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Inflation and Output in Italy : a Rational Expectations Interpretation

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Pubblicazione dell'Istituto di Economia
Facoltà di Scienze Economiche e Bancarie
Università degli Studi di Siena

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1983, gennaio
Stamperia della Facoltà

Giulio Cifarelli insegna Economia Monetaria e Creditizia

presso l'Istituto di Economia

della Facoltà di Scienze Economiche e Bancarie

dell'Università di Siena

La presente ricerca è stata effettuata presso il Centro di Calcolo dell'Università di Cambridge (Gran Bretagna), grazie ad un contributo del Consiglio Nazionale delle Ricerche.

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I. INTRODUCTION.

Macrorational models have been the object of intensive empirical investigation.

Approaches of varying complexity have been developed for that purpose.
They will be used in this paper to assess whether abstract models of this kind can be used to depict the Italian economy.

The answer is, on the whole, positive, a rather surprising result, since it was generally believed that neoclassical models could not be used to explain the behaviour of such an economy, because of oligopolistic market structures and of price rigidities.

A possible explanation is that during periods of rapidly rising prices - as was the case in Italy in the 1970s - nominal price rigidities tend to fade away, restoring the effectiveness of market forces.

The empirical investigation deals with a relatively long time period, spanning from 1960 to 1979, in which can be distinguished:

- the 1960-1969 subperiod, with relatively stable prices and rapidly growing output;
- the 1970-1979 subperiod, with rapidly growing prices and slow rate of growth of output.

The overall model fit is very good. If estimated using data from the first decade only, however, the quality of fit declines. On the whole the neoclassical elements of the mod el, connected with the Lucas supply curve, seem to be stronger in the 1970s than in the 1960s.

II. THE NATURAL RATE OF UNEMPLOYMENT WITH RATIONAL EXPECTATIONS MODEL.

T. Sargent (1973,1976), T. Sargent and N. Wallace (1975, 1976), R. Barro (1976), R. Barro and S. Fisher (1976) and others have investigated the economic policy ineffectiveness proposition with the help of relatively simple models, based on the juxtaposition of a supply curve relationship (which incorporates the Natural Rate of Unemployment hypothesis), of a demand side relationship (sometimes labelled equilibrium price relationship) and of a relationship describing the formation of Rational Expectations.(1)

We shall investigate two variants of this model: II-1 and II-2.

II-1 Consider the following model, which includes the following relationship.

Aggregate Supply Relationship.

1) $y_t = \alpha + \beta y_{nt} + \gamma (P_t - P^o_t) + u_{1t}$;

Equilibrium Prices Relationship (Aggregate Demand

(1) A byproduct of macrorational models is the "economic policy ineffectiveness proposition", which states that systematic (and thus anticipated) economic policy measures (events) do not influence output; they influence only prices. Unsystematic (and thus unanticipated) economic events only influence output, bringing about deviation from its equilibrium path.

Relationship).

2) $P_t = AM_t + BZ_t + C + u_{2t}$, where

M_t = money supply,

Z_t = vector of predetermined variables that influence prices,

P_t = prices,

P^o_t = anticipated (expected) prices,

y_t = real output.

The aggregate supply relationship 1) incorporates the Natural Rate of Unemployment hypothesis about the behaviour of economic agents: unexpected increases in the general price level raise supply because economic agents erroneously interpret such increases as increases in the relative price of the goods they are supplying, and they usually receive information about the price of their own goods faster than about the general price level. As a consequence, unanticipated increases in the inflation rate have an expansionary effect on output, raising its rate of growth above the trend rate.

The price level (sometimes labelled aggregate demand) relationship is a standard reduced form for the price level, which connects prices to money supply and to other stimuli.

- $x^o_t = E(x_t/\theta_{t-1})$ = value of x_t the public expects to prevail at time t;
- θ_{t-1} = set of observations on variables dated t-1 and earlier, at the disposal of the public and of the Government at time t;
- $E(\cdot)$ = mathematical expectations operator.

Expectations Formation Relationship.

We assume that economic agents believe price determination to be explained by equation 2).Taking expectations of eq.2),we obtain the price expectations formation relationship.

3) $E(P_t/\theta_{t-1}) = P^o_t = AM^o_t + BZ^o_t + C$ (2).

Equations 1), 2) and 3) constitute the first model that shall be investigated empirically.

T. Sargent (1973),T. Sargent and N. Wallace (1975) and R. Shiller (1978) have developed a slightly different model, in which the IS-LM framework is used to account explicitly for the determinants of aggregate demand.

II-2 Consider the following model:

Aggregate Supply Relationship.

1) $y_t = \alpha + \beta y_{nt} + \gamma(P_t - P^o_t) + u_{1t}$.

IS. Relationship (or Aggregate Demand Schedule).

4) $y_t = b_1 + b_2 r_t + b_3 Z_t + u_{3t}$

LM. Relationship (or Portfolio Balance Schedule).

5) $M_t = P_t + c_1 y_t + c_2 r_t + u_{4t}$, where

r_t = interest rate.

We have here a three equations model in y_t, r_t and P_t. Solving the model for P_t,we obtain the following reduced form:

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(2) We assume that

$E(u_{2t} / \theta_{t-1}) = 0.$

Sargent and Wallace (1976),p.170, pointed out that ".... the Rational Expectations hypothesis does not require that peoples' expectations equal conditional expectations,only that they equal conditional expectations plus what may be a very large random term (random with regard to the conditioning information)"

2') $$P_t = J(\alpha + \beta y_{nt}) + J\gamma P^o_t + Jwb_1 + Jwb_3 Z_t + Jw\frac{b_2}{c_2}M_t + Jw\left(u_{3t} - \frac{b_2}{c_2}u_{4t} - w^{-1}u_{1t}\right),$$ where

$$J = \left[\gamma + \left(1 + b_2\frac{c_1}{c_2}\right)^{-1} b_2\frac{c_1}{c_2}\right]^{-1} = \left[\gamma + wb_2\frac{c_1}{c_2}\right]^{-1};$$

$$w = \left(1 + b_2\frac{c_1}{c_2}\right)^{-1}.$$

Equation 2') can be rewritten as:

2") $P_t = A'M_t + B'Z_t + D'P^o_t + C' + u_{2''t}$.

Equation 2") is analogous to the price equation (aggregate demand reduced form) 2) of the previous model.

Price Expectations Relationship.

We assume economic agents believe price formation to be explained by equation 2").Taking expectations of P_t,conditional on information available at time t-1,we obtain:

6) $$P^o_t = \frac{J(\alpha + \beta y_{nt})}{1 - J\gamma} + \frac{Jwb_3 Z^o_t}{1 - J\gamma} + \frac{Jw\frac{b_2}{c_2}M^o_t}{1 - J\gamma} + \frac{Jwb_1}{1 - J\gamma}$$

$$P^o_t = \frac{A'}{1 - D'}M^o_t + \frac{B'}{1 - D'}Z^o_t + \frac{C'}{1 - D'} = A''M^o_t + B''Z^o_t + C''.$$ (3)

Equations 1), 2") and 6) constitute an additional model,

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(3) If Z_t is a vector such that

$Z_t = (Z_{1t}\ Z_{2t})$, where

Z_1 is a subvector of lagged variables,such that

$Z^o_{1t} = Z_{1t}$,

equation 6) could be rewritten as:

$$P^o_t = \frac{J(\alpha + \beta y_{nt} + wb_3 Z_{1t})}{1 - J\gamma} + \frac{Jwb_3 Z^o_{2t}}{1 - J\gamma} + \frac{Jw\frac{b_2}{c_2}M^o_t}{1 - J\gamma} + \frac{Jwb_1}{1 - J\gamma}.$$

This approach shall be followed in the empirical investigation below.

that has been tested empirically.

In both models, subtracting from the price determination relationship the corresponding price expectations relationship, we obtain an equation of the form:

7) $(P_t - P^o_t) = A(M_t - M^o_t) + B(Z_t - Z^o_t) + u_{7t}$.

It explains the behaviour of unanticipated prices in terms of unanticipated stimuli. Subtituting in equation 1), we obtain the Lucas supply curve "reduced".

8) $y_t = \alpha + \beta y_{nt} + \gamma [A(M_t - M^o_t) + B(Z_t - Z^o_t)] + (u_{1t} + \gamma u_{7t})$.

It illustrates how unanticipated stimuli bring about output deviations from trend. Anticipated stimuli are here assumed not to exert any effect on output. Reduced form 8) has been used to measure the relevance of the "economic policy ineffectiveness proposition" once equation 1) has been used to assess its validity, since, as has been shown by T. Sargent (1976, b), relationships of this kind are compatible with non neutral interpretations.

II-3 The following equations will be estimated:

Rational Expectations Relationship.

$E(P_t / \theta_{t-1}) = P^o_t = F(M^o_t, Z^o_t$, constant term).

It is obtained by regressing current prices on M^o_t, Z^o_t and a constant, i.e. as least squares forecasts of the random variable P_t, based on information available at time t.(4) It should

(4) P^o_t is the fitted value of the following relationship, estimated by OLS: 3') $P_t = AM^o_t + BZ^o_t + C + u_{3't}$ $P^o_t = P_t - u_{3't}$; or of

6') $P_t = \frac{A''}{1-D''} M^o_t + \frac{B'}{1-D'} Z^o_t + \frac{C'}{1-D'} + u_{6't}$ $P_t = P_t - u_{6't}$.

Current prices are used as a proxy for unobservable price

be noticed that it can be interpreted either as equation 3):

$P^o_t = AM^o_t + BZ^o_t + C$, or as equation 6):

$P^o_t = \frac{A'}{1-D'} M^o_t + \frac{B'}{1-D'} Z^o_t + \frac{C'}{1-D'}$.(5)

If the instrumental variables approach to Rational Expectations estimation is replaced by non linear simultaneous equations approaches, this is no longer the case.

Price Determination Relationship.

2) $P_t = AM_t + BZ_t + C + u_{2t}$.

2") $P_t = A'M_t + B'Z_t + D'P^o_t + C' + u_{2"t}$.

Aggregate Supply Relationship (Lucas Supply Curve).

1) $y_t = \alpha + \beta y_{nt} + \gamma (P_t - P^o_t) + u_{1t}$. We assume that $E(u_{1t} / \theta_{t-1}) = 0$.

Price Forecast Error Equations (Unanticipated Prices).

7) $(P_t - P^o_t) = A(M_t - M^o_t) + B(Z_t - Z^o_t) + u_{7t}$,

or, alternatively:

7') $P_t = P^o_t + A(M_t - M^o_t) + B(Z_t - Z^o_t) + u_{7't}$.

