint, many authors have come up with models challenging the standard NAIRU framework and obtaining a result of long-run money non-neutrality. As a consequence, in these models monetary policy can determine not only the volatility of real output and employment, but also their long-run time paths. According to Fontana and Palacio-Vera (2007) this literature can be divided in two main strands: path dependency models and market imperfections models. The former comprehends Demand Led Growth models (Setterfield, 1999, 2002; León-Ledesma and Thirlwall, 2002; McCombie et al., 2002), Hysteresis models (Blanchard et al., 1986; Franz, 1987; Ball, 1999) and Multiple Equilibria models (De Long and Summers, 1988; Diamond, 1982; Weitzman, 1982). The latter focuses on inserting some kind of rigidity in the functioning of the labor market, and it comprehends ADP's (2000) model among others.

There is a clear consensus on the fact that it is mainly nominal and real downward wage rigidities which cause monetary policy to affect the labor market performance, at least in the short-run. Nominal wage rigidities generally arise from resistance to nominal wage cuts. This resistance can be motivated by money illusion, fairness considerations, nominal minimum wages or nominal

[1] "Near rational behaviour is behaviour that is perhaps suboptimal but nevertheless imposes very small individual losses on its practitioners relative to the consequences of their first best policy"(Akerlof and Yellen, 1985b, p.825).

contracts (Keynes 1936; Slichter and Luedicke 1957; Tobin 1972; Akerlof, Dickens and Perry 1996 and 2000). Real wage rigidities have three main sources: real wage cuts can by prevented by efficiency wages (Shapiro and Stiglitz, 1984), by wage indexation (Gray, 1976; Fisher, 1977a), and by union bargaining (Holden, 1997 and 2004). Empirical studies show that the third source may be the main responsible for the cronically high unemployment rates in EU countries .

Under low inflation, such rigidity means that more workers than needed maintain their wage unchanged and fewer workers than needed experience wage cuts. This implies higher unemployment and some more inflation could facilitate real wage adjustments ("greasing the wheels" of the market) with consequent benefits in employment and output: this is what the literature calls *grease effect*[2] of inflation. On the other hand, there is also the sand effect of inflation, which refers to inflation affecting real price and wage adjustments in response to nominal shocks, hence misdirecting resources and lowering output below the potential. When inflation is low grease effects should prevail, while at higher rates sand effects are supposed to dominate. This means that on the side of inflation-unemployment dynamics, grease and sand effects could be responsible for nonlinearities in the PC. In this case, higher inflation does not ameliorate the problems associated with downward rigidity. Only higher productivity growth, by providing scope for higher growth in real wages, can reduce the unemployment caused by a real wage floor.

There are a number of studies suggesting that the long-run Phillips curve may not be vertical also in the empirical literature. In particular, several studies have tested the presence of nonlinearities in the Phillips curve, due to the grease and sand effects we referred above. To this purpose, evidence regarding European countries is provided by Groshen and Schweitzer (1997). Previously Bullard and Keating (1995) found a negative long-run response of output to a reduction in inflation in countries with low inflation. In the US, studies by King and Watson (1994) and Fair (2000) also suggest a long-run unemployment-inflation trade-off. Furthermore, evidence from ADP (1996) and (2000), and ADP and Fortin (2002), indicates that both American and Canadian data reject the traditional natural rate hypothesis against that of nonlinearity. However, attempts to apply the ADP model outside the United States and Canada are few and far from being exhaustive. The most in-depth study belongs to Lundborg and Sacklén (2003, 2006) and it regards the Swedish economy. In addition also Wysploz (2001) and Dickens (2001, commenting on Wysploz) proposed some preliminary estimates concerning France, Germany, Switzerland and the Netherlands. The point is that these studies produced some robust results only when applied to countries with centralized wage setting and with a tradition of low inflation, like Sweden and Germany.

This article aims at filling this research gap, by applying ADP's model to Italian data and cross-checking the results by using Wysplosz's (2001) atheo-

[2] The first who referred to grease and sand effects of inflation , was James Tobin (1978) in his Presidential address. By contrast Milton Friedman (1977) gave a contrasting interpretation of such effects. More recently Groshen and Schweitzer (1996, 1997) gave further contributions on this issue.

retical approach. We employed Italian quarterly data for the period 1960-2003 and we undertook the standard empirical procedure proposed by ADP. First, we estimated a short-run Phillips curve allowing for state-dependent slopes and intercepts. Second, we computed from the estimated parameters the numerical values for the long-run nonlinear Phillips curve and its key indicators. However, the literature has contested the validity of this procedure since long-run behavior and short-run deviations should theoretically be captured by a cointegration relationship. For this reason we also checked the robustness of our results following an approach similar to the one of Wyplosz (2001), with a cointegration interpretation.

Under the two specifications, we obtain reasonably strong evidence that the Italian short-run Phillips Curve is not accelerationist and that the coefficient on expected inflation varies with the inflation rate. In particular the state dependent area of our Phillips Curve suggests that at zero inflation at least 10 percent of price setters are taking inflation fully into account, while it takes extremely high inflation rates (almost 3-4 % quarterly) to turn all firms into rational actors. The long-run results are much more puzzling and they probably require further theoretical and empirical research. However, at this stage the estimates indicate that in Italy a long-run trade-off between inflation and unemployment exists. This supports the general result of the literature that the NAIRU model needs to be revised, especially for European countries where hysteresis effects may be very important. Nevertheless our estimate for the Italian lowest sustainable rate of inflation of 3-4% quarterly, casts some doubts on the ability of the model to tell a coherent story about unemployment at high rates of inflation. We conclude that real wage rigidities as well as other labor market problems should probably be integrated into this approach in order to obtain a better fit for European data.

The rest of the paper is organized as follows. Section 2 presents the main points of ADP's model, deriving both the short-run and the long-run Phillips Curves. Our methodology to apply ADP's model to Italian post-war data is described in section 3: the first part is devoted to ADP-type procedure, while the second contains the cointegrating system approach, along the lines of Wyplosz (2001). Section 4 draws some policy implications for Italy within the EU and offers some concluding remarks.

2 The ADP (2000) Model

2.1 price and wage setting behavior

This section is devoted to a discussion of the main theoretical points of ADP's (2000) model. As explained in the previous section, near rational behavior towards inflation expectations is supported by robust psychological evidence. We show that, in ADP's model, if firms and/or workers disregard inflation at low rates, the aggregate consequences will be relevant from a welfare point of view: wages will be set at a lower level than they should be with respect to nominal demand, and similarly for prices. The general result will be low unemployment at moderate inflation rates.

ADP assume a continuum of n monopolistically competitive firms, dividing up total aggregate demand according to the relative price for their respective good. Aggregate demand is of the simplest form, determined by a quantity theory equation with unit velocity of circulation:

$$Y = \frac{M}{p}$$

Where Y is real income, M is the money supply and $\overline{p}$ is the average price level in the economy. Each firm faces an individual demand function with constant elasticity β:

$$y_i^d = \frac{1}{n}\frac{M}{\overline{p}}\left(\frac{p_j}{\overline{p}}\right)^{-\beta}$$

The description of firms' wage setting behavior is quite simple: they set efficiency wages, minimizing unit labor costs. The rationale of this wage setting policy is that here firms cannot exactly measure workers' effort, and thus they must take into consideration the expected effort level when minimizing the labor cost per efficiency unit. For each firm the expected productivity or effort level will be a concave function of the relative wage, and a positive function of unemployment:

$$e_j^e = -A + B\left(\frac{w_j}{w_j^R}\right)^{\alpha} + Cu \tag{1}$$

with $0 < \alpha < 1$ and $A, B, C > 0$

Here the key variable for firms is the relative wage $\left(w_j/w_j^R\right)$, i.e. the nominal wage paid by firm j compared to the reference wage of workers in that firm.

The reference wage gives workers the perception of the wages paid to other workers in other industries, and thus it represents a benchmark concerning outside opportunities. In this context, workers' productivity depends on their morale, which is assumed to increase as nominal wages increase relative to the reference wage.

Once again the reference wage perceived by workers is not exactly measurable by the firm, which has to guess it following a simple rule of thumb. Rational firms ($j = r$) will set wages for the next period after having projected the effects of expected inflation on the reference wage of their workers:

$$w_r^R = \overline{w}_{-1}(1 + \pi^e) \tag{2}$$

Where $\overline{w}_{-1}$is given, and represents last period average wage, in the light of expected inflation. By contrast near rational firms ($j = nr$) will underweight or ignore some part of future expected inflation:

$$w_{nr}^R = \overline{w}_{-1}(1 + \gamma\pi^e) \tag{3}$$

Where $0 < \gamma < 1$ can be seen as the 'degree of rationality' of firms. In what follows we assume for simplicity that near rational firms ignore inflation ($\gamma = 0$). It can be shown that the qualitative results of the model do not change if only a fraction of inflation is incorporated ($0 < \gamma < 1$) . The efficiency wages set by rational and near rational firms will be set minimizing the labor cost per expected efficiency unit, and they will evidently differ due to the reference wage considered. Each firm will solve the following minimization problem:

$$\underset{w_j}{Min} \left(\frac{w_j}{e_j} \right) \text{ subject to (1)}$$

The first order condition of this problem is:

$$\left(\alpha \frac{B}{w_R^{\alpha}} w_j^{\alpha} \right) - \left[-A + B \left(\frac{w_j}{w_j^R} \right)^{\alpha} + Cu \right] = 0$$

It is easy to see that when the Solow condition is satisfied, i.e. the elasticity of expected effort with respect to the wage rate equals unity, the optimal wage will be set as a multiple of the respective reference wage. More precisely it will be:

$$w_j = \left(\frac{A - Cu}{B(1-\alpha)} \right)^{1/\alpha} w_j^R \quad \text{for } j = r, nr \tag{4}$$

The reference wage is therefore lower in the near rational sector. Furthermore, real wages will also be lower in the near rational sector, and employment will be higher as a result. An interesting property of this model is that although wages set by rational and near rational firms are different over time, the difference does not accumulate because they are both multiples of w_j^R. With steady inflation, the reference wage will rise for both types of firms but it will always stand in the ratio $z = (1 + \gamma\pi^e / 1 + \pi^e)$. As a consequence of this, the difference between the expected reference wages in the two sectors will be small and unimportant at low rates of inflation.

