Money, Prices, and Wages in Italy*

I. Introduction

This paper investigates the causes of inflation in Italy from 1952 to 1977 by exposing to empirical test alternative explanations of inflation. The hypotheses under consideration are the cost push, the monetarist, and the price augmented Phillips curve with mark-up pricing. The juxtaposition of opposing theories is a valuable exercise for it permits the stronger theory to survive over the weaker one. In the case of Italy this confrontation is particularly useful in light of the strong cost-push tradition and the general scepticism with which monetary explanations of inflation are received.

The study is organized as follows. I discuss the general issues of the cost-push literature and test two of its forms in Section II. In the following section I investigate whether or not changes in wages cause, in the Granger-Sims sense, changes in the price level. Section IV is devoted to the development of the Dominant Impulse Hypothesis (DIH) which yields, under suitable constraints, monetarist implications. This section draws on Fratianni (1978) from which it differs, however, in two aspects. Firstly, DIH is here estimated imposing appropriate theoretical constraints in contrast to the " free " estimation performed in the 1978 article. Secondly, the rate of change of the expected price level is quantified independently of the model itself, whereas in the earlier article expected prices were estimated within the model. Section V compares and contrasts DIH to the more traditional explanation of inflation, namely the Phillips curve *cum* mark-up pricing. The issue of

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whether wages or money are the ultimate cause of inflation is tackled in Section VI by applying, again, Granger-Sims causality tests. The last section summarizes the major findings of the study and draws a few conclusions.

II. The Cost-Push Explanation of Inflation

a) *Basic Issues*

The cost-push explanation of inflation is accepted doctrine amongst the majority of Italian economists; thus it behooves us to consider in some detail several variants of this approach and test empirically a few of their dominant forms.

One version of cost-push inflation begins with the assertion that sustained increases in the general price level result from the market power of large monopolistic firms which have complete control over price determination. This is the *leitmotif* of Galbraith (1967); with minor changes it is also the *leitmotif* in the writings of Sylos Labini in Italy. Monetarists have usually dismissed this argument on two grounds. First, the Galbraithian literature seems to overlook that prices are determined jointly by both demand and supply schedules and not by supply forces alone. Second, the ability of a large monopolistic firm to set a price can explain at best changes in relative prices but not a continued increase in the general price level. To explain the inflation of the recent past one would have to seriously entertain the empirical proposition that accelerations of inflation are accompanied by a larger degree of monopolization (or a growing exploitation of a given potential market power) in the economy and that decelerations of inflation by demonopolization (Brunner, 1973). Given the speed with which both accelerations and decelerations of inflation have occurred I believe the above mentioned relationship to be self-evidently disconfirmed by the facts.

There remains, however, the notion that the market power of a few firms could explain a secular increase in the general price level. Assume an industry (supposedly dominated by one or a few price-setting firms) were to raise prices in the inelastic portion of its demand curve. This would reduce aggregate demand for all other industries which, in turn, might respond by cutting output

rather than prices. The general price level would therefore rise (Mayer (1975)). There are aspects in this line of argumentation which require examination.

First, why would a monopolist, who maximizes profits along the elastic portion of the demand curve, raise *continuously* the price of its product unless his cost curves were also to shift continuously. If they do we would have to explain why these cost curves shift; a cost-push explanation of inflation at best takes us a step back in the chain of events. Second, notwithstanding this argument, is the increase in the general price level the result of the monopolist's action or of the ensuing excess demand in the rest of the economy? Mayer (1975, p. 211) sums the difference between monetarists and Keynesians as follows: " ... to the monetarist aggregate demand, as determined by the quantity of money, functions as a budget constraint. In the Keynesian system it is a variable. Hence, to the Keynesian it is at least possible that a rise in the price of commodity A raises aggregate demand enough so that other prices (and outputs) will not have to fall, and might even rise." Third, do the cost curves of the "inflation-export industry" rise in an exogenous fashion. The traditional explanation is that wage increases in excess of productivity occur independently of market conditions and that strong labour unions prefer to tackle large monopolistic firms to produce a demonstration effect on all other industries. In Italy the power of labour unions is heavily concentrated in manufacturing where markets, according to the proponents of the wage-push theory, are dominated by a few large-scale firms.

The second cost element emphasized more recently by cost-push theorists is the import price, a variable over which a relatively small open economy like Italy has little control. An exasperation of this position is the Scandinavian model of differential productivity where domestic inflation depends directly on world inflation, the proportion of output produced by the so-called sheltered sector and by the difference between the productivity increases of the competitive and sheltered sectors (Fratianni (1974), pp. 293-94). Inflation is transmitted from the world to the domestic economy via the assumption that labour income shares in the two sectors are constant and the institutional or political constraint that growth rates of money wages are the same in the two sectors.

Two serious problems must be raised concerning the import-price version of the cost-push theory. The first one is that, while it is correct for a small open economy to take the world price level as given, the world as a whole cannot. Clearly, here we are facing a fallacy of composition which this study cannot remedy. The second shortcoming of the Scandinavian model is the exclusive reliance on supply forces just like the domestic wage-push version of the theory. An increase in the price of imports is taken to raise automatically domestic prices through the aggregate output supply function. But this view ignores (i) the substitution between domestic and foreign