Prices will be equal to anticipated prices if economic policy

(Suite of note (4)) ... expectations. In other words, $P^o_t = E(P_t / \theta_{t-1})$ is the prediction from a least squares regression of P_t on θ_{t-1}. As a consequence, $u_{3't}$ and $u_{6't}$ are least squares residual vectors, orthogonal to θ_{t-1} by construction.

(5) It should be noticed that if $D' \equiv 1$, equation 6) becomes indeterminate.

stimuli are correctly anticipated. Price forecast errors are associated with economic stimuli forecast errors.

Lucas Supply Curve Reduced.

$$8)\quad y_t = \alpha + \beta y_{nt} + \gamma\left[A(M_t - M_t^o) + B(Z_t - Z_t^o)\right] + (u_{1t} + \gamma u_{7t}).$$

It can be estimated by means of non linear least squares. Alternatively, the following relationship has been estimated by means of linear approaches:

$$8')\quad y_t = \alpha + \beta y_{nt} + \gamma_1 (M_t - M_t^o) + \gamma_2 (Z_t - Z_t^o) + (u_{1t} + \gamma u_{7t}).$$

III. EMPIRICAL ESTIMATION OF THE NATURAL RATE OF UNEMPLOYMENT WITH RATIONAL EXPECTATIONS MODEL.

III- 1 The Data.

We assume that

$$Z_t = (y_{nt}\ P_{t-1}\ e_t\ P_{mt})' = (Z_{1t}\ Z_{2t})', \quad \text{where}$$

$$Z_{1t} = (y_{nt}\ P_{t-1})'; \quad Z_{2t} = (e_t\ P_{mt})'.$$

M_t = quarterly rate of growth of the money supply;(6)

e_t = quarterly rate of growth of the volume of exports. This index is assumed to take into account the demand of the "Rest of the World" for Italian goods.

P_{mt} = quarterly rate of growth of import prices in domestic currency. (Import prices, expressed in foreign currencies

(6) The quarterly rate of growth of the variable x_t is given by $\dfrac{x_t - x_{t-4}}{x_{t-4}}$.

multiplied by the Lira exchange rate with these currencies). This index takes into account exchange rate devaluations.(7)

P_t = quarterly rate of growth of consumer prices;(8)

y_t = quarterly rate of growth of Italian industrial output;

y_{nt} = trend rate of growth of industrial output.

In the investigations below we have assumed that either

$$y_{nt} = c_1\, y_{t-1}, \quad \text{or} \quad y_{nt} = \sum_{i=1}^{3} c_i y_{t-i}.$$

These assumptions have been made on the basis of the autoregressive structure of the y_t time series.(9)

(7) P_{mt} coefficients quantify foreign price effects. Three basic channels of influence are usually identified, through which an external price increase can affect domestic inflation and economic activity:
- the trade balance effect, which raises exports, aggregate demand, output and the price level;
- the overall balance of payments effect, which raises international currency reserves, the monetary base and thus output and prices;
- the direct cost effect, which leads to higher prices and lower output insofar as imports enter production functions and higher import prices raise production costs. If the coefficient of P_{mt} is positive in the output relationship, the first two effects dominate this direct cost effect; if the P_{mt} coefficient is negative, the direct cost effect is dominant. This coefficient turns out to be positive in our investigations.

(8) No quarterly data are available for the general price level, or GNP deflator.

(9) The y_t time series can be represented either by a first order or by a third order autoregression: Over the 1960.I-1979.IV time period, we obtain the following estimates:

$$\underset{(10.15)}{y_t = 0.79\, y_{t-1}}. \qquad y_t = \underset{(6.89)}{0.85}\, y_{t-1} + \underset{(0.79)}{0.13}\, y_{t-2} \underset{(-2.27)}{-0.28}\, y_{t-3}.$$

S.E.=0.052; D.W=1.81; D.h=-0.97. S.E.=0.050; D.W=2.13; D.h=2.69.

Additional estimations have been performed, in which public debt (outstanding) in the hands of the public $-DB_t-$ and Government expenditures $-DG_t-$ have been included in Z_t. They do not exert any significant effect and have been dropped in the estimation below. The fit is not affected by their removal.[10]

III-2 The Quantification of Rational Expectations:

Anticipations of the public about the behaviour of a given economic policy variable x_t (an element of vector Z_t) are proxied in two ways:

- as a moving average of this very variable, spanning over four time periods;
- as the fitted value of a regression (by OLS) of this variable on its own past values.

MA (Moving Average):

$$E(x_t / \psi_{t-1}) = x^o_t = 1/4 \sum_{i=1}^{4} x_{t-i} ;^{(11)}$$

(10) DB_t was assumed to include Treasury Bills and Public Sector Assets not purchased by the Bank of Italy. Public Sector Assets lump together Government assets and Bonds issued on behalf of the Treasury and of various Local Agencies. To this aggregate are added Postal Savings. DG_t was assumed to be the year to year change - on a quarterly basis - of Government expenditure per unit of the labour force. (J.Stein's approach (1976) was used here).

(11) $\psi_{t-1} = (x_{t-1}\ x_{t-2}\ x_{t-3}\ x_{t-4})$;

θ_{t-1} is composed of $Z_{t-1}, Z_{t-2}, Z_{t-3}$ and Z_{t-4} ;

x_t is an element of Z_t .

OA (Own Autoregression):

$$E(x_t / \psi_{t-1}) = x^o_t = \hat{\lambda}(L)x_t ,^{(12)}$$

where it is assumed that x_t can be represented by the corresponding time series:

$$x_t = \lambda(L) + e_t = \lambda_0 + \lambda_1 x_{t-1} + \lambda_2 x_{t-2} + \dots + e_t .$$

x^o_t is the anticipated value of x_t, conditional on information about it, at time t-1. ψ_{t-1} is the information set of the public about x_t. The idea is that individuals derive anticipations about the (unobserved) current value of x_t by looking at its own past value.

Unanticipated stimuli are obtained as:

$$x_t - x^o_t = x_t - 1/4 \sum_{i=1}^{4} x_{t-i} ,$$

and as:

$$x_t - x^o_t = x_t - \hat{\lambda}(L)x_t = e_t .$$

III-3 Empirical Findings Based on Quarterly Data from 1960, I-1979. IV.

Estimations are performed over the three time periods:

1960, I° quarter to 1979, IV° quarter;
1960, I° quarter to 1969, IV° quarter;
1970, 1° quarter to 1979, IV° quarter.

a) Price Expectations Table (I)

$$3)\ P^o_t = AM^o_t + BZ^o_t + C = \frac{A'}{1-D'} M^o_t + \frac{B'}{1-D'} Z^o_t + \frac{C'}{1-D'} = 6).$$

(12) We accept here the conclusions of McCallum (1979) and E.J. Bomhoff (1980) about the implausibility of stable economic policy behaviour rules. Indeed because of flexible exchange rates the hypothesis of a "normal" rate of money growth has to be rejected. Money growth and the growth of other stimuli are, as suggested by Bomhoff, more or less noisy random processes.

TABLE I

$$\begin{cases} (3) \quad P_t = a_1 \; M^o_t + a_2 \; e^o_t + a_3 \; P^o_{mt} + E \; P_{t-1} + F \; y_{nt} + C + u_{3t} \; ; \quad P^o_t = P_t - u_{3t} \; . \\ (6) \quad P_t = \frac{a'_1 M^o_t}{1-D'} + \frac{a'_2 e^o_t}{1-D'} + \frac{a'_3 P^o_{mt}}{1-D'} + \frac{E'P_{t-1}}{1-D'} + \frac{F'y_{nt}}{1-D'} + \frac{C'}{1-D'} + u_{6t} \; ; \quad P^o = P_t - u_{6t} \; . \end{cases}$$

	$y_{nt} = c_1 \; y_{t-1}$				$y_{nt} = c_1 y_{t-1} + c_2 y_{t-2} + c_3 y_{t-3}$			
OLS Estimates	$\bar{R}^2$	S E	D W	Anti. St.	$\bar{R}^2$	S E	D W	Anti. St.
1960.I-1 979.IV	0.94	0.016	1.45	MA	0.94	0.016	1.40	MA
	0.95	0.015	1.80	OA	0.95	0.014	1.7	OA
1970.I-1979.IV	0.92	0.017	1.93	MA	0.92	0.017	1.70	OA
	0.92	0.017	1.97	OA	0.92	0.017	1.80	MA
1960.I-1969.IV	0.78	0.008	1.25	MA*	0.78	0.012	2.33	MA
	0.80	0.007	1.29	OA	0.87	0.006	1.93	OA

* The explanatory power of the expected inflation rate regression is smaller in the 1960.I-1969.IV time period than in the 1970.I-1979.IV time period. Chow tests show that the coefficients of this regression have not been stable over the two time periods.

The empirical findings can be alternatively interpreted in terms of price equations 2) or 2").

They support the Rational Expectations hypothesis. The quality of fit seems to be lower if anticipated stimuli are measured as moving averages. (M.A.). Autocorrelation of residuals is low, as should be the case following the Rational Expectations hypothesis (since lagged prices are included in the information set), but for stimuli of the 1960,I-1969,IV period, if the trend rate of growth of output, y_{nt}, is proxied by y_{t-1}.(13) Autocorrelation of residuals seems on the whole to be lower, if anticipated stimuli are measured as fitted values of their own autoregressions (O.A.). Trend rate of growth of output, y_{nt}, which appears in the information set of the public, has been proxied either by y_{t-1}, or by $\sum_{i=1}^{3} c_i \; y_{t-i}$. There are no differences in the corresponding price expectations, but for the 1960,I-1969,IV time period.(14)

(13) If lagged values of P_t - the rate of growth of prices - are not included in the information set, autocorrelation of residuals becomes severe, but, as shown by T.Sargent (1979), p. 331, this is not in contradiction with the Rational Expectations. Serial correlation of residuals damages the Rational Expectations orthogonality hypothesis only if lagged dependent variables are included in the information set.

The model has been tested for various specifications of the information set, in particular with an information set that includes anticipated values of public debt issues in the hands of the public $-DB_t-$ and Government expenditure $-DG_t-$. The latter experiments do not improve, however, the quality of the fit, and have not been included here.

(14) The rate of growth of output of the previous quarter seems to play a relevant role in the determination of price expectations. We can consider it as an excess demand proxy, which influences price expectations of suppliers.

b) Price Determination Equations.[15]

2) $P_t = AM_t + BZ_t + C + u_{2t}$ (Table II)

From an economic point of view this reduced form is quite general and is not connected with the Rational Expectations hypothesis.

Over both the 1960,I-1979,IV and 1970,I-1979,IV time periods, the quality of fit is good. Chow tests show that the coefficients have not been stable over these two periods.