The key element in this model can be found in the optimal effort level expected to be supplied by workers of firm type j, which can be found by substituting either (2) or (3) in (4). A graphical illustration of the supplied effort level in equilibrium is very useful in order to fully appreciate its importance. As shown in figure 1, assuming a moderate rate of inflation, near rational firms ignore inflation and overestimate productivity, expecting the effort level $e\prime$; for this reason they think they are positioned at point B and set their wage at level w_{nr}. In reality, near rational firms will be positioned at point C, where they get a much lower effort level, e_{nr}. On the contrary, rational firms, which are not plagued by money illusion, are positioned at point A. They correctly guess the reference wage of their workers and thus their workers' productivity. Paying wage w_r they will obtain exactly the expected productivity $e\prime$. Near rational behavior in expectations formation is therefore translated into a failure to minimize unit labor costs, as the wage w_{nr} satisfies the Solow condition only with respect to expected effort and not with respect to the actual one. As a consequence, rational firms will always have slightly higher profits than near rational ones: the unit labor cost per efficiency unit at point C (the inverse of the ratio e_{nr}/w_{nr}) will always be greater than the unit labor cost at point A (the inverse of the ratio e_r/w_r). However, If inflation is below a certain level, such non-maximizing behavior can remain in place in the long-run, since profit losses implied by these errors are very small and do not accumulate over time.

-Figure 1 about here-

The profits for both types of firms Π_j are described by equation (5) while the profit maximizing price will simply consist in a constant mark up over unit labor costs, as equation (6) shows.

$$\Pi_j = \frac{1}{n}\frac{M}{\overline{p}}\left[p_j\left(\frac{p_j}{p}\right)^{-\beta} - \left(\frac{p_j}{p}\right)^{-\beta}\frac{w_j}{e_j^e}\right] \tag{5}$$

$$p_j^* = \frac{\beta}{\beta-1}\left(\frac{w_j}{e_j^e}\right) \tag{6}$$

Now we define a crucial element for the concept of near rationality, that is to say the profit loss that near rational firms face as a consequence of their failure to incorporate expected inflation in workers' reference wage. We call L the relative increase in profits that a near rational firm could make by becoming rational:

$$L = \frac{\Pi_r - \Pi_{nr}}{\Pi_r} = 1 - z^{1-\beta}\left[\beta - (\beta-1)\frac{\alpha}{z^{\alpha} - 1 + \alpha}\right] \tag{7}$$

Equation (7) carries two fundamental properties of the model. First, when inflation is zero,$z = 1$ and thus near rational behavior produces no losses. Moreover when inflation is near zero, these losses will also continue to be small, as $\frac{dL}{d\pi}|_{\pi=0} = 0$. By means of equation (7) it is also possible to calculate losses due to near rational behavior at different rates of inflation, and for different values of the structural parameters α and β. In their article ADP show that, as long as yearly inflation is below 5%, the maximum share of profit loss due to near rational behavior is roughly 3.5%.[3]

Finally the loss function (7) is useful to calculate the fraction of near rational price-setters in the economy at a given inflation rate. Psychological studies[4]

[3] It was estimated (see Leonard (1987), Davis, Haltiwanger and Schuh (1996))that a typical American firm annually experiences demand shocks that cause it to adjust its size up or down by 10%, and failing to adjust to such a shock would cost the firm 10% of its profits. Considering such a benchmark, ADPconclude that a profit loss of 3.5% seems to be far down in the list of dangerous things for a typical firm.

[4] See Shiller (1997) among others.

show that as long as inflation is below a certain threshold of salience, it is not perceived as costly to economic agents. As a consequence, ADP assume that firms are willing to tolerate losses only up to a given threshold ε before switching to fully rational behavior. The hypothesis is that there are different thresholds, normally distributed with mean μ_ε and standard deviation σ_ε. Accordingly, for a given level of expected inflation π^e ,the fraction of near rational price setters will be:

$$1 - \Phi \left\{ \frac{1 - z^{1-\beta} \left[\beta - (\beta - 1) \frac{\alpha}{z^\alpha - 1 + \alpha} \right] - \mu_\varepsilon}{\sigma_\varepsilon} \right\} \tag{8}$$

Where Φ is the standard normal cumulative distribution, and it is an increasing function of π^e, via $z = (1 + \gamma\pi^e/1 + \pi^e)$.

2.2 Derivation of the short-run and long-run Phillips Curve

Up to this point the model consists of nine equations, two equations determined by (1), equations (2) and (3) , two equations each of (4) and (6), determining eight unknowns $w_{nr}^R, w_r^R, w_{nr}^*, w_r^*, p_{nr}^*, p_r^*, e_{nr}^e, e_r^e$. In order to close the model and derive the Phillips curve, we now need an equation for the aggregate price level $\overline{p}$, as a weighted average of prices set in this economy:

$$\overline{p} = \Phi p_r^* + (1 - \Phi) p_{nr}^*$$

With the corresponding expressions at $t - 1$ we obtain the short-run price Phillips curve as:

$$(1 + \pi_t) = \left(\frac{A - Cu_t}{A - Cu_{t-1}} \right)^{\frac{1-\alpha}{\alpha}} \left(\frac{A - Cu_{t-1}}{B(1-\alpha)} \right)^{\frac{1}{\alpha}} (1 + \Phi\pi_t^e)$$

Taking logarithms on both sides and making the following approximations:

$$\log(1 + \pi_t) \simeq \pi_t, \log(1 + \Phi\pi_t^e) \simeq \Phi\pi_t^e$$

$$\log \left(\frac{A - Cu_t}{A - Cu_{t-1}} \right)^{\frac{1-\alpha}{\alpha}} + \log \left(\frac{A - Cu_{t-1}}{B(1-\alpha)} \right)^{\frac{1}{\alpha}} \simeq d - cu_t + g\Delta u_t^e$$

we finally obtain the following short-run Phillips curve:[5]

$$\pi_t = d - cu_t + \Phi\pi_t^e + g\Delta u_t^e \tag{9}$$

Equation (9) is only a slightly modified form of the standard inflation augmented short-run Phillips curve, the only relevant difference is that here only a fraction Φ of future expected inflation is taken into account. Notice that here

[5] A slightly different form of the short-run Phillips curve is obtained when agents only underweight inflation ($\gamma \neq 0$): $\pi_t = d - cu_t + (1-f)\pi_t^e + (1-f)h\Delta u_t^e$ where $h = -C/B(1-\alpha)$ and $f = (1-\gamma)(1-\Phi)$.

Φ is not a simple parameter, but it represents the share of rational price setters in the economy and it varies with the inflation rate. For low or modest inflation rates, Φ will be positive but small, as many agents will be ignoring inflation in price and wage setting. As inflation rises up to the salient level, an increasing number of firms will become rational: Φ=1 is an asymptote for very high inflation rates. Figure 2 gives a graphical representation of equation (9) in the simplified case in which $d = 0$ and $\Delta u_t^e = 0$, for different levels of the inflation rate. As expected, the Phillips curve intercept gradually shifts upwards as the inflation rate increases. At high inflation all expected inflation is incorporated.

-Figure 2 about here-

A surprising feature of this model emerges when one considers the long-run behavior of inflation and unemployment. From the formal point of view the derivation of the long-run Phillips curve is straightforward. Assuming $\pi = \pi^e$ and being constant and known the unemployment rate, equation (9) becomes:

$$\pi_t = \frac{c}{1-\Phi}(u^n - u) \tag{10}$$

where $u^n = \frac{d}{c}$.

In this framework the natural rate of unemployment u^n is not the usual NAIRU, but it represents the unemployment rate that occurs when all firms are rational. It can be derived simply by imposing $\pi = 0$ on equation (10), since disregarding zero inflation is equivalent to fully rational behavior. Figure 3 clearly shows that the long-run Phillips curve (10) will not generally be vertical.

-Figure 3 about here-

The interesting macroeconomic implication of near rational neglect of inflation, is that the long-run Phillips Curve is no longer vertical, but backward bending. The relationship becomes non-monotonous due to the presence of the coefficient Φ, which varies with the inflation rate.

At both zero and very high inflation, ignoring inflation is either fully rational or excessively costly, for this reason in both cases the unemployment rate is close to its natural level: in the former case because even near rational firms are fully rational disregarding zero inflation, in the latter case because Φ is close to one, and all price setters have become completely rational. By contrast, at low inflation near rationality kicks in: losses from ignoring inflation are quite small, Φ is always positive but smaller than one, and many near-rational firms set a wage that is lower than the wage set by fully rational firms. As this implies a lower average wage compared to the wage in an economy where all firms always behave rationally, unemployment will be lower than the natural rate. This explains a long-run negative trade-off between inflation and unemployment at low inflation rates. However as inflation rises, there are two opposing forces at work, the *grease* and *sand effects* we mentioned earlier. While near rational firms ignore higher inflation rates, which tends to further reduce unemployment (grease effect), it also becomes increasingly costly for firms to behave this way.