The main factor influencing inflation is, besides the lagged inflation rate, the rate of growth of import prices. Neither foreign demand, nor money supply seem to exert a relevant impact. The quality of fit declines somewhat if the equation is estimated over the 1960,I-1969,IV time period.

2") $P_t = A'M_t + B'Z_t + D'P^o_t + C' + u_{2''t}$ (Table III)

The quality of fit is rather poor if P_{t-1}, the lagged rate of growth of prices, is included in Z_t, the vector of predetermined variables, because of collinearity between P^o_t and P_{t-1}. As a consequence, I have tested two alternative versions of equation 2"), in which either P_{t-1} has been replaced by P_{t-2}, the rate of growth of prices lagged two periods, or P_{t-1} has been dropped altogether. In both cases the growth rate of import prices and inflationary expectations seem to be the two main factors influencing inflation. These findings are stable both with respect to the choice of stimuli anticipation proxies

(15) Equations of this kind are not usually estimated in Rational Expectations models. Reduced forms 7), 7') only are estimated since, as we shall see, they provide a better fit.

TABLE II

2) $P_t = a_1 M_t + a_2 e_t + a_3 P_{mt} + EP_{t-1} + Fy_{nt} + C + u_{2t}$.

$y_t = c_1 y_{t-1}$

	P_t	M_t	e_t	P_{mt}	P_{t-1}	y_{t-1}	C	$\bar{R}^2$	S.E.	D.W.	Durb.h
1960.I-1979.IV	OLS	0.04 (1.58)	0.01 (0.68)	0.13 (7.38)	0.81 (22.8)	0.02 (0.40)	-0.004 (-0.69)	0.97	0.007	1.57	1.80
	CO*	0.03 (1.03)	0.01 (0.01)	0.14 (6.94)	0.78 (18.8)	0.01 (0.40)	-0.0001 (-0.01)	0.97	0.007	1.96	-
1970.I-1979.IV	OLS	0.03 (0.48)	0.01 (0.26)	0.13 (5.25)	0.79 (16.5)	0.04 (0.95)	0.002 0.13	0.95	0.006	1.65	1.17
1960.I-1969.IV	CO**	-0.07 (-0.9)	-0.04 (-1.0)	-0.05 (-0.47)	0.25 (1.06)	-0.10 (-1.37)	0.05 (2.59)	0.82	0.0008	1.62	-

$y_{nt} = c_1 y_{t-1} + c_2 y_{t-2} + c_3 y_{t-3}$.

	P_t	M_1	e_t	P_{mt}	P_{t-1}	y_{t-1}	y_{t-2}	y_{t-3}	C	$\bar{R}^2$	S.E.	D.W.	Durb.h
1960.I-1979.IV	OLS	0.04 (1.37)	0.01 (0.47)	0.13 (7.07)	0.81 (22.9)	0.001 (0.03)	0.06 (1.59)	-0.003 (-1.10)	-0.003 (-0.50)	0.97	0.007	1.53	1.94
	CO	0.03 (0.92)	0.01 (0.37)	0.14 (6.44)	0.79 (18.8)	-0.005 (-0.16)	0.05 (1.7)	-0.03 (-0.87)	-0.001 (-0.02)	0.97	0.007	1.94	-

* CO = Cochrane Orcutt iterative approach, used to eliminate first order serial correlation of residuals of the OLS estimates.

**OLS estimates are affected by serial correlation of residuals, since the corresponding Durbin's h statistic is 2.84.

TABLE III

) $P_t = a_1'M_t + a_2' e_t + a_3' P_{mt} + E'P_{t-2} + F'y_{nt} + D'P^o_t + C' + u_{2''t}$. $(P_{t-1} = P_{t-2})$.

$y_{nt} = c_1 \; y_{t-1}$

	P_t	M_t	e_t	P_{mt}	P_{t-2}	y_{t-1}	P^o_t	C'	$\bar{R}^2$	S.E.	D.W.	Ant.St.	Dur.h
;0.I-1979.IV	CO	0.02 (0.41)	0.02 (0.86)	0.18 (7.33)	0.24 (2.35)	-0.05) (-1.52)	0.49 (4.51)	0.006 (0.68)	0.97	0.011	1.83	MA	-1.16
	CO	0.02 (0.46)	0.02 (0.80)	0.18 (7.11)	0.34 (3.48)	-0.03 (-1.03)	0.38 (3.66)	0.005 (0.52)	0.97	0.011	1.73	OA	-1.70
70.1-1979.IV	OLS	0.07 (1.28)	0.02 (0.87)	0.13 (5.75)	0.01 (0.13)	-0.11 (-2.26)	0.84 (6.38)	-0.01 (-1.03)	0.96	0.012	1.90	MA	-0.46
	CO	0.03 (0.38)	0.01 (0.17)	0.19 (6.12)	0.37 (2.71)	-0.03 (-0.69)	0.36 (2.55)	0.003 (0.13)	0.95	0.013	1.62	OA	-2.23
,0.1-1969.IV	OLS	-0.15 (-2.40)	-0.01 (-.01)	-0.01 (-0.16)	-0.29 (-1.7)	0.02 (0.35)	1.18 (5.17)	0.02 (1.36)	0.83	0.007	1.88	MA	-0.54
	OLS	-0.03 (-0.46)	-0.04 (1.1)	-0.03 (-0.34)	-0.24 (-1.5)	-0.02 (-.45)	1.23 (5.40)	0.01 (0.72)	0.84	0.007	2.08	OA	0.33

$y_{nt} = c_1 \; y_{t-1} + c_2 y_{t-2} + c_3 y_{t-3}$.

	P_t	M_t	e_t	P_{mt}	P_{t-2}	y_{t-1}	y_{t-2}	y_{t-3}	P^o_t	C'	$\bar{R}^2$	D.W.	Ant.St.
:0.1-1979.IV	CO	0.02 (0.43)	0.01 (0.70)	0.17 (6.85)	0.28 (2.57)	-0.04 (-1.25)	0.01 (0.18)	0.03 (1.12)	0.46 (4.09)	0.004 (0.41)	0.97	1.80	MA
	CO	0.02 (0.50)	0.01 (0.64)	0.17 (6.60)	0.37 (3.69)	-0.03 (-0.84)	0.02 (0.57)	0.04 (1.24)	0.36 (3.38)	0.003 (0.27)	0.97	1.71	OA

; $P_t = a_1' M_t + a_2' e_t + a_3' P_{mt} + F' y_{nt} + D' P^o_t + C' u_{2''t}$. $(P_{t-1}$ is dropped) .

$y_{nt} = c_1 \; y_{t-1}$

	P_t	M_t	e_t	P_{mt}	P_{t-2}	y_{t-1}	P^o_t	C'	$\bar{R}^2$	S.E.	D.W.	Ant.St.
0.1-1979.IV	CO*	0.02 (0.59)	0.02 (0.92)	0.14 (6.86)		-0.09 (-3.46)	0.77 (18.40)	0.006 (0.87)	0.97	0.011	1.97	MA
	CO	0.03 (0.66)	0.01 (0.58)	0.14 (5.44)		-0.09 (-3.12)	0.75 (14.45)	0.007 (0.90)	0.97	0.012	2.04	OA

P^o_t and P_{t-2} must be correlated: dropping P_{t-2} we double the absolute value of the coefficient of P^o_t.
Estimates with the alternative proxy of output rate of growth trend, and for the other two time periods are similar to those set forth here.

and with respect to the choice of trend proxy $-y_{nt}$-.(16)

In the 1960.I-1969.IV time period the impact on inflation of import prices is almost nil, whereas the relevance of inflationary expectations rises. These results are not surprising, the abandonment of fixed exchange rates, oil price increases and associated inflationary pressures being phenomena of the 1970s only.

c) The Lucas Supply Curve:

1) $y_t = \alpha + \beta \, y_{nt} + \gamma \, (P_t - P^o_t) + u_{1t}$.(17)

(16) If the volume of exports and the money supply are dropped from price equation 2"), we obtain the following results over the 1960.I-1979.IV time period:

$$P_t = \underset{(2.19)}{0.01} \; \underset{(-1.51)}{-0.05} \, y_{nt} + \underset{(2.34)}{0.24} \, P_{t-2} + \underset{(4.51)}{0.49} \, P^o_t + \underset{(7.42)}{0.17} \, P_{mt} \;;$$

$\bar{R}^2$=0.97;D.W.=1.86;Ant.St.=MA.

$$P_t = \underset{(1.91)}{0.01} \; \underset{(-1.06)}{-0.04} \, y_{nt} + \underset{(3.45)}{0.34} \, P_{t-2} + \underset{(3.65)}{0.37} \, P^o_t + \underset{(7.29)}{0.18} \, P_{mt} \;;$$

$\bar{R}^2$=0.97;D.W.=1.78;Ant.St. = OA.

In both cases serial correlation of residuals has been eliminated with the Cochrane Orcutt iterative approach. These estimates are not seriously affected by the choice of output rate of growth trend proxy. (We have assumed here that $y_{nt} = c_1 \; y_{t-1}$).

(17) This relationship is important for the neutrality issue. We assume that M^o_t, e^o_t and P^o_{mt}, variables that influence price expectations, do not have an independent influence on output rate of growth.
We avoid in this way the problem of observational equivalence between neutral and non-neutral relationships mentioned by T.Sargent (1976,b).

TABLE IV

1) $y_t = \alpha + \beta y_{nt} + \gamma (P_t - P^o_t) + u_{1t}$

$y_{nt} = c_1 \; y_{t-1}$

	y_t	α	y_{t-1}	$(P_t-P^o_t)$	$\bar{R}^2$	S.E.	D.W.	Durb.h	Ant.St.
1960.I-1979.IV	OLS	0.01 (1.88)	0.69 (7.83)	0.90 (2.19)	0.50	0.049	1.62	2.11	MA
	CO	0.02 (2.12)	0.43 (3.75)	1.12 (2.80)	0.54	0.048	2.02	-	MA
	OLS	0.03 (2.90)	0.69 (7.83)	0.97 (2.20)	0.50	0.049	1.65	1.94	OA
	CO	0.02 (2.13)	0.49 (3.44)	1.07 (2.53)	0.53	0.048	2.02	-	OA
1970.I-1979.IV	CO	0.01 (1.20)	0.48 (3.48)	1.57 (3.23)	0.59	0.051	2.02	0.13	MA
	CO	0.02 (1.26)	0.49 (3.52)	1.20 (2.32)	0.54	0.054	2.00	0.0	OA
1960.I-1969.IV	CO	0.01 (0.36)	0.74 (3.28)	-0.98 (-0.95)	0.62	0.032	1.49	-	MA
	CO	0.01 (0.45)	0.73 (3.29)	-0.87 (-0.80)	0.61	0.033	1.54	-	OA

$y_{nt} = c_1 \; y_{t-1} + c_2 \; y_{t-2} + c_3 \; y_{t-3}$

	y_t	α	y_{t-1}	y_{t-2}	y_{t-3}	$(P_t-P^o_t)$	$\bar{R}^2$	S.E.	D.W.	Ant.St.
1960.I-1979.IV	OLS	0.02 (3.15)	0.75 (6.52)	0.14 (0.93)	-0.39 (-3.35)	0.86 (2.22)	0.58	0.045	2.20	MA
	CO	0.02 (3.79)	1.02 (7.05)	-0.11 (-.54)	-0.34 (-2.77)	0.66 (1.84)	0.60	0.042	2.10	OA

1') $y_t = \alpha + \beta y_{nt} + \gamma(\hat{P}_t - P^o_t) + (u_{1t} + \gamma f_t)$.

y_t	y_{t-1}	α	$(\hat{P}_t-P^o_t)$	$\bar{R}^2$	S.E.	D.W.	Durb.h	Ant.St.
OLS	0.01 (1.90)	0.69 (7.89)	1.19 (2.42)	0.51	0.049	1.56	2.45	MA
CO	0.03 (2.07)	0.40 (3.50)	1.66 (3.36)	0.56	0.047	1.95	-	MA
OLS	0.04 (3.15)	0.69 (7.92)	1.37 (2.51)	0.51	0.049	1.62	2.14	OA
CO	0.02 (2.13)	0.49 (4.48)	1.45 (2.90)	0.54	0.048	1.98	-	OA
CO	0.02 (1.19)	0.46 (3.36)	1.88 (3.58)	0.61	0.049	1.88	-0.70	MA
CO	0.02 (1.27)	0.47 (3.32)	1.38 (2.46)	0.55	0.053	1.91	0.59	OA
CO	0.005 (0.30)	0.77 (3.62)	-2.09 (-1.50)	0.64	0.032	1.41	-	MA
OLS	0.003 (0.28)	0.85 (5.85)	-3.16 (-2.41)	0.62	0.032	1.55	-1.56	OA

y_t	α	y_{t-1}	y_{t-2}	y_{t-3}	$(\hat{P}_t-P^o_t)$	$\bar{R}^2$	S.E.	D.W.	Ant.St.
OLS	0.02 (3.19)	0.75 (6.46)	0.13 (0.86)	-0.38 (-3.31)	0.82 (2.03)	0.57	0.046	2.17	MA
OLS	0.02 (3.19)	0.75 (6.43)	0.13 (0.86)	-0.38 (-3.29)	0.81 (1.91)	0.57	0.046	2.23	OA

As pointed out by T.Sargent (1973),macroeconomic theory implies that y_t and P_t be simultaneously determined and,as a consequence,that P_t and u_{1t} in equation 1) be correlated ,making least squares estimation of this equation inappropriate.[18]

Sargent suggests that the problem be solved by means of the standard instrumental variable approach,replacing P_t in equation 1) by $\hat{P}_t$, the predicted value of P_t from a first stage regression on auxiliary instruments.[19] As a consequence, we have estimated the following additional equation:

1') $y_t = \alpha + \beta y_{nt} + \gamma(\hat{P}_t - P^o_t) + (u_{1,t} + \gamma f_t)$, $\quad f_t = P_t - \hat{P}_t$

The alternative use of OA or MA approaches for the quantification of anticipated stimuli does not alter significantly the quality of fit. Over the 1960,I - 1979,IV and 1970, I - 1979,IV periods,the quality of fit is good:coefficient estimates are significant and have the appropriate signs. Over the 1960,I - 1969,IV time period,however,the quality of fit declines,unanticipated inflation having either a negative ef

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(18) The simultaneous equations bias affects coefficient γ only.Since it is assumed that
$$E(u_{1t} \,/\, \theta_{t-1}) = 0,$$
it follows that u_{1t} is uncorrelated with P^o_t. Moreover, by construction of P^o_t in equation 3), $(P_t - P^o_t)$is orthogonal to y_{nt}, P_{t-1} and to M^o_t, e^o_t and P^o_{mt} by the orthogonality of least squares residuals to regressors.However P_t and thus $(P_t - P^o_t)$ is correlated with u_{1t}, the error term of equation 1).

(19) $\hat{P}_t$ is the fitted value of P_t from a first stage OLS regression of P_t on a constant,y_{nt}, P_{t-1} and current and lagged values (with lags of up to four quarters) of the exogenous variables of the model, i.e. of M_t, e_t and P_{mt} . We take account here of the critiques of R. Fair (1979) to Sargent's original approach: here only variables appearing in the model are included among the regressors.

fect or even no effect at all on output rate of growth deviations from trend. Thus the Lucas supply curve does not seem to be stable over the period investigated. The effect of unanticipated inflation seems to be largest if estimation is restricted to the 1970,I - 1979,IV time period.

Evidence is also found of a downward bias in estimates of coefficient γ in equation 1), if compared to those of equation 1'), bias due to positive correlation between P_t and u_{1t} in equation 1).[20] The estimates do support the Natural Rate of Unemployment hypothesis: unanticipated accelerations in inflation will, on the whole, have a positive, significant effect on output rate of growth deviations from trend.[21]

The neutrality issue will be analysed in another paper: we assume here that economic agents are not affected by money illusion. We have tested, however, various specifications of the Lucas supply curve, in which unanticipated stimuli are assumed to affect output deviations from trend with lags, i.e. we have tested relationship of the form:

$$1'')\quad y_t = \alpha + \beta y_{nt} + \gamma_0(\hat{P}_t - P^o_t) + \sum_{i=1}^{n} \gamma i(P_{t-i} - P^o_{t-i}) + (u_{1''t} + \gamma f_t)$$

$$n = 1,2,3,4;$$

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(20) As pointed out by T. Sargent (1973) since u_{1t} and P_t are expected to be positively correlated estimating equation 1) instead of equation 1') should produce an estimate of coefficient biased downwards in large samples.

(21) The estimations above have been repeated with an enlarged information set, which includes DB_t (public debt in the hands of the public) and DG_t (Government expenditures), both expressed as rates of growth, with no significant alteration of the results.

TABLE V

$$1'')\quad y_t = \alpha + \beta y_{nt} + \gamma^o(\hat{P}_t - P^o_t) + \sum_{i=1}^{n} \gamma_i(P_{t-1} - P^o_{t-i}) + (u_{1''t} + \gamma f_t).$$

	$y_{nt} = c_1 y_{t-1}$					$y_{nt} = c_1 y_{t-1} + c_2 y_{t-2} + c_3 y_{t-3}$				
	Ant. St. n	$F^*_n \sum_{i=1} \gamma_i = 0$	MA $\bar{R}^2$	$F^*_n \sum_{i=1} \gamma_i = 0$	OA $\bar{R}^2$	Ant. St. n	$F^*_n \sum_{i=1} \gamma_i = 0$	MA $\bar{R}^2$	$F^*_n \sum_{i=1} \gamma_i = 0$	OA $\bar{R}^2$
1960.I-1979.IV	1	(1,60) 0.261	0.55	(1,60) 0.251	0.54	1	(1,58) 2.311	0.59	(1,58) 0.652	0.59
	2	(2,59) 1.351	0.52	(2,59) 0.294	0.50	2	(2,57) 1.422	0.59	(2,57) 0.344	0.58
	3	(3,58) 0.448	0.55	(3,58) 0.266	0.53	3	(3,56) 0.743	0.56	(3,56) 0.154	0.54
	4	(4,57) 0.351	0.54	(4,57) 0.202	0.52	4	(4,55) 0.986	0.58	(4,55) 0.196	0.56

* F tests of the null hypothesis that $\sum_{i=0}^{n} \gamma_i = 0$. The hypothesis is always accepted.
These tests have been repeated with relationships in which P_t has not been adjusted for correlation with the equation error term $- u_{1t} -$, with no relevant change in the results.

$$1''')\quad y_t = \alpha + \beta y_{nt} + \tau_i(P_{t-i} - P^o_{t-i}) + u_{1'''t}.$$

	$y_{nt} = c_1 y_{t-1}$					$y_{nt} = c_1 y_{t-1} + c_2 y_{t-2} + c_3 y_{t-3}$				
	Ant. St. n	$F^{**}\ \tau_i = 0$	MA $\bar{R}^2$	$F^{**}\ \tau_i = 0$	OA $\bar{R}^2$	Ant. St. n	$F^{**}\ \tau_i = 0$	MA $\bar{R}$	$F^{**}\ \tau_i = 0$	OA $\bar{R}^2$
1960.I-1979.IV	1	(1,61) 0.072	0.47	(1,61) 0.072	0.46	1	(1,59) 0.880	0.59	(1,59) 0.193	0.58
	2	(1,61) 1.32	0.48	(1,61) 0.315	0.47	2	(1,59) 1.606	0.59	(1,59) 0.189	0.58
	3	(1,61) 0.294	0.47	(1,61) 0.00	0.46	3	(1,59) 0.561	0.58	(1,59) 0.002	0.58
	4	(1,61) 2.704	0.49	(1,61) 1.08	0.47	4	(1,59) 1.438	0.59	(1.59) 0.220	0.58

** F tests of the null hypothesis that $\tau_i = 0$. The hypothesis is always accepted.

$$1''')'y_t = \alpha + \beta y_{nt} + \tau_i(P_{t-i} - P^o_{t-i}) + u_{1'''t} \quad [22],\ i = 1,2,3,4.$$

F tests have been performed of the null hypothesis that lagged unanticipated changes in inflation have coefficients not significantly different from zero. It turns out, as can be seen from Table V, that lagged stimuli are on the whole irrelevant and that equations 1) and 1') provide the appropriate specification of the Lucas supply curve.

d) Unanticipated Price Changes: (Table VI)

$$7)\quad P_t = FP^o_t + A(M_t - M^o_t) + B(Z_t - Z^o_t) + u_{7t} \quad ;$$

$$7')\quad (P_t - P^o_t) = A(M_t - M^o_t) + B(Z_t - Z^o_t) + u_{7't} \quad .$$

Inflationary expectations and unanticipated import price changes only have a significant effect on inflation.[23] Inflationary expectations have a one to one effect on inflation: the fit of equation 7), in which the coefficient of P^o_t is unrestricted, is almost identical to that of equation 7'), in which it is restricted to one.[24]

(22) We assume that $P^o_{t-i} = E(P_{t-i}/\theta_{t-i-1})$.