More and more firms switch to full rationality ($\Phi \longrightarrow 1$) and hence set higher wages, which in turn tends to increase unemployment (sand effect). In this instance, the *Lowest Sustainable Unemployment Rate of Inflation (LSURI)* plays a fundamental role.

Below the LSURI, the grease effect dominates, and unemployment decreases to its lowest sustainable level, i.e. the *lowest sustainable unemployment rate (LSUR)*. Above the LSURI, the sand effect prevails, and the share of rational firms increases to such an extent that unemployment starts to increase. This explains the existence of the upward sloping segment of the long-run Phillips Curve at high inflation rates. The process continues until inflation has reached the level at which all firms have switched to fully rational behavior. At this level of inflation and above, unemployment is again at its natural rate and the Phillips Curve becomes vertical.

It is worth explaining the difference between an LSURI approach, and a NAIRU or natural rate approach to inflation. In the NAIRU framework, a short-run standpoint is assumed, and inflation is considered as an indicator of the state of economic equilibrium. If inflation is increasing, it means that unemployment is below the NAIRU: the economy is over-heating, and the monetary authority should enact contractionary monetary policy. The reverse holds if inflation is falling. By contrast in an LSURI framework, even if we assume a long-run perspective, inflation is viewed as an adjustment mechanism that facilitates labor market adjustment. If inflation is below the LSURI, an increase in inflation will lower the equilibrium unemployment rate. If it is above the LSURI, it will raise it. Inflation is therefore an adjustment mechanism that can be calibrated optimally in the long-run, aiming at the lowest sustainable unemployment. However, just as the NAIRU is an unobservable concept, so too is the LSURI, and it should be empirically estimated as it varies structurally for each economy.

Some authors[6] argue that the LSURI should be seen as a guiding concept for inflation targeting, although in an European Union framework this objective may prove potentially problematic: there is nothing to suggest that long-run trade-offs between inflation and unemployment are identical across European countries. It is also for this reason that it is interesting to develop further the issue of empirical estimation of the LSURI, and to draw some practical policy implications.

3 The Italian evidence

3.1 ADP's procedure

The standard procedure for the empirical estimation of the ADP (2000) model requires first to estimate a short-run Phillips curve of the form (9), and then numerically compute from the estimated parameters the long-run Phillips curve and its key indicators, the natural rate of unemployment, the LSUR and the

[6] See Lundborg, Sacklèn (2003, 2006) and Palley (2003) among others.

LSURI. The validity of this procedure is of course an open question, as long-run behavior and short-run deviations should theoretically be captured by a cointegration relationship. For this reason we apply the ADP-procedure, followed by robustness tests of our results following Wyplosz's (2001) approach, which has a cointegration interpretation.

Recall that the short-run Phillips curve we wish to estimate is:

$$\pi_t = d - cu_t + \Phi\pi_t^e + g\Delta u_t^e \tag{11}$$

It is worth repeating that Φ is not a simple parameter, but a function of inflation as it represents the share of rational firms at each level of inflation. Formally Φ is a cumulative standard distribution of losses implied by near rational behavior, where the loss thresholds are also normally distributed among price setters and equation(8) explicitly describes the argument of this cumulative function.

The estimation of the entire model would require estimation of all the structural parameters $(\alpha, \beta, \mu_\varepsilon, \sigma_\epsilon)$ influencing Φ, which is particularly complicated in the absence of large samples. Consequently, ADP approximate the argument of (8) by $D + E\pi_L^2$. We follow their simplification. It can be shown that in practice that only two parameters are required in order to capture the dynamics of the argument of the cumulative normal distribution when inflation varies.[7]

Therefore, approximating $L \simeq D + E\pi_L^2$, the empirical specification of our short-run Phillips Curve becomes:

$$\pi_t = d + g_1 u_t^e + g_2 u_{t-1} + \Phi(D + E\pi_L^2)\pi_t^e + k\boldsymbol{x}_t + \epsilon_t \tag{14}$$

where d, g_1, g_2, D, E and k are parameters to be estimated, $\boldsymbol{x}_t$[8] is a vector of dummy variables and ϵ_t is the error term.

With regards to π_L, the theoretic model tells us only that its squared value should have a positive effect on Φ (E should be large and positive): past high inflation should make people increasingly rational and dissipate their money

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[7] To see this, consider the Taylor series approximation of the loss function (7) around a value of zero inflation

$$L \simeq L(\pi = 0) + \frac{dL}{d\pi}|_{\pi=0}(\pi - 0) + \frac{1}{2}\frac{dL}{d^2\pi}|_{\pi=0}(\pi - 0)^2 + ... \tag{12}$$

The loss will be positive but small at zero inflation, so the constant term will likely be present. The first order term will be null at zero inflation, and very small with inflation ranging between 1 and 10 percent, as the definition of near rationality requires. Furthermore simulations conducted by ADP show that the second order term will be relevant, while third and higher order terms will not. This is the rationale of making the following approximation:

$$L \simeq D + E\pi_L^2 \tag{13}$$

Where π_L^2 approximates the effects of past inflation on the loss implied by near rational behaviour, and in practice will be estimated as a univariate forecast of actual inflation.

[8] As an alternative to dummy variables, in order to take into account supply shocks some specifications employ price changes of energy (fuel electricity and gasoline) and of food. See the appendix for details.

illusion. For this reason in line with ADP, we proxy π_L with three different specifications.

The first is a geometrically declining weighted moving average of past inflation:

$$\pi_L = (1-\delta)\pi_{L-1} + \delta\pi_L \tag{15}$$

where δ is estimated.

We also estimate π_L as a four year (16 quarter) moving average of past inflation, with weights restricted to be identical within each year:

$$\pi_L = \sum_{i=1}^{16} \alpha_i \pi_{t-i} \tag{16}$$

where $\sum_{t=1}^{16} \alpha_i = 1$ and relative weights α_i are estimated.

In some specifications we also used Box-Jenkins univariate methods to estimate π_L as an autoregressive polynomial with lag length n to be identified:

$$\boldsymbol{p}(L)\pi_L = \epsilon_t \tag{17}$$

Where $\boldsymbol{p}(L)\pi_L = \pi_t - p_1 L\pi_t - p_2 L^2\pi_t - ... - p_n L^n \pi_t$ and L is the lag operator.

In standard practice inflation expectations π^e are estimated applying some adaptive expectations scheme. In line with ADP, we first use a twelve-quarter unrestricted lag or a simple exponential smoothing method as in (15). Alternatively we employ Ball's (2000) definition of near rational expectations, treating π^e as an optimal univariate forecast. This implies that we should again employ Box-Jenkins procedure as in (17), identifying the appropriate ARMA structure for the inflation data generating process. Alternatively, following Debelle and Vickery (1998), and more recently Wyplosz (2001), we also use the Fisher equation to proxy long term expected inflation. Hence as a measure of π^e we take the difference between the nominal rate on long-term Italian bonds and a measure of the world real interest rate r^*:

$$\pi^e = i^{LT} - r^* \tag{18}$$

where the world real interest rate is computed as the difference between the long-term US Treasury bond rate, and a five-year moving average of American CPI inflation.[9]

In line with π^e, also u^e is constructed using adaptive expectations schemes, and the appropriate number of lags is separately estimated for each specification. The measure we took for unemployment is the total unemployment rate

[9] This approximation assumes that Italy can be considered a *small open economy*, taking the world real interest rate as uniform and given. In any case Debelle and Vickery (1998) argue that the results are not sensitive to the precise calculation of the real interest rate.

calculated by the Italian statistical office *ISTAT*, and re-scaled by US *Bureau of Labor Statistics,* to facilitate international comparisons.[10]

For the dependent variable we used three different measures of inflation: the annualized percentage change in the Italian consumer price index, in the deflator for GDP at market prices, and in the deflator for personal consumption expenditures.

We used quarterly data from the first quarter of 1960 to the fourth quarter of 2003, all taken from the *OECD Statistical Compendium.* The sample consists in 176 observations, although in some specifications we are forced to use a smaller sub-sample due to the large number of lags and to missing data. Detailed variables definitions and the specification of the dummy variables used can be found in the *Appendix*. All the parameters of the model were estimated using Non-Linear Least Squares methods.

3.2 ADP's procedure: results

Italian prices have experienced periods of huge increases between the mid seventies and the eighties, whatever measure of inflation we consider. It was the period after the Dollar devaluation, the period of Oil shocks and great union conflicts, when Italian inflation reached peaks never achieved previously. Both the new wage indexation system (the so called "Scala Mobile") and the devaluation of the Italian currency contributed to the creation of high price volatility. While in the 1990s inflation decreased but remained at sustained levels, in the final part of the sample it averages at lower rates, between 3 and 5 percent. It is clear that at that time Italy could never be considered a 'virtuous country' with respect to inflation. On the other hand, in the recent years of the European monetary regime, it displays inflation slightly below the European average. On the unemployment side, we can say that despite the recent decline, the current unemployment rate is still rather high from long-run perspective: 6% in September 2007, just one percentage point less than the European average. However in the time period we considered (1960-2003), the Italian unemployment rate has generally been higher that the European average, and probably institutional reforms in the labor market account for a structural break at some point in the sample.

How does the near rational Phillips Curve model fit our Italian data? Table 1 presents our results concerning the estimation of the short-run Phillips curve in equation (14), where we chose our preferred regressions in terms of fit and summary statistics.[11]

-Table 1 about here-

[10] For a detailed description on the methodology used see "Unemployment Rates: Approximating U.S. Concepts" series in Comparative Civilian Labor Force Statistics: Ten Countries, 1959–1999", published on the *Bureau of Labor Statistics* website.

[11] Many regression, with different combinations of the dependent variables and different samples, have been estimated. The ones we present here are those which seem more representative to our eyes.

The value of D is always small and generally significant, implying that the coefficients on expectations at inflation close to zero, range between 12 percent and 50 percent depending on the specifications. The share of firms completely taking into account future inflation in wage setting is already consistent at price stability, and increases as inflation rises.

Another key parameter is E, the coefficient multiplying the square of lagged inflation in $\Phi(.)$. It represents the state-dependent part of our Phillips curve; if it is zero, the coefficient on expected inflation would not vary with past rates of inflation, and the standard inflation-augmented Phillips Curve would be obtained. By contrast, Italian price setters seem to incorporate future inflation differently in their decisions depending on past inflation being low or high: the estimated value of E is always significant and positive. Nevertheless, when compared to US or Swedish estimates, the differences in its order of magnitude are striking. LS' results for parameter E were in the order of magnitude of 400-500, ADP's were between 1700 and 2800, while ours range between 18,77 and 25,16. Fortunately, Dickens preliminary results on some other European countries are a little bit more similar to ours.

To see the implication of these differences we examine Table 2, which contains the estimates of the Italian natural rate of unemployment, the LSUR and the LSURI. Additionally table 3 reports these indicators as estimated inside and outside the US.

-Table 2 and Table 3 about here-

While almost all American and Swedish firms have become rational actors at an inflation rate ranging between 4 and 6 percent, at that same inflation rates only half of Italian price setters totally incorporate inflation. In the majority of our specifications a yearly inflation rate in the order of 25-30 percent is necessary to turn all price setters into fully rational actors.

This in turn reflects the estimated value of the lowest sustainable unemployment rate, which is important because it indicates the point at which the long-run Phillips Curve stops being negatively sloped. The Swedish data suggested that 2.3 percent of unemployment could be obtained raising the inflation target to roughly 5 percent; ADP also found that at inflation rates ranging between 3 and 4 percent significant reduction in unemployment could be obtained.

Italian data look much more similar to French and British data, reported on the right side of table 3. The natural unemployment rate, which represents the rate that prevails when all money illusion has vanished due to high inflation, varies from 9 percent to 14 percent. Correspondingly the LSUR occurs at extremely high inflation rates, between 16 and 19 percent, with a concurrent implication of incredibly low values of unemployment. The most reasonable estimate comes from the GDP deflator specification and it is roughly 5 percent.

These results are unsurprising. As Dickens (2001) claimed, there are many difficulties in applying the near rational model to European countries. For example Dickens could not derive a backward-bending Phillips curve in the cases of both Germany and of France, mainly because he found a negative or zero constant term, implying that finding an asymptote of unemployment as inflation increases is impossible. This class of problems is not present in our data, the expected backward-bending shape of the long-run Phillips curve can be inferred from our estimates. However the backward-bending segment persists till such high inflation rates that it is likely never to bend forward, unless Italy experiences an episode of hyper-inflation. If that was the case, such a high inflation rate would be so costly for Italy inside the European Union that the loss in terms of lower competitiveness and financial instability would more than overcome the benefits from the (uncertain) reduction of unemployment. For these reasons we conclude that the ADP-procedure applied to Italian data for "sensible" inflation ranges, implies just a negatively sloped long-run Phillips Curve.

Figure 4 summarizes the crucial features of the long-run Phillips Curve implied by our regressions: for each regression reported in table 1, we evaluated the long-run unemployment rate corresponding to inflation from zero to 35 percent, according to equation (10)[12]. To obtain the "average" Italian Phillips curve, we evaluated the average unemployment rate at the different levels of inflation. The black spotted lines represent the natural rate and the LSUR intervals, varying with the different specifications.

-Figure 4 about here-

Can the Phillips curve in figure 4 predict Italian recent economic performance? First of all we already said that figure 4 should be considered only in its lower part, for a sensible inflation range that could be 0-8 percent. In addition, the ADP-procedure has several other shortcomings. One of its major problems is that it does not allow one to discriminate between short-run deviations from the long-run, and the long-run structure itself. The long-run indicators are numerically computed according to the short-term estimated parameters. It could well be that the support for the ADP-type Phillips curve simply reflects a mispecified model, which does not take into consideration shifts of a vertical long-run Phillips curve due to institutional changes or productivity growth. Furthermore only the NAIRU model with its vertical curve can be nested in such a Phillips Curve.[13] This makes it difficult to assess the risk that the data are in fact generated along the lines of some other model (associated with a non-vertical long-run Phillips curve). In which case, our support for the ADP-type Phillips curve would have followed mainly from functional misspecification. Dickens (2001) presents regressions that also include a term for nominal wage rigidity, arguing that this could be the crucial variable when one deals with

[12]It was necessary to set a maximum inflation rate this high to show where the vertical segment of the Phillips Curve starts.

[13]As we already said the standard inflation augmented short-run Phillips Curve emerges if the data imply a D coefficient which is big and positive, and an E coefficient which is small and insignificant. In such a case the Φ coefficient would be almost one and not dependent on π, yielding an accelerationist Phillips Curve in the short-run and a vertical one in the long-run.

European countries. Indeed near-rationality and nominal wage rigidity could play a major role in unionized labor markets, and this is a promising route for future research. Nevertheless, we want to make it clear that the rejection of the NAIRU model in our data, does not exclude the relevance of other models yielding non-vertical long-run Phillips curves.

3.3 An alternative approach: capturing long-run nonlinearities

Wyplosz's (2001) approach could prove useful on the issue of identifying any nonlinearities in the long-run Phillips Curve, besides the backward-bending shape derived by ADP. Dickens (2001) states that it should be used as a complementary technique to ADP-type estimation.

Wyplosz's atheoretic approach of estimating nonlinearities in the relationship between long-run unemployment and inflation has several advantages and disadvantages. The method is particularly powerful in identifying other influences on the shape of the long-run Phillips Curve, which cannot be identified under the ADP specification. It might prove to be a powerful tool in testing the effect of nominal rigidities and near rationality together, where the functional form of the trade off is estimated and not *a priori* assumed. Significantly, the procedure explicitly takes into account short-run deviations from the steady state equilibrium, as it estimates the long-run relationship as a cointegrating equation.

Of course there are disadvantages to take into account. The procedure does not give much credence to the effect of productivity growth, which may shift the Phillips curve up or down. A measure of Tobin's Q is included in order to attempt to capture such effects. Furthermore, this procedure has been criticized for not having its roots in a solid theoretical model, but one may argue that it is consequently less vulnerable to misspecification.

Along with Dickens' suggestions, in order to see whether our results are robust, we will also investigate the shape of the Italian long-run Phillips Curve employing Wyplosz's approach. In particular we want to understand whether it is plausible that the Italian long-run Phillips Curve displays a negatively sloped shape until extremely high inflation rates.

Our procedure[14] consists of the estimation of a cointegrating relationship along the lines of an Engel and Granger (1987) two-step method. A polynomial

[14] Actually Wysplosz (2001) takes a slightly different approach from ours to estimate the long-run relation between inflation and unemployment. He first estimates a standard near-accelerartionist Phillips Curve with a polynomial in long-term inflation. Then he includes the polynomial in the long-run equation to predict unemployment directly, and sees the short-run accelerationist Phillips Curve as a possible ECM representation of inflation-unemployment dynamics. Nevertheless he admits that the cointegrating interpretation shouldn't be pushed too far because his ECM model doesn't follow the standard specification. Furthermore nonlinearities in the long-run equation preclude the use of Johansen's rank procedure (see Wysplosz (2001) p. 24). As we are mainly interested in a robustness check of our previous long-run results we estimated a traditional cointegration system, where the long-run equilibrium is the same as in Wysplozs, but the ECM representation is the standard one. This approach performs much better with our Italian data than Wysplosz's original one, and seems to be more

in a five-year moving average of expected inflation is introduced to allow non-linearities in the long-run equation to predict unemployment directly[15]. The corresponding ECM model is estimated, in order to link properly the long-run and short-run behaviors.

The cointegrating system we estimate is the following:

$$u_t = c + \exp(\vartheta\pi_t)P(\overline{\pi_t}) + \gamma q_t + \epsilon_t^u \tag{19}$$

$$\Delta u_t = (1-\lambda)(\pi_t^e - \pi_{t-1}) + \alpha\Delta\pi_t + \alpha\epsilon_{t-1}^u + \beta\Delta q_t + \delta\boldsymbol{x}_t + \epsilon_t \tag{20}$$

Where $P(\overline{\pi_t})$ is a second or third order polynomial of long-term lagged inflation, and $\vartheta \leq 0$ is a parameter to be estimated. q_t is a measure of Tobin's Q, introduced to account for productivity shifts (Phelps and Zoega, 2000). Here the vector $\boldsymbol{x}_t$ contains dummy variables accounting for oil shocks and other temporary supply shocks, together with price changes of food, energy prices and imported goods.

Equation (19) is a flexible specification to capture grease and sand effects of inflation on unemployment. Given wage rigidity, it is not expected to hold at every point in time but it is built to capture nonlinearities in long-term unemployment-inflation relationship. It can be seen as a cointegration relationship in some way similar to a long-run Phillips curve where nonlinearities are explicitly taken into account. Equation (20) can be seen as its error correction representation, if the residuals ϵ_t^u are found to be stationary.