(23) M.Fratianni (1978) estimated an equation of this kind, using annual data, over the 1953 - 1975 time period, and found that unanticipated import price changes had no effect on inflation, their coefficient is equation 7) being not significantly different from zero.

(24) Comparing equations 7) and 2"), we find that substitution of stimuli with their unanticipated part only raises the absolute value of the coefficient of inflationary expectations to one, without altering the overall quality of the fit.

If we take into account the fact that expected inflation, P^o_t, was obtained by regressing P_t on P_{t-1} (the rate of inflation lagged one period), y_{nt} (trend rate of growth of output) and expected values of money supply, the volume of exports and the rate of change of import prices, we can say that these (expected) impulses and the unanticipated component of the growth rate import prices, are the determinants of inflation in Italy during the period under investigation.[25]

Money supply changes and changes in foreign demand for Italian goods affect inflation with a lag of at least one quarter, as soon as they enter the information set of

(25) The results are in line with what M. Fratianni (1978) labels the "dominant impulse" hypothesis of inflation: excess demand and inflationary expectations are the main determinants of inflation.
We have included here past rates of growth of output and prices among the determinants of inflationary expectation in order to reduce the serial correlation of residuals of equation 3) and thus to obtain an expression that is liable to simultaneous equations estimation approaches. We have performed additional estimations of the model equations, in which past rates of growth of output and prices are not included in the information set of the public.
The fit of equations 3) and 2") is affected by severe first order serial correlation of residuals. Eliminating it by means of standard approaches, we obtain estimates that are similar to those set forth above.
Alternative estimations have been performed, in which two additional instruments are taken into account: Government expenditure and public debt issues held by the private sector. Government expenditure seems to have an expansionary effect on prices and no effect at all on output. On the whole the coefficients of these additional stimuli are unstable and not significantly different from zero. They have been dropped from successive estimations.

TABLE VI

7) $P_t = FP^o_t + a_1 (M_t - M^o_t) + a_2 (e_t - e^o_t) + a_3 (P_{mt} - P^o_{mt}) + u_{7t}$

	P_t	P^o_t	$(M_t-M^o_t)$	$(e_t-e^o_t)$	$(P_{mt}-P^o_{mt})$	S.E.	D.W.	Ant. St.
1960.I.1979.IV	OLS *	1.00 (68.74)	0.03 (0.78)	-0.0004 (-0.02)	0.08 (4.91)	0.013	1.67	MA
	OLS	0.99 (75.89)	0.04 (0.82)	0.003 (0.13)	0.12 (5.38)	0.012	1.69	OA
1970.I-1979.IV **	OLS	1.00 (60.38)	-0.02 (-0.39)	0.01 (0.45)	0.06 (3.36)	0.014	2.15	MA
	OLS	0.99 (55.54)	-0.02 (-0.21)	0.002 (0.06)	0.11 (4.03)	0.014	1.80	OA
1960.I-1969.IV	CO	1.01 (17.85)	-0.09 (-1.54)	-0.01 (-0.41)	-0.03 (-0.34)	0.007	1.74	MA
	OLS	1.02 (22.82)	-0.03 (-0.46)	-0.03 (-1.24)	0.02 (0.32)	0.006	1.84	OA

* The fit is not significantly affected by the choice of alternative output (rate of growth) trend proxies in the price expectations formation equation 3). We assume here that $y_{nt} = c_1 y_{t-1}$

** Chow tests for coefficient stability over the different time periods, accept the hypothesis with OA anticipated stimuli and reject it with MA anticipated stimuli at the 5 percent significance level. The hypothesis is accepted with both kinds of anticipated stimuli at the 1 percent significance level.

7') $(P_t - P^o_t) = a_1 (M_t - M^o_t) + a_2 (e_t - e^o_t) + a_3 (P_{mt} - P^o_{mt}) + u_{7't}$.

		$(P_t-P^o_t)$	$(M_t-M^o_t)$	$(e_t-e^o_t)$	$(P_{mt}-P^o_{mt})$	S.E.	D.W.	Ant. St.
1960.I-1979.IV	OLS ***		0.03 (0.79)	-0.0004 (-0.02)	0.08 (4.96)	0.013	1.67	MA
	OLS		0.04 (0.85)	0.003 (0.17)	0.12 (5.41)	0.011	1.69	OA

*** The fit is similar to that of equations 7) above: this result is not surprising, since the null hypothesis that F = 1, where F is the coefficient of P^o_t, is accepted at the 5 percent level of significance, using F tests, in the three time periods analysed and with both kinds of anticipated stimuli proxies.

the public.[26] Meanwhile they have, as we shall see, a significant effect on output, an effect which in turn fades away as soon as these stimuli enter the information set of the public.

e) Lucas Supply Curve Reduced

8) $y_t = \alpha + \beta y_{nt} + \gamma [A(M_t - M^o_t) + B(Z_t - Z^o_t)] + (u_{1t} + \gamma u_{7t})$.

As seen above, this relationship has been obtained by substituting in the Lucas supply curve, eq. 1), the determinants of unanticipated price changes as set forth in eq. 7). As in the case of the Lucas supply curve, output rate of growth is assumed to consist of a trend rate and a transitory component, which depends upon unanticipated impulses. The advantage of relationships of this kind is that they allow to ascertain directly which stimulus brings about deviations of output from trend and by how much. (A further advantage is that such a relationship bypasses such price rigidities as might affect the estimation of the standard Lucas supply curve).

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(26) If equations 7) and 7') are estimated using besides inflationary expectations, import prices only as explanatory variables, we obtain the following results, over the 1960.I-1979.IV time period:

7) $P_t = 1.00 P_t + 0.08 (P_{mt} - P^o_{mt})$. (70.02) (5.06)
Ant. St. = OA; SE = 0.013; D.W. = 1.69.

7') $(P_t - P^o_t) = 0.08 (P_{mt} - P^o_{mt})$. (5.09)
Ant. St. = MA; S E = 0.013; D.W. = 1.69.

7) $P_t = 0.99 P^o_t + 0.13 (P_{mt} - P^o_{mt})$. (77.40) (5.65)
Ant. St. = OA; S.E = 0.011. D.W. = 1.78.

7') $(P_t - P^o_t) = 0.13 (P_{mt} - P^o_{mt})$. (5.67)
Ant. St. = OA; S.E = 0.011; D.W. = 1.79.

These estimates are not seriously affected by the choice of output rate of growth trend proxy. (We have assumed here that $y_{nt} = c_1 y_{t-1}$).

Estimates are set forth, both in linear and nonlinear forms: the quality of fit is in both cases very good. The main impulse is due to unanticipated monetary shocks, especially in the 1960, I - 1969, IV time period, a period in which unanticipated import price increases did not exert any significant effect (a result in line with the relatively low and predictable rate of international inflation, in those years of fixed exchange rates). The impact of import price unanticipated increases is highest in the 1970, I - 1979, IV time period, a finding which can be explained by the highly successful "beg at my neighbour" policy followed by Italian Authorities during this period. (This assumption is further corroborated by the large expansionary effect that unanticipated increases in the volume of exports have on output rate of growth). The quality of fit was not affected by the choice of trend rate of growth of output proxy, nor was it affected by the choice of anticipated stimuli proxies. Linear and nonlinear estimates were very similar. The estimate of coefficient γ in equation 8) is moreover very close to that obtained for equation 1).[27]

Neither unanticipated increases in Government expenditure[28] nor unanticipated increases in public debt exert any

(27) Chow tests for coefficient stability show that equation 8') estimates have been stable over time with OA anticipated stimuli and unstable with MA anticipated stimuli.

(28) Total ineffectiveness of unanticipated shifts in Government expenditure is rather surprising. These findings coincide however with those of L.Leiderman (1979) and of M.Fratianni (1978): in these studies, as in ours, industrial output has been used as dependent variable.

TABLE VII

Linear Estimation

$$8') \; y_t = \alpha + \beta y_{nt} + \left[\gamma_1 (M_t - M^o_t) + \gamma_2 (e_t - e^o_t) + \gamma_3 (P_{mt} - P^o_{mt})\right] + (u_{1t} + \gamma u_{2''t})^{*}.$$

$y_{nt} = c_1 \, y_{t-1}$.

	y_t	γ_1	γ_2	γ_3	y_{t-1}	α	$\bar{R}^2$	S.E.	D.W.	Durb.h	Ant.St.	L.L.F.
1960.I-1979.IV	OLS**	0.48 (4.59)	0.17 (3.25)	0.21 (3.39)	0.53 (6.06)	0.02 (3.24)	0.72	0.037	1.80	-1.11	MA	122.21
	OLS	0.57 (3.17)	0.25 (3.65)	0.25 (2.97)	0.66 (8.43)	0.01 (2.22)	0.70	0.038	1.95	-0.27	OA	120.97
1970.I-1979.IV	OLS	0.43 (3.43)	0.20 (3.02)	0.34 (5.03)	0.26 (2.46)	0.02 (3.69)	0.79	0.036	1.74	-1.13	MA	78.66
	OLS	0.52 (2.17)	0.24 (2.53)	0.30 (3.07)	0.58 (6.14)	0.005 (0.64)	0.72	0.041	1.88	-0.48	OA	73.14
1960.I-1969.IV	OLS	0.66 (3.74)	0.22 (1.97)	-0.05 (-0.16)	1.11 (7.96)	-0.01 (-1.27)	0.76	0.025	2.40	1.34	MA	57.04
	OLS	0.77 (2.48)	0.35 (2.78)	0.16 (0.50)	1.06 (7.75)	-0.01 (-1.24)	0.72	0.027	2.13	0.45	OA	55.01

$y_{nt} = c_1 \, y_{t-1} + c_2 \, y_{t-2} + c_3 y_{t-3}$.

	y_t	γ_1	γ_2	γ_3	y_{t-1}	y_{t-2}	y_{t-3}	α	$\bar{R}^2$	S.E.	D.W.	Durb.h	Ant.St.	L.L.F.
1960.I-1979.IV	CO***	0.51 (3.55)	0.19 (3.39)	0.24 (3.47)	0.29 (2.80)	0.16 (1.50)	-0.02 (-0.19)	0.02 (2.63)	0.72	0.0367	1.86	-	MA	122.07
	OLS	0.50 (2.76)	0.23 (3.34)	0.22 (2.59)	0.69 (6.60)	0.05 (0.43)	-0.16 (-1.53)	0.02 (2.70)	0.71	0.0378	2.07	0.54	OA	122.53

* These equations have been estimated including public debt and Government expenditure unanticipated changes as regressors; the null hypothesis that their coefficients are zero has been tested and accepted at the 5% significance level by means of F tests. These stimuli have been dropped from our estimation.