Here we briefly describe how we constructed the variables in (19) and (20). Basically we took our GDP deflator specification in table 1 and re-elaborated to make it compatible with the cointegrating interpretation.

As a measure of the unemployment rate we used again the BLS measure, and we took the annualized percentage change in the Italian GDP deflator as a measure of inflation.

Long-term inflation is approximated by a five years moving average of expected inflation $\overline{\pi}$ again proxied by the Fisher equation (18)[16]:

$$\overline{\pi}_t = \frac{1}{5}\sum_{i=0}^{4}\pi_{t-i}^e \quad \text{for every } t \tag{21}$$

The measure of Tobin's Q, q_t , was calculated as the ratio of the price index of Italian shares to the investment deflator, normalized to the zero-unity interval over the sample.[17] In (19) a time trend is also included to account for

econometrically coherent.

[15] Wysplosz allows for an exponential decay factor $\exp(\vartheta\pi_t)$, where $\theta \leq 0$,multyplying the polynominal of expected inflation.This is to ensure that the inflation effect dissipates when inflation becomes large.

[16] Theoretically long-term inflation should be given by $\pi_t = \pi_t^e = \overline{\pi_t}$, but as this definition is not sufficient to derive a time series, Wysploz (2001) approximates long-term inflation as a five year moving average of π_t^e.

[17] We exactly employed Wyplosz's approximation of Tobin's Q. The theoretic relevance of including a measure of Tobin' Q in studying unemployment is discussed in Phelps and Zoega (2000).

unmodelled demand and supply shocks affecting the labor market. All data are quarterly and taken from the *OECD statistical compendium*. In this specification they span from 1966 to 1999.

3.4 Capturing long-run nonlinearities: results

Table 4 shows the results of estimating system (19 and 20) by means of Non-Linear Least Squares.

-Table 4 about here-

Note that the first parameter of the second order polynomial is significant, but the parameter on squared inflation is not precisely estimated. Nevertheless it is negative, providing support for the presence of grease and sand effects of inflation. Generally, the other parameters are significant and carry the expected sign, and especially the error correction parameter which is negative and active. The strong significance of the linear trend in the long-run equation however may be due to the absence of other labor market variables in our model. We can finally derive the representative long-run Phillips Curve implied by these new results: if its shape is comparable to that which we found in the previous section then we can feel a bit more confident in our results.

Figure 5 shows the simulated path of long-term unemployment when inflation ranges between 0 and 40%.[18] To compute long-run unemployment we used the cointegrating equation reported in table 4, setting all the terms other than inflation at their sample means.

-Figure 5 about here-

It is comforting to compare figure 5 with figure 4, the ADP-type Phillips curve. They look quite similar, presenting both a backward bending shape and a tendency to become vertical at very high inflation rates. Furthermore both curves bend forward at an unemployment rate close to 5 percent, corresponding at a very high inflation of almost 20 percent. By contrast, the most striking difference between the two curves is that they imply two different natural unemployment rates: in figure 4 zero inflation corresponded to a natural rate of 15 percent, while in figure 5 the natural rate is near to 8 percent, a more reasonable value.

On the basis of these results, what can we argue about the Italian long-run Phillips curve? Considering that a yearly inflation rate of 15-20 percent is not likely to occur, nor would it be desirable, we can only conclude that there is reasonably strong evidence for a long-run inflation unemployment trade-off in Italy. It is sensible therefore to cut off the unrealistic sections of both figure 5 and figure 4. Figure 6 suggests the possible shape of the representative Italian Phillips Curve consistent with our estimates implied by both ADP's and Wysploz's procedures. It has been computed as an average of the ADP-type and Wyplosz–type long-run results, and It is negatively sloped for positive and moderate inflation rates.

[18] As before, we needed to set such a wide inflation range, in order to show where the Phillips curve tends to become vertical with the Italian data.

-Figure 6 about here-

4 General discussion and concluding remarks

The ADP (2000) model of near rational behavior in price and wage setting yields very controversial results about the long-run unemployment-inflation trade off. We showed that Italian data seem to partly confirm ADP's results: a long-run trade-off exists, and is negative at low and moderate inflation rates. Whether ADP's results are confirmed at higher inflation rates is an open question. However, ADP's model has been widely criticized, both for its theoretical foundations and for its policy implications. In what follows we discuss the strengths and weaknesses of the model, and outline its policy implications.

Three fundamental questions are addressed:

- Does near rationality always have a positive effect on unemployment?
- Is the Lowest Sustainable Unemployment Rate (LSUR) a sustainable equilibrium in the long-run?
- What is the role of economic policy in the ADP framework?

Regarding the first problem, recall that the ADP model is a pure efficiency wage model which sought to represent the American labor market. Wages are set unilaterally by firms, that estimate the effort exerted by their workers with different real wages. Ignoring or underweighting future expected inflation implies setting a nominal wage lower than what should be required to satisfy the Solow condition. The average wage is thus lower than it should be compared to aggregate demand, and as a result employment is higher at low inflation rates.

It is clear that this is not the only possible scenario. Blinder (2000) notes that if labor demand is a decreasing function of the real wage, one should expect that the firms' misperception implies an underdeflation of money wages, and hence an overestimation of expected real wages, compared to actual real wages. Firms would demand less labor and aggregate unemployment should increase. Furthermore, another type of cognitive error could occur: if firms overweight inflation,instead of underweighting it employment would again be reduced.[19]

Of course the main difference between ADP's model and European reality is the structure of the labor market. In many European countries the labor market is highly centralized and union bargaining issues contribute strongly to explain consistent wage rigidity, and this is even more so in the Italian labor market. Several attempts have been made to study the effects of union bargaining in an efficiency wage framework, as it is quite likely that these two issues interact (See for example Bulkley and Myles,1997, a and b). One of the main results

[19] Overestimating inflation is not an infrequent occurrence in European countries, particularly if one recalls the episode of high perceived inflation after the introduction of the Euro. Indeed this type of error is more likely to occur in the context of consumer behaviour than in the context of firm behaviour.

of this literature is that because effort can only be imperfectly controlled, if a monopolistic union decides wages while firms determine employment and effort, it will set wages higher relative to the competitive solution and thus a higher level of effort will be exerted. What would the outcome of combining near rationality in wage setting and such a monopolistic union be? The impulsive answer is that probably wages would be higher, and with effort and employment being perfect substitutes in ADP's model, the higher level of exerted effort could even imply higher aggregate unemployment.

Bhalotra (2006) reaches similar results, but starting from a different point of departure. She notes that examining near rational behavior in an efficiency wage setting is particularly interesting, as there are positive but decreasing returns to increasing the wage beyond the efficient level. She suggests that employers may in fact behave near rationally when they allow for small and positive wage deviations, accounting of union power. Her evidence suggests that this could be the case in the United Kingdom, while in the United States pure efficiency wages seem to provide an appropriate description of the labor market. In ADP, paying lower wages implied second order losses for near rational firms when inflation was low, and hence unemployment was lower. What would the costs be to a firm if it pays a wage slightly higher than the efficiency wage? If these costs are negligible, European firms may give in to union demands with negative consequences for unemployment. It is true that near rational behavior in wage setting as argued by Bhalotra does not imply any connection between wages and inflation. Nevertheless, it seems to yield the same implications as Blinder's results: such near rationality in wage setting would reduce aggregate employment.

Summarizing, in ADP near rationality is equivalent to a downward shift of the *No Shirking Condition (NSC)*, holding labor demand constant.[20] On the contrary, Bhalotra and Blinder's idea of near rationality, implies that the NSC may in fact shift upward. Figure 7 clearly shows that the aggregate consequences in terms of employment are very different.

-Figure 7 about here-

Indeed a promising route for future research could be focused on assessing whether the two arguments we presented could significantly change the macroeconomic results of the entire model. For the moment, caution is necessary when drawing conclusions with respect to unemployment.

Regarding the long-run sustainability of the LSUR and the accompanying rate of inflation, the debate is also open. Indeed ADP are firmly convinced

[20] In Shapiro and Stiglitz (1984) the No Shirking Condition (NSC) is an upward sloping schedule which links the real wage to be paid by the firm to prevent workers from shirking, and the number of workers actually employed. In the usual efficiency wage framework, the NSC plays the role that labour supply does in a competitive labour market. Of course, being the efficiency wage higher than the competitive real wage, the NSC will be positioned above and to the left of the competitive labour supply, implying involuntary unemployment in equilibrium. Indeed ADP never talk in terms of NSC, but as they work in an efficiency wage setting, they implicitly see high real wages as a deterrent to workers' moral hazard, as well as a "morale booster".

of the fact that some low inflation could actually improve macroeconomic performance, "greasing the wheels" of the labor market, and reducing long-run unemployment. Moreover recently Akerlof and Yellen (2006) have also affirmed that policy makers should be concerned both with maintaining low inflation and with stabilizing output volatility. They argue that with Phillips Curves like (9) and (10), such policies would bring nonnegligible gains in employment and welfare. Nevertheless even ADP show themselves quite cautious in encouraging central banks to target the LSURI. They admit that it is not clear whether this inflation rate accompanies an unemployment rate, the LSUR, which also maximizes output. LS (2003) showed that in ADP's model, depending on the parameters output may increase or decrease with inflation,and hence it must be empirically investigated whether output is maximized roughly at the same rate at which unemployment is minimized. The issue needs to be evaluated empirically for every country, but clearly our Italian estimates are so extreme that they cast some doubts on the validity of the theoretical model itself. Empirical studies about ADP-type Phillips Curves outside the US, suggest that the grease and sand effects are likely to influence differently the shape of the long-run unemployment inflation trade-off in every country[21]. Particularly the labor market structure, the strength of wage bargaining issues, and mostly the degree of nominal wage rigidities, are of particular significance in explaining the different patterns of long-run unemployment and inflation. In addition, productivity growth and supply shocks must also be taken into account. Our empirical specification ignores many of these factors, and this could explain why our results are somewhat puzzling.

Moreover we recalled Blinder's (2000) doubts that the LSUR could be optimal and sustainable from a welfare point of view. He further argues that allowing for explicit inflation costs, which are absent in the ADP model, the LSURI could actually prove too high, overcompensating for the benefits of minimal unemployment. This could especially be true for our Italian estimates, where we obtained a LSURI averaging at 15-20 percent, far too high from what the ECB would see as an appropriate inflation target.[22] Blinder's argument against optimality is reinforced by LS' (2003) results regarding social optima in the ADP model, since they argued that from a theoretical viewpoint it cannot be excluded that a negative inflation output trade-off exists. Yet some scholars of the Post-Keynesian school of thought, such as Palley (2006) and Summers (1991), argue that the LSURI has the potential advantage of providing an inflation margin allowing for a negative real interest rate. In case the nominal rate hits the zero floor it should avoid a deflationary trap. Still in the Euro era of price stability, deflationary spirals seem quite low on the list of phenomena demanding policy attention.

Finally, we would like to raise another question: would the LSURI be a dy-

[21] See Lundborg and Sacklén (2003, 2006), Wysploz (2001) and Dickens (2001,commenting on Wysploz).

[22] Furthermore, a standard result in monetary economics is that price volatility increases with high inflation (Cukierman (1984)), and this would render such an high inflation target even more costly.

namically stable position? As a negative output-inflation trade-off could occur at low inflation rates, the shape of the long-run Aggregate Supply curve could cease being vertical, and even become downward-sloping. If this was the case, a dynamic stability problem would occur when considering the AD-AS equilibrium: it would only be stable if the AD curve were accidentally more rigid than the AS curve. Otherwise we would be condemned to endless inflationary or deflationary spirals. The weaknesses we have just analyzed suggest a need to be cautious about encouraging Central Banks to use a LSURI-targeting approach.

Finally, let us try to answer to the most relevant question, concerning the role of economic policy in ADP's framework. ADP's model implies a concave long-run Phillips Curve, where a negative trade-off between inflation and unemployment emerges at low inflation rates. Our estimates for the Italian economy suggest that such a trade-off may indeed be present in the long-run, although we must admit that these results should be taken with caution. At the same time, the estimated Italian short-run Phillips Curve seems more reliable, and it strongly rejects the accelerationist hypothesis. Any policy conclusions drawn from our evidence must thus clearly distinguish between long-run and the short-run outcomes. Akerlof and Yellen (2006) argue that price stability must be viewed as an important long-term policy objective. Given the possible persistent trade-off between inflation and unemployment at low and moderate inflation rates, central banks have an even stronger rationale than the rational expectations-credibility models (Barro and Gordon (1984) and Rogoff (1985)) for fighting high inflation. However full price stability, i.e. near zero inflation, seems inadvisable. The literature agrees on at least three pitfalls in targeting zero inflation. First, during a contraction, monetary policy would be less effective because nominal interest rates approach the zero floor, with the risk of a positive real rate and the consequent negative impact on investment. Second, downward wage-rigidity, implied by workers' resistance to nominal wage cuts, could create substantial real wage rigidity if inflation is near zero. Third, although many have showed that very high inflation yields negative effects on growth, there is no evidence that the reverse holds, i.e. that zero inflation fosters growth.[23] ADP present a fourth rationale for avoiding very low inflation targets: in the long-run excessively low inflation targets would imply higher rates of unemployment because near rational neglect of inflation is not operational. In such a framework monetary policy should target a low or moderate inflation rate. As we already said, it is difficult to assess univocally what a moderate inflation rate is. It is even more difficult to say whether the LSURI could be an appropriate policy target. Hence, at this stage, we can only conclude like Wyplosz: we do not know how low the European inflation target should be. Nevertheless, necessary caution requires us also to question the current 0-2 percent target. Concerning the short-run, Akerlof and Yellen (2006) encourage central banks to exploit the fact that expectations do not respond one-to-one to inflation and pursue *active stabilization policies,* i.e. short-run output and

[23] In Europe, the 60s was a period of fast growth and low unemployment, despite the fact that inflation rates were averaging at 2.5-3.5 percent.

employment stabilization policies, along with inflation stabilization around a low or moderate target, provided that it could be sustainable in the long-run. As De Long and Summers (1988, p.434) put it, economic policy could "fill in troughs, without shaving off peaks". If people actually behave as psychologists suggest, they will fully incorporate future inflation only if it is very salient; for example according to our estimates, almost all Italian firms incorporate all their expected inflation in wage setting only when yearly inflation reaches 15-20 percent. In this case at low initial inflation rates, monetary policy can combat high unemployment without renouncing the opportunity of having low unemployment in the future. Active stabilization policy is advisable in the short-run: central banks should contain inflation, preventing inflation from reaching salient levels, while simultaneously combating recessions.

Figure (8) can help us explaining why short-run stabilization policy can be so beneficial when the Phillips Curve is not accelerationist.

-Figure 8 about here-

With an accelerationist Phillips Curve (left hand side of the picture), a cyclical downturn at time t implies going from point A to point B, with lower inflation but higher unemployment. Consequently, agents will revise their inflationary expectations downwards and the Phillips Curve will shift downward, implying lower unemployment for every given inflation target. If the central bank enacts an expansive monetary policy to maintain the previous inflation target π_0, at time $t+1$ it will bring the economy to point C: unemployment will be reduced by exactly the same amount by which it had increased during the recession. Recall that an accelerationist short-run Phillips Curve also implies a vertical long-run Phillips Curve, so point C will not be a stable equilibrium and agents will again revise their expectations upwards. Eventually the economy will go back to the natural rate of unemployment, but the concomitant equilibrium rate of inflation will be higher.

By contrast, the right side of figure 8 shows that if the coefficient of inflationary expectations is less than one, as it is in the ADP-type curve at low initial inflation, the outcome will be different. Now monetary policy brings the economy from point B to point D, yielding a much greater decrease in unemployment than in the previous case. The key difference is the reaction of the short-run Phillips Curve to the process of expectations adjustment. A non-accelerationist Phillips Curve responds to lower expected inflation shifting downwards more than in the previous case (only $\Phi\pi^e$ enters in the Phillips Curve), and this gives the central bank the opportunity to restore the inflation target at a much lower unemployment rate. Note too that for ADP, if the inflation target lies on the long-run concave Phillips Curve, D will also be a sustainable equilibrium as the majority of agents will continue to neglect inflation in a near rational manner. Furthermore, policy-makers might choose the LSURI as the inflation target, therefore positioning the economy at the leftmost point of the long-run Phillips Curve. According to this theory, active stabilization policy brings significant welfare gains. Whereas, in the traditional NAIRU framework it entails only small unemployment reductions in the short-run, and it even reveals detrimental outcomes in the long-run.

Short-run active stabilization policy therefore seems advisable. It is necessary to assess whether the outcomes would be similar in European countries where demand management policies are inevitably made more difficult by the Stability and Growth Pact restrictions. The ADP-type Phillips Curve provides an even stronger motivation to criticize the pact. Many have already claimed that it is insufficiently flexible and that it needs to be applied over the economic cycle, rather than over one calendar year. In reality, the Commission has recently acknowledged that specific country conditions have to be take into account when evaluating fiscal policies. Given the difficulties for single countries in using the fiscal stimuli countercyclically, there seem to be two possible solutions for the European Union. The first is quite difficult to accomplish as it requires a political agreement between the member states. It consists of centralizing or coordinating fiscal policies at the community level in order to render the stabilization policy effective at a Euro level. Nevertheless the literature hasn't yet reached a consensus about the net effect of fiscal coordination in a monetary union. The second method seems more easily achievable: monetary policy could aim at both stabilizing inflation and output. Fontana and Palacio-Vera (2005) suggest that such a monetary policy could employ what they call a *flexible-opportunistic approach to disinflation*. The pure opportunistic approach (Orphanides et al. (2002)) suggests that when inflation is moderate, but still above the long-run objective, the central bank should not take deliberate anti-inflationary action but, rather, should wait for exogenous circumstances, such as favorable supply shocks and unforeseen recessions, to deliver the desired reduction in inflation. The consequences on unemployment would obviously be quite different: favorable in the first instance, disastrous in the second. In the meanwhile, high inflation should, however, be fought aggressively. Furthermore, the flexible opportunist approach suggests to substitute the notion of a strict inflation target with that of a target zone, which would lead to a policy of monetary tightening only when current and expected inflation exceed the target-zone. Part of this approach implies that when current inflation is at the long-run target or when inflation is below the target, the central bank should adopt a strategy of lowering the real interest rate, in order to trigger some of the positive path dependent effects of long-term employment and output that emerge in ADP's model.

We do not know yet whether any of these suggested strategies would prove to be useful for the ECB. Further research is necessary in order to asses the validity of ADP's approach to near rationality and of its macroeconomic implications. Certainly many doubts emerge in terms of the microfoundations of the model, and with respect to its policy implications for a country like Italy that belongs to a monetary union.