** Linear and nonlinear estimation fits are almost identical, over the three time periods: L.L.F. statistics almost coincide and $\gamma_1 = \gamma a_1$ in the corresponding equations.

*** OLS estimates are affected by serial correlation of residuals (Durbin's h = 2.2147).

These estimates have been repeated for the 1970.I-1979.IV and 1960.1-1969.IV time periods: coefficient estimates are, as in the case of nonlinear estimation, smaller in absolute value than in the $y_{nt} = c_1 \, y_{nt}$ version. The null hypothesis that the coefficients of y_{t-2} and y_{t-3} are zero is accepted at the 5% level, if tested using the F test.

TABLE VII

Nonlinear Estimation

8) $y_t = \alpha + \beta y_{nt} + \gamma \left[a_1(M_t - M_t^o) + a_2(e_t - e_t^o) + a_3(P_{mt} - P_{mt}^o)\right] + (u_{1t} + \gamma u_{2t})$.

$y_{nt} = c_1 y_{t-1}$

	y_t	γ	a_1	a_2	a_3	y_{t-1}	y_{t-2}	y_{t-3}	α	M.L.σ^2	L.L.F.	Ant. St.
1960.I-1979.IV	NL*	1.04 (6.52)	0.46 (3.66)	0.16 (2.70)	0.20 (2.57)	0.53 (5.29)			0.02 (3.12)	0.00128	122.20	MA
	NL	1.10 (5.25)	0.51 (3.40)	0.23 (2.42)	0.23 (2.32)	0.66 (8.75)			0.01 (2.09)	0.00133	120.97	OA
1970.I-1979.IV	NL	0.42 (5.38)	1.03 (3.02)	0.48 (2.55)	0.81 (4.91)	0.26 (2.66)			0.02 (3.91)	0.00115	78.66	MA
	NL	1.03 (3.34)	0.51 (2.22)	0.24 (1.63)	0.29 (1.76)	0.58 (6.37)			0.005 (0.67)	0.00151	73.14	OA
1960.I-1969.IV	NL	0.81 (2.16)	0.82 (2.13)	0.28 (1.32)	-0.06 (-0.20)	1.11 (9.40)			-0.14 (-1.50)	0.00050	57.04	MA
$y_{nt} = c_1 y_{t-1} + c_2 y_{t-2} + c_3 y_{t-3}$												
1960.I-1979.IV	NL**	0.62 (4.13)	0.76 (2.81)	0.26 (3.09)	0.32 (3.53)	0.49 (4.56)	0.11 (0.94)	-0.08 (-0.77)	0.02 (3.18)	0.00126	122.72	MA
	NL***	0.74 (2.70)	0.68 (2.03)	0.31 (2.60)	0.31 (2.12)	0.69 (6.86)	0.05 (0.45)	-0.16 (-1.63)	0.02 (2.86)	0.00127	122.53	OA

* Nonlinear Estimation approach provided by the SHAZAM computer program.

** γ coefficient estimates are, as was the case for the Lucas supply curve estimates, eq. 1), smaller in absolute value when the trend rate of growth of output is proxied by $c_1 y_{t-1} + c_2 y_{t-2} + c_3 y_{t-3}$.

***These estimates have been repeated for the 1970.I-1979.IV and 1960.I-1969.IV time periods: coefficient estimates are smaller in absolute value than in the $y_{nt} = y_{t-1}$ version above, but the overall fits are not significantly different and have not been set forth here.

effect on output rate of growth deviations from trend. On the other hand, by means of shifts in the three remaining stimuli, it could be possible to alter significantly output rate of growth in the short run. Systematic, i.e. anticipated, stimuli do not exert any effect on output, in line with the "economic policy ineffectiveness" proposition. Avoiding unanticipated shifts in these stimuli, it could then be possible to minimise deviations of output rate of growth from trend.

The findings of the model investigated above suggest that active countercyclical economic policy is effective in the short run, but inflationary in the longer run. A devaluation, an autonomous increase in the volume of exports, or an increase in the money supply rate of growth have large expansionary effects. After one time period these stimuli enter the information set of the public and begin to affect inflationary expectations and thus inflation. The inflationary effect will disappear when a sufficient number of time periods has elapsed for the stimulus to be excluded from the information set of the public.(29) Depending upon the nature of the shock and upon whether MA or OA approaches have been used to

(29) I have investigated the hypothesis that unanticipated stimuli influence output rate of growth deviations from trend with lags of various length. With the exception of unanticipated changes of import prices, which may have a deflationay effect on output after three quarters, the remaining stimuli do not seem to have lagged effects. Using annual data, E.J. Bomhoff (1980) has found instead that, in the U.S., an unanticipated increase in money supply has a large negative effect on output after one year, which does offset the expansionary effect of the initial period.

quantify anticipated stimuli, such a lag may vary over time.

IV. SIMULTANEOUS EQUATIONS APPROACHES.

Estimating equations 1), 2) and 3) by OLS yields consistent but inefficient estimates, since cross equation restrictions are not taken into account.

To take into account the latter we can either constrain to zero the off diagonal elements of the variance covariance matrix of residuals, as suggested by C.Attfield, D.Demery and N.Duck(1981),[30] of a two equations system consisting of equations 1) and 2), or we can collapse the system into its constrained reduced form, as suggested by L.Leiderman (1980), J.B. Taylor (1979) and T. Sargent (1978).

In the latter case we can estimate a system consisting of equations 8) and 2"), without constraining the variance covariance matrix of error terms by means of maximum likelihood estimation approaches.[31]

The following systems have been estimated by means of an iterative nonlinear seemingly unrelated equation routine that can be found in the TSP computer package, constraining to zero the off diagonal elements of the variance covariance matrix of residuals.[32]

(30) Such an approach had been used by R. Barro (1978).

(31) J.B.Taylor suggests the use of a "minimum distance estimator", such as that developed by S. Malinvaud (1970), which converges to maximum likelihood estimates for large sample sizes. L.Leiderman (1980) suggests the use of FIML approaches using Wymer's Resimul (1978) computer program.

Model I:

$$1)\quad y_t = \alpha + \beta y_{nt} + \gamma \left[P_t - (AM^o_t + BZ^o_t + C)\right] + u_{1t} \quad ;$$

$$2)\quad P_t = AM_t + BZ_t + C + u_{2t} \quad .$$

Model II:

$$1)\quad y_t = \alpha + \beta y_{nt} + \gamma \left[P_t - \left(\frac{A'}{1-D'} M^o_t + \frac{B'}{1-D'} Z^o_t + \frac{C'}{1-D'}\right)\right] + u_{1t} \quad ;$$

$$2")\quad P_t = A'M_t + B'Z_t + \frac{D'}{1-D'}(A'M^o_t + B'Z^o_t + C') + C' + u_{2"t} \quad .$$

Alternatively, the following restricted reduced forms have been estimated by means of a FIML algorithm, imposing no restrictions on the variance covariance matrix of error terms.[33]

Model I:

$$1)\quad y_t = \alpha + \beta y_{nt} + \gamma\left[A\,(M_t - M^o_t) + B(Z_t - Z^o_t)\right] + (u_{1t} + \gamma u_{2t}) \quad ;$$

(32) The system becomes recursive if the off-diagonal elements of the variance covariance matrix of error terms are set to zero.. $\begin{bmatrix}\sigma_{11} & 0 \\ 0 & \sigma_{22}\end{bmatrix}$, where

$$\begin{bmatrix}\sigma_{11} & \sigma_{12} \\ \sigma_{21} & \sigma_{22}\end{bmatrix} = E\left[(u_{1t}\ u_{2t})(u_{1t}\ u_{2t})'\right]$$

(33) These relationships have been obtained by replacing P_t and P^o_t by their determinants as set forth in the corresponding price equations 2), 2"), 3) and 6).

TABLE VIII

MODEL I

$$\begin{cases} 1) & y_t = \alpha + \beta y_{nt} + \gamma \left[P_t - (C + a_1 M^o_t + a_2 e^o_t + a_3 P^o_{mt} + E P_{t-1} + F y_{nt})\right] + u_{1t} \\ 2) & P_t = C + a_1 M_t + a_2 e_t + a_3 P_{mt} + E P_{t-1} + F y_{nt} + u_{2t} . \end{cases}$$

$y_{nt} = c_1 y_{t-1}$.

	α	β	γ	C	a_1	a_2	a_3	E	F	L.L.F.	Ant. St.	Eq. Nb.	S.E.	D.W.	Covariance Matrix of Transformed Residuals	
1960.I-1979.IV	0.02	0.41	2.88	-0.02	0.09	0.04	0.11	0.85	0.03	312.171	MA	(1)	0.053	1.44	1.0013	-0.0084
	(4.00)	(5.15)	(7.99)	(-3.41)	(4.07)	(3.15)	(7.19)	(25.70)	(1.15)			(2)	0.011	1.61	-0.0084	0.9986
	0.01	0.58	3.47	-0.01	0.07	0.05	0.12	0.84	0.02	311.272	OA	(1)	0.058	1.72	1.0008	-0.0085
	(2.54)	(7.82)	(9.02)	(-3.02)	(3.17)	(3.80)	(7.56)	(25.68)	(1.02)			(2)	0.011	1.63	-0.0085	0.9991
1970.I-1979-IV	0.03	0.19	3.50	-0.02	0.09	0.05	0.12	0.85	0.03	193.680	MA	(1)	0.056	1.73	0.9998	-0.0083
	(4.21)	(2.02)	(8.73)	(-2.20)	(2.95)	(3.05)	(6.30)	(19.87)	(4.21)			(2)	0.013	1.73	-0.0083	1.0001
	0.01	0.51	3.71	-0.01	0.07	0.05	0.12	0.84	0.03	187.556	OA	(1)	0.062	1.96	1.0004	-0.0079
	(0.94)	(5.77)	(8.06)	(-1.19)	(1.55)	(2.79)	(6.00)	(18.76)	(0.88)			(2)	0.013	1.75	-0.0079	0.9995
1960.I-1969-IV	-0.01	1.00	5.92	-0.01	0.07	0.02	-0.02	0.83	-0.03	137.557	MA	(1)	0.063	0.86	0.9949	-0.0599
	(-0.63)	(7.64)	(8.65)	(-0.56)	(2.79)	(1.26)	(-0.41)	(7.58)	(-0.55)			(2)	0.008	1.03	-0.0599	1.0012
	-0.01	1.05	-6.20	0.04	-0.11	-0.06	-0.06	0.64	-0.05	140.939	OA	(1)	0.042	1.71	0.9964	0.0648
	(-1.39)	(8.49)	(-8.83)	(4.23)	(-2.8)	(-3.2)	(-1.4)	(7.39)	(-1.18)			(2)	0.007	1.11	0.0648	0.9989

TABLE VIII

MODEL II

$$\begin{cases} 1) & y_t = \alpha + \beta y_{nt} + \gamma \left[P_t - \left(\frac{C'}{1-D'} + \frac{a'_1 M^o_t}{1-D'} + \frac{a'_2 e^o_t}{1-D'} + \frac{a'_3 P^o_{mt}}{1-D'} + \frac{E' P_{t-2}}{1-D'} + \frac{F' y_{nt}}{1-D'}\right)\right] + u_{1t} . \\ 2") & P_t = \frac{C}{1-D'} + \frac{1}{1-D'} D'(a'_1 M^o_t + a'_2 e^o_t + a'_3 P^o_{mt}) + E' P_{t-2} + F' y_{nt} + a'_1 M_t + a'_2 e_t + a'_3 P_{mt} + u_{2"t} ;^{*} \end{cases}$$

$y_{nt} = c_1 y_{t-1}$.**

	α	β	γ	C'	D'	a_1	a_2	a_3	E'	F'	L L F	Ant St	Eq. Nb.	S E	D W	Covariance Matrix of Transformed Residuals	
1960.I.1979.IV	0.02	0.40	2.18	-0.02	0.43	0.11	0.07	0.15	0.36	0.03	291.104	MA	(1)	0.056	1.10	0.9990	0.0099
	(4.08)	(5.14)	(8.32)	(-4.34)	(4.71)	(4.68)	(4.07)	(7.48)	(4.38)	(1.62)			(2")	0.016	0.76	0.0099	1.0008
	0.02	0.58	3.25	-0.01	0.49	0.07	0.06	0.13	0.34	0.01	291.264	OA	(1)	0.069	1.30	1.0007	-0.0118
	(2.58)	(7.89)	(10.6)	(-3.49)	(5.03)	(3.00)	(4.18)	(5.83)	(4.30)	(0.53)			(2")	0.016	0.88	-0.0118	0.9991
1970.I-1979.IV	0.03	0.23	2.61	-0.02	0.59	0.07	0.11	0.14	0.22	0.03	184.420	MA	(1)	0.048	1.46	0.9996	-0.0086
	(4.08)	(2.49)	(8.93)	(-2.49)	(8.92)	(2.10)	(5.20)	(5.85)	(4.13)	(1.50)			(2")	0.017	0.96	-0.0086	1.0003
	0.01	0.52	3.48	-0.01	0.52	0.07	0.07	0.12	0.30	0.004	176.646	OA	(1)	0.073	1.55	1.0001	-0.0098
	(0.80)	(5.93)	(9.69)	(-1.36)	(4.70)	(1.77)	(3.33)	(5.12)	(3.49)	(0.15)			(2")	0.017	1.00	-0.0098	0.9998
1960.I-1969.IV***	-0.01	0.90	-2.42	-0.002	1.38	0.05	-0.07	-0.02	-0.23	-0.01	129.483	OA	(1)	0.030	1.93	1.0211	0.0441
	(-0.46)	(6.24)	(-4.20)	(-.22)	(5.07)	(0.86)	(-2.27)	(-.51)	(-1.35)	(-.25)			(2")	0.009	1.14	0.0441	0.9770

* P_{t-1} has been replaced by P_{t-2}, since P_{t-1} and P^o_t (and its determinants) are strongly correlated. Estimates of an alternative version of Model II, in which P_{t-1} is dropped, are affected by strong serial correlation of residuals, and have to be discarded.

** The model has been estimated also with $y_{nt} = c_1 y_{t-1} + c_2 y_{t-2} + c_3 y_{t-3}$, with no significant change in the numerical value of the coefficients.

*** A proper fit with MA anticipated stimuli proxies cannot be obtained.

2) $P_t = AM_t + BZ_t + C + u_{2t}$. (34)

Model II:

1) $y_t = \alpha + \beta y_{nt} + \gamma \left[A'(M_t - M_t^o) + B'(Z_t - Z_t^o) \right] + (u_{1t} + \gamma u_{2t})$.

(34) These equations form an autoregressive model with restrictions on the parameters, which can be written in vector form as:

$w_t = L(\varphi)\, x_t + a_t = L(\varphi)\, x_t + K u_t$;

$w_t = (y_t\ P_t)'$;

$x_t = (1\ y_{nt}\ M_t\ e_t\ P_{mt}\ M_t^o\ e_t^o\ P_{mt}^o\ P_{t-1})'$;

$u_t = (u_{1t}\ u_{2t})'$;

$\varphi = (\alpha\ \beta\ \gamma\ a_1\ a_2\ a_3\ E\ F\ C)$

$$L(\varphi) = \begin{pmatrix} \alpha & \beta & \gamma a_1 & \gamma a_2 & \gamma a_3 & -\gamma a_1 & -\gamma a_2 & -\gamma a_3 & 0 \\ C & F & a_1 & a_2 & a_3 & 0 & 0 & 0 & E \end{pmatrix} ;$$

$$K = \begin{pmatrix} 1 & \gamma \\ 0 & 1 \end{pmatrix} ;$$

The coefficients of the predetermined variables x_t depend upon the nine unknown free parameters of the structural model, φ .

As pointed out by J.B.Taylor (1979), the "minimum distance estimator" of φ can be obtained by minimising:

$$\frac{1}{T} \sum_{i=1}^{T} \left[w_t - L(\varphi)\, x_t \right]' S \left[w_t - L(\varphi)\, x_t \right] ,$$

With respect to φ, for some positive matrix S. E.Malinvaud (1970) proposed that the minimum distance estimator be iterated by setting S equal to $\left(\sum_{i=1}^{T} \hat{u}_t\, \hat{u}_t' \right)^{-1}$ at each iteration where $\hat{u}_t$ is the vector of computed residuals from the previous iteration.

As shown by G.T.Wilson (1973), Y.Bard (1974) and P.C.B.Phillips (1976), this iterated minimum distance estimator would provide maximum likelihood estimates of φ, calculated as if the u_t were normally distributed. An analogous approach can be developed for model II, pag. 34 .

TABLE IX

FIML Estimates

Model I

8) $y_t = \alpha + \beta y_{nt} + \gamma \left[a_1 (M_t - M_t^o) + a_2 (e_t - e_t^o) + a_3 (P_{mt} - P_{mt}^o) \right] + (u_{1t} + \gamma u_{2t})$.

2) $P_t = C + a_1 M_t + a_2 e_t + a_3 P_{mt} + E\, P_{t-1} + F\, y_{nt} + u_{2t}$.

$y_{nt} = c_1\, y_{t-1}$.*

	α	β	γ	C	a_1	a_2	a_3	E	F	L.L.F.	Ant. St.
1960.I-1979.IV	0.02 (3.94)	0.41 (4.77)	2.91 (4.50)	-0.01 (-3.29)	0.09 (3.82)	0.04 (2.88)	0.11 (6.44)	0.84 (24.65)	0.03 (1.11)	312.159	MA
	0.01 (2.54)	0.58 (7,67)	3.59 (4.46)	-0.01 (-2.97)	0.07 (3.06)	0.05 (3.43)	0.12 (6.61)	0.84 (24.60)	0.03 (1.03)	311.265	OA
1970.I-1979.IV	0.03 (4.17)	0.19 (1.87)	3.57 (4.15)	-0.02 (-1.86)	0.09 (2.49)	0.05 (2.69)	0.11 (4.75)	0.85 (19.50)	0.03 (0.72)	193.669	MA
	0.01 (0.94)	0.50 (5.56).	3.77 (3.75)	-0.01 (-1.07)	0.07 (1.42)	0.05 (2.54)	0.12 (4.90)	0.84 (18.54)	0.03 (0.80)	187.544	OA

*Likelihood ratio tests for the null hypothesis, that the restrictions imposed by the theory on equation 8) are correct, suggest that they should be rejected over the 1960 I-1979.IV time period and accepted over the 1970.I-1979.IV time period. (The likelihood ratio is asymptotically distributed as chi-square with 7 degrees of freedom, the number of restrictions imposed by the Rational Expectations and Neutrality hypotheses, 6 restrictions and 1 restriction respectively, following the approach of L.Leiderman (1980)).

TABLE IX'

FIML Estimates

Model II

$$\begin{cases} 8)\quad y_t = \alpha + \beta y_{nt} + \gamma\left[a'_1(M_t - M^o_t) + a'_2(e_t - e^o_t) + a'_3(P_{mt} - P^o_{mt})\right] + (u_{1t} + \gamma u_{2''t})\,. \\ 2'')\quad P_t = \frac{C'}{1-D'} + \frac{1}{1-D'}\, D'(a'_1 M^o_t + a'_2 e^o_t + a'_3 P^o_{mt}) + E'P_{t-2} + F'y_{nt} + a'_1 M_t + a'_2 e_t + a'_3 P_{mt} + u_{2''t}\,. \end{cases}$$

$$y_{nt} = c_1\, y_{t-1}\,.^*$$

	α	β	γ	C'	D'	a'_1	a'_2	a'_3	E'	F'	L.L.F.	Ant. St.
1960.I-1979.IV	0.02	0.41	2.11	-0.02	0.42	0.11	0.07	0.16	0.36	0.03	291.113	MA
	(3.97)	(4.80)	(4.34)	(-3.94)	(4.35)	(4.30)	(3.50)	(6.53)	(4.33)	(1.53)		
	0.02	0.58	3.66	-0.01	0.53	0.07	0.06	0.11	0.31	0.01	291.317	OA
	(2.60)	(7.84)	(3.27)	(-2.94)	(4.31)	(3.11)	(3.10)	(3.78)	(3.40)	(0.57)		
1970.I-1979.IV	0.03	0.22	2.65	-0.02	0.58	0.07	0.11	0.14	0.22	0.03	184.420	MA
	(4.12)	(2.29)	(4.70)	(-2.32)	(7.85)	(2.24)	(3.71)	(5.08)	(3.93)	(1.40)		
	0.01	0.51	3.68	-0.01	0.54	0.07	0.06	0.12	0.29	0.01	176.663	OA
	(0.78)	(5.80)	(3.05)	(-1.19)	(4.11)	(1.60)	(2.46)	(3.41)	(3.06)	(0.19)		

* Likelihood ratio tests of the null hypothesis, that the restrictions imposed by the theory on equation 8) are correct, suggest that they should be rejected over the 1960.I-1979.IV time period and accepted over the 1970.I-1979.IV time period. (The likelihood ratio is asymptotically distributed as chi-square with 7 degrees of freedom, the number of restrictions imposed by the Rational Expectations and Neutrality hypotheses, 6 restrictions and 1 restriction respectively, following the approach of L.Leiderman (1980)).
It is much more difficult to reject these restrictions in the case of Model II than in the case of Model I.

$$2'')\quad P_t = A'M_t + B'Z_t + \frac{D'}{1-D'}(A'M^o_t + B'Z^o_t + C') + C' + u_{2''t}\,.$$

The estimates have been performed over three different time periods, using the standard hypotheses about the formation of stimuli anticipation (OA and MA). The findings are broadly similar to those obtained with OLS and support the economic interpretation suggested above. The fit is good over the 1960,I - 1979,IV and 1970,I - 1979,IV time periods, but declines as usual in the 1960,I - 1969,IV time period.(35)

The estimates of γ, the unanticipated inflation changes coefficient of the Lucas supply curve, tend to be larger than in the OLS case, and the estimates of individual stimuli coefficients tend to be smaller, especially that of unanticipated changes in the money supply. Simultaneous equation estimations are, on the whole, more efficient than their OLS counterparts, since they bring about a reduction in individual coefficient standard errors. It should finally be pointed out that the two estimation approaches used in this section bring about parameter estimates that are not significantly different.