The ECB is strongly committed to an inflation target of 2 percent. It is not likely to change its strategy along the lines of the prescriptions we have discussed, at least not until a more robust consensus is reached. Regardless of this fact, structurally high unemployment is an extant phenomenon in Italy and in many others European countries. Long-run policies to enhance the flexibility and the competitiveness of our labor market should probably still be encouraged. Higher productivity growth would also shift Italy's Phillips Curve downwards, with significantly lower unemployment for every long-term inflation target. Since these policies require a long period of time before their effects are observable, the short-run problem of unemployment remains. The unhappy conclusion is that, although we have benefited greatly from the European Union and the euro in terms of price stability, we lack the monetary and fiscal instruments for a demand management policy. Given the above considerations, let us conclude with an open question: are supply side policies the only tool that remains? Futher research is needed to answer this question and many other unresolved ones concerning the role of economic policy in European member states.

Figures

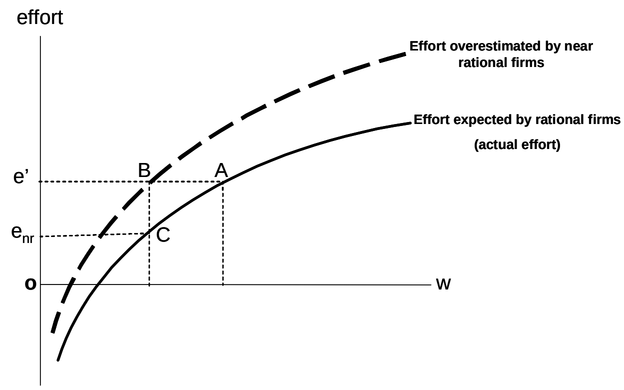


Figure 1: Wages and effort levels in ADP (2000)[source: LS(2003)]

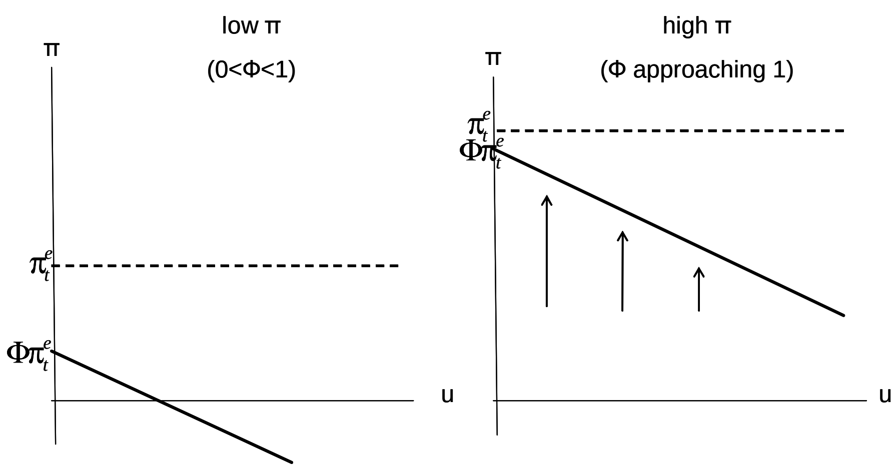


Figure 2: Short-run non accelerationist Phillips Curve

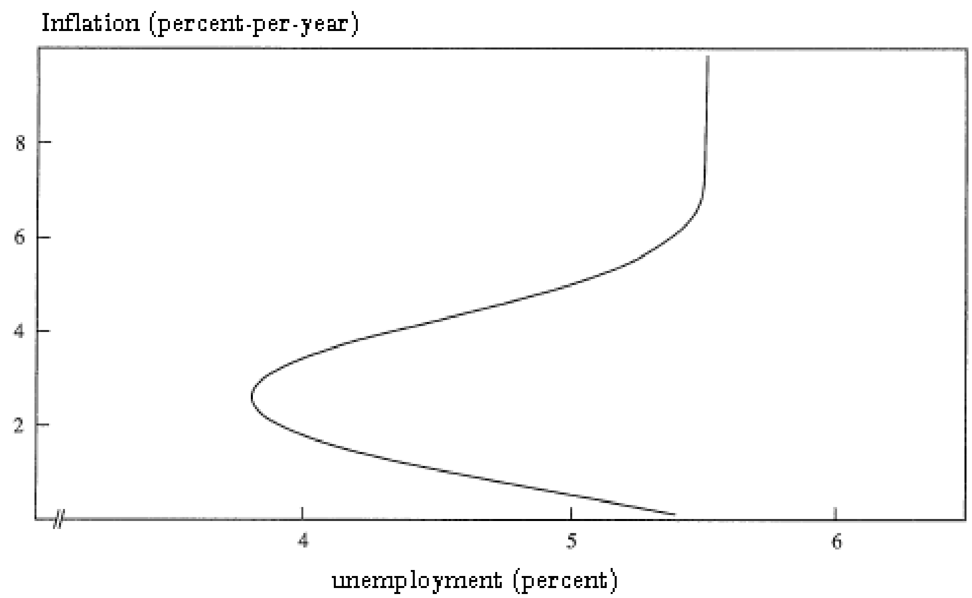


Figure 3: Representative long-run Phillips Curve [Source: ADP (2000)]

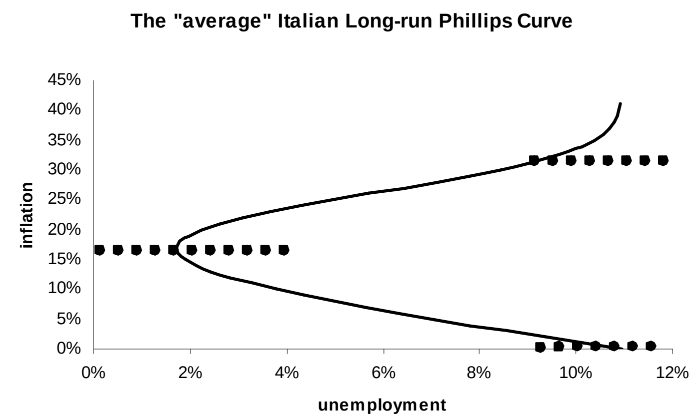


Figure 4: Average Italian long-run Phillips Curve

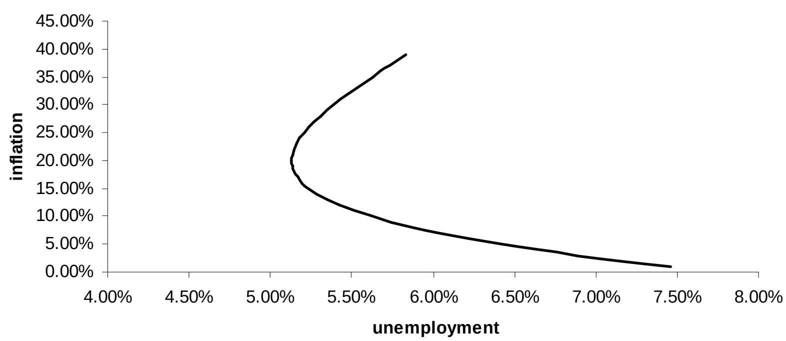


Figure 5: Long-run Italian Phillips Curve following Wyplosz (2001) approach

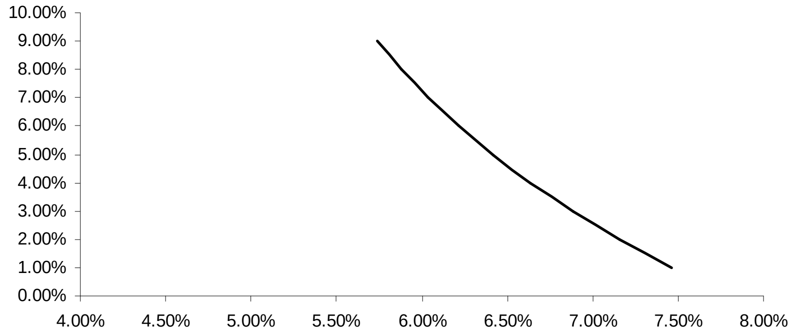


Figure 6: Average long-run Italian Phillips Curve for a sensible inflation range

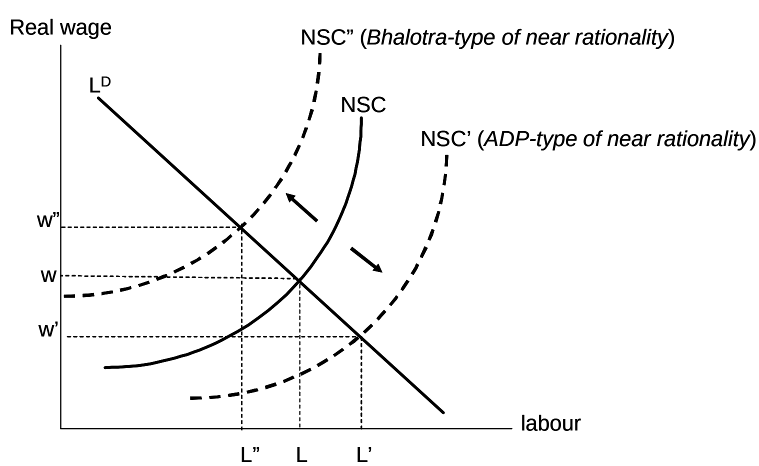


Figure 7: Employment implications of different types of near rational behaviours in wage setting

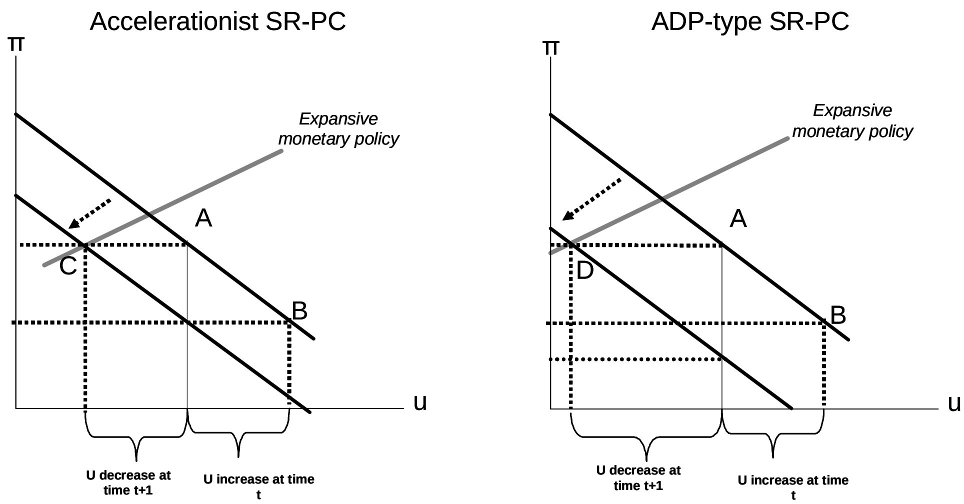


Figure 8: Short-run unemployment effects of a recession with accelerationist and ADP-type Phillips Curves.

Tables

Estimated parameters for the Near Rational Phillips Curve *(a)*

independent variable and characteristics	*CPI*	*GDP deflator*	*PCE deflator*
Costant	0.051*** (0.005)	0.033*** (0.006)	0.124*** (0.012)
coefficient of Unemployment	-0.541** (0.049)	-0.22 ** (0.008)	-1.22* (0.581)
D (constant in coefficient on expectations)	-0.01 (-0.081)	-1.26*** (0.175)	-1.18*** (0.142)
E (coefficient on π_L^2*)*	18.77** (2.472)	31.02*** (3.824)	25.16*** (2.292)
method for constructing π_L^2	geometric	2-unrestricted lag	6-unrestricted lag
method for constructing inflation expectations	12-unrestricted lag	Fisher equation	Fisher equation
number of lags in unemployment expectations	32	16	32
method for accounting for supply shocks	dummies	food and energy prices	food and energy prices
R squared	0.95	0.92	0.96
DW-statistic	0.92	1.13	1.43
sample period	1968Q2-2000Q4	1966Q2 -1999Q4	1973Q1- 1999Q4
number of observations	131	135	108

(a) Standard errors in parentheses
* denotes significance at the 10% confidence level, ** denotes significance at the 5% confidence level,
*** denotes significance at the 1% confidence level.

Table 1

Key indicators for long-run Near Rational Phillips Curve **(a)**

Share of rational firms	*CPI*	*GDP deflator*	*PCE deflator*
Φ(π=0%)	0,50	0,10	0,12
Φ(π=2%)	0,50	0,11	0,12
Φ(π=4%)	0,51	0,11	0,13
Φ(π=6%)	0,52	0,12	0,14
Φ(π=8%)	0,54	0,14	0,15
Φ(π=30%)	0,95	0,93	0,86
Natural rate of unemployment (percent)	9.6	14.9	10,13
LSUR (percent)	0	4,19	1
LSURI (percent)	16	16	19

(a) Author s calculations from the estimated parameters reported in Table 4

Table 2

Key indicators for long-run Near Rational Phillips Curve: US, Sweden, UK, France **(b)**

Share of rational firms	*US*	*SWEDEN*	*UK*	*FRANCE*
Φ(π=0%)	0,32	0,10	0,09	0,42
Φ(π=2%)	0,39	0,13	0,09	0,44
Φ(π=4%)	0,62	0,28	0,12	0,49
Φ(π=6%)	0,90	0,61	0,17	0,58
Φ(π=8%)	1,00	0,94	0,27	0,70
Natural rate of unemployment (percent)	7,5	7,3	15	-4,2
LSUR (percent)	4,5	2,3	2.5-5	-
LSURI (percent)	3,4	4,5	3-4	-

(b) Author s calculations from the estimated parameters reported in ADP (2000), LS (2003), Dickens (2001)

Table 3

Estimated parameters for long-term unemployment system ***(a)***

	Long-run relationship *[Cointegrating equation]*		*Short-run model* *[ECM representation]*
independent variable	UNEMPLOYMENT RATE	*independent variable*	D(UNEMPLOYMENT RATE)
constant	0.021***	$(\pi_t^e - \pi_{t-1})$	0.98***
	(0.006)		(0.004)
exponetial decay factor	-6.26***	*ECM parameter (α)*	-0.096**
	(2.14)		(0.037)
$\overline{\pi}_t$	-0.36***	$\Delta\pi_t$	-0-00041
	(0.009)		(0.008)
$\overline{\pi}^2_{t-1}$	-0.59	Δq_t	0.0078*
	(1.03)		(0.005)
q_t	0,004		
	(0.004)		
trend	0.0006***		
	(0.00)		
R-squared	0,94	*R-squared*	0,26
DW	0,23	*DW*	2,06
sample period	1966Q2-1999Q4	*sample period*	1966Q2-1999Q4
N. of observations	140	*N. of observations*	140

(a) *Standard errors in parentheses*

* denotes significance at the 10% confidence level,** denotes significance at the 5% confidence level,

*** denotes significance at the 1% confidence level.

Table 4

Appendix: Detailed data description and sources

All data were obtained from the OECD statistical compendium.

CPI Inflation: Annualized percentage change of Consumer Price Index (All items), quarterly data . Annualized inflation rate was obtained from quarterly figures as:
$inflation = (1 + growthrate(CPI))^4 - 1$

GDP Deflator Inflation: Annualized percentage change of Deflator for GDP at Market Prices, quarterly data.
Annualized inflation rate was obtained from quarterly figures as:
$inflation = (1 + growthrate(GDP\ Deflator))^4 - 1$

PCE Deflator Inflation: Annualized percentage change of Deflator of private consumption expenditures, quarterly data. Annualized inflation rate was obtained from quarterly figures as:
$inflation = (1 + growthrate(PCE\ Deflator)^4 - 1$

Imported Goods Inflation: Annualized percentage change of Import price of Goods and Services index (IPI), quarterly data. Annualized inflation rate was obtained from quarterly figures as:
$inflation = (1 + growthrate(IPI))^4 - 1$

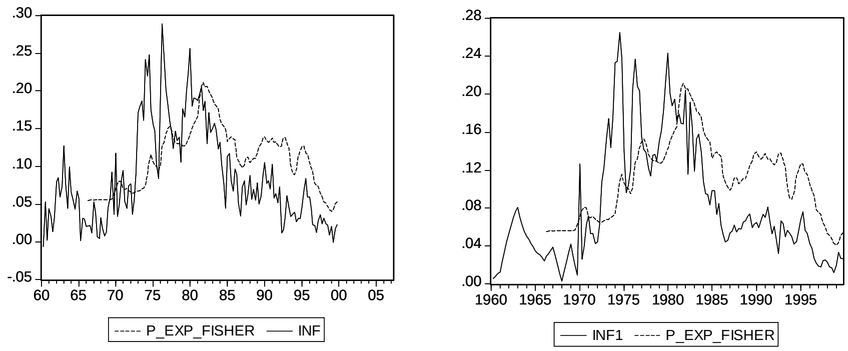
Unemployment Rate-*Approximating US concepts*: Civilian unemployment rate taken from Bureau of Labor Statistics (ISTAT) website, in the section "Labor Force, Employment, and Unemployment–International Statistics." Data were rescaled by the Bureau of labor Statistics (BLS) in order to facilitate international comparisons. For details see "Comparative Civilian Labor Force Statistics, 10 Countries, 1960-2004".

Tobin's q: Ratio of share price index to the investment deflator, normalized to be unity on average. Share price index (all shares) is relative to MIB stock exchange; Investment deflator is simply the deflator for total investment.

Inflation expectations-Fisher Equation: Difference between the nominal rate on long-term Italian bonds and a measure of the world real interest rate :

$$\pi^e = i^{LT} - r^* \tag{22}$$

The world real interest rate $r^*$is computed as the difference between the long-term US Treasury bond rate, and a five-year moving average of American CPI inflation (OECD data). Italian long-term and short-term quarterly interest rates were also taken from the OECD statistical compendium.



Expected and actual inflation: PCE (left) and CPI (right) specification

Method for accounting for supply shocks: Dummy variables or percentage changes of fuel and food prices, were alternatively used to account for supply shocks. The choice depends on the specification. For fuel prices we took the CPI of fuel, electricity and gasoline; for food prices the CPI for food excluding restaurants was employed.

- CPI specification:

D69=1 in 1969 Q2 ; zero otherwise
D74 =1 in 1974 Q1; zero otherwise
D75 =1 in 1975 Q1; zero otherwise
D76 =1 in 1976 Q3; zero otherwise
D80=1 in 1980 Q2; ; zero otherwise

- GDP Deflator specification

Current and lagged food price index percentage change
Current and lagged fuel price index percentage change

- PCE Deflator specification

Current and lagged food price index percentage change
Current and lagged fuel price index percentage change

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