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(35) Multicollinearity between P^o_t and P_{t-1} affects the estimation of price equation 2") in Model II. We can eliminate it - as in the OLS estimation above - either replacing P_{t-1} with P_{t-2}, the rate of inflation lagged two time periods, or dropping P_{t-1} from the price equation and eliminating the ensuing serial correlation of residuals, that would impair simultaneous equation estimation.

- Some authors, e.g. R.Barro (1976,1980) and L.Leiderman (1979,1980), tend to associate directly the estimation of the expectations formation relationship to that of the output equation (which includes these expectations among its predetermined variables).

We have thus estimated the following system, in the two alternative ways mentioned above. (TABLE X)

$$1)\quad y_t = \alpha + \beta y_{nt} + \gamma (P_t - P^o_t) + u_{1t}$$

$$3)\quad P_t = AM^o_t + BZ^o_t + C + u_{3t}\,.\quad (36)$$

M.Fratianni (1978), M.Fourcans (1978) and E.J. Bomhoff (1980) tend to emphasize the role of price equation 7), (unanticipated price changes determination), and to associate it with the output equation, since its fit is markedly superior to that of equations 2) and 2"). To assess the relevance of their approach for the conclusions of our analysis, we have estimated, with the above mentioned techniques, the following system: (TABLE XI)

$$1)\quad y_t = \alpha + \beta y_{nt} + \gamma (P_t - P^o_t) + u_{1t}$$

$$7)\quad P_t = P^o_t + A(M_t - M^o_t) + B(Z_t - Z^o_t) + u_{7t}\,.$$

The findings are very close to those obtained with price equations 2) and 2"), a further proof of the stability of our model.

(36) This system can be interpreted either in terms of Model I, with price equation 2), or in terms of Model II, with price equation 2".

TABLE X

$$\begin{cases} 1)\; y_t = \alpha + \beta y_{nt} + \gamma \left[P_t - (C + a_1 M^o_t + a_2 e^o_t + a_3 P^o_{mt} + E\,P_{t-1} + F\,y_{nt})\right] + u_{1t}\,.^{**} \\ 3)\; P_t = C + a_1 M^o_t + a_2 e^o_t + a_3 P^o_{mt} + E\,P_{t-1} + F\,y_{nt} + u_{3t}\,. \end{cases}$$

$$y_{nt} = c_1\, y_{t-1}\,.^{*}$$

	α	β	γ	C	a_1	a_2	a_3	E	F	L.L.F.	Ant. St.	Eq. Nb.	S.E.	D.W.	Covariance Matrix Transformed Residuals	
1960.I-1979.IV	0.01	0.69	1.60	-0.02	0.09	0.06	0.07	0.93	0.11	282.39	MA	(1)	0.047	1.59	1.0007	0.0009
	(1.86)	(7.72)	(4.16)	(-2.92)	(2.16)	(1.62)	(1.73)	(13.92)	(3.67)			(3)	0.015	1.44	0.0009	0.9993
	0.01	0.69	1.47	-0.02	0.08	0.12	0.10	0.87	0.05	286.64	OA	(1)	0.047	1.65	1.0009	0.0013
	(1.86)	(7.72)	(3.49)	(-2.37)	(1.93)	(1.79)	(3.85)	(17.20)	(1.36)			(3)	0.014	1.85	0.0013	0.9991
1970.I-1979.IV	0.01	0.66	1.23	-0.01	-0.01	0.24	0.15	0.77	0.16	173.88	MA	(1)	0.046	1.66	1.0033	0.0019
	(1.51)	(5.74)	(2.98)	(-0.87)	(-.23)	(3.98)	(3.58)	(10.08)	(4.31)			(3)	0.017	1.76	0.0019	0.9967
	0.01	0.66	1.36	0.001	0.003	0.10	0.09	0.85	0.09	170.46	OA	(1)	0.051	1.59	1.0022	0.0022
	(1.51)	(5.74)	(2.69)	(0.06)	(0.03)	(1.52)	(2.74)	(13.3)	(1.54)			(3)	0.016	2.05	0.0022	0.9978
1960.I-1969.IV	0.01	0.85	-0.66	0.01	-0.001	0.03	-0.10	0.75	-0.06	135.76	MA	(1)	0.031	1.13	1.0011	-0.0008
	(0.27)	(5.53)	(-.82)	(0.47)	(-0.01)	(0.94)	(-.98)	(9.35)	(-0.71)			(3)	0.007	1.03	-0.0008	0.9989
	0.003	0.85	-1.04	0.01	-0.13	0.09	-0.07	0.71	0.02	137.72	OA	(1)	0.030	1.26	1.0021	-0.0015
	(0.27)	(5.53)	(-1.3)	(0.96)	(-1.56)	(1.16)	(-.87)	(8.67)	(0.28)			(3)	0.007	1.18	-0.0015	0.9979

**The model has been estimated also with $y_{nt} = c_1 y_{t-1} + c_2 y_{t-2} + c_3 y_{t-3}$, with no significant change in the numerical value of the coefficients.

* It should be noticed that the coefficient estimates are quite similar to those obtained with single equation instrumental variables approaches set forth in TABLE IV above. (The estimates are more efficient however since standard errors tend to be smaller). As usual the quality of fit is good over the 1960.I-1979.IV and 1970.I-1979.IV time periods and declines over the 1960.I-1969.IV time period.

TABLE XI

$$\begin{cases} (1)\quad y_t = \alpha + \beta y_{nt} + \gamma \left[P_t - (C + a_1 M^o_t + a_2 e^o_t + a_3 P^o_{mt} + E\, P_{t-1} + F\, y_{nt}) \right] + u_{1t} \;{}^{*} \\ (7)\quad P_t = (C + a_1 M^o_t + a_2 e^o_t + a_3 P^o_{mt} + E\, P_{t-1} + F\, y_{nt}) + a_1 (M_t - M^o_t) + a_2 (e_t - e^o_t) + a_3 (P_{mt} - P^o_{mt}) + u_{2t} \end{cases}$$

$$y_{nt} = c_1\, y_{t-1} \;{}^{**}$$

	α	β	γ	C	a_1	a_2	a_3	E	F	L.L.F.	Ant. St.	Eq. N.	S.E.	D.W.	Covariance Matrix of Transformed Residuals	
1960.I-1979.IV	0.02	0.41	2.88	-0.02	0.09	0.04	0.11	0.85	0.03	312.171	MA	(1)	0.053	1.44	1.0013	-0.0084
	(4.00)	(5.15)	(7.99)	(-3.40)	(4.07)	(3.15)	(7.19)	(25.70)	(1.15)			(7)	0.011	1.61	-0.0084	0.9986
	0.02	0.58	3.47	-0.01	0.07	0.05	0.12	0.84	0.02	311.272	OA	(1)	0.058	1.72	1.0008	-0.0085
	(2.54)	(7.83)	(9.02)	(-3.01)	(3.17)	(3.80)	(7.56)	(25.68)	(1.02)			(7)	0.011	1.63	-0.0085	0.9991
1970.I-1979.IV	0.03	0.19	3.50	-0.02	0.09	0.05	0.12	0.85	0.03	193.680	MA	(1)	0.056	1.73	0.9998	-0.0083
	(4.21)	(2.02)	(8.73)	(-2.20)	(2.95)	(3.05)	(6.30)	(19.87)	(0.78)			(7)	0.013	1.74	-0.0083	1.0001
	0.01	0.51	3.71	-0.01	0.07	0.05	0.12	0.84	0.03	187.556	OA	(1)	0.063	1.96	1.0004	-0.0079
	(0.94)	(5.77)	(8.06)	(-1.19)	(1.55)	(2.79)	(6.01)	(18.76)	(0.88)			(7)	0.013	1.75	-0.0079	0.9995
1960.I-1969.IV***	-0.01	1.05	-6.21	0.04	-.12	-0.06	-0.06	0.64	-0.05	140.939	OA	(1)	0.042	1.71	0.9964	0.0648
	(-1.4)	(8.49)	(-8.83)	(4.43)	(-2.8)	(-3.2)	(-1.4)	(7.39)	(-1.18)			(7)	0.007	1.11	0.0648	0.9989

* Coefficient estimates are quite similar to those of model I TABLE VIII above. As usual the fit is good over the 1960.I-1979.IV and 1970.I-1979.IV time periods, and declines over the 1960.I-1969.IV time period.

** The model has been estimated also with $y_{nt} = c_1\, y_{t-1} + c_2\, y_{t-2} + c_3\, y_{t-3}$, with no significant change in the numerical value of the coefficients.

***A proper fit with MA anticipated stimuli proxies cannot be obtained.

V. CONCLUSION.

The model examined here provides a realistic view of the determinants of Italian output and prices behaviour: the quality of fit, over the 1960.I-1979.IV time period, is good and its explanatory power high. The findings of this paper do not necessarily contradict previous (mostly Keynesian) statistical investigations: the model does not perform very well in the 1960.I-1969.IV time period, a period which provides strong support for Keynesian Phillips curves, and performs very well in the 1970.I-1979.IV time period, a period in which empirical support for Phillips curves is very weak.

The lack of effectiveness of fiscal policy instruments is rather surprising. This finding, which is corroborated by previous statistical investigations, is probably due to the specific use (or misuse) of Italian Government expenditure and to the peculiar financing procedure of Italian budget deficits.

An increase in Government expenditure is often accompanied by a parallel increase in money supply: part of its expansionary effect on output is thus accounted for by the expansionary effects of the increase in money supply.

A final point deals with the effects of unanticipated stimuli on output: large and significant, they are in line with the standard Keynesian view of aggregate demand determination.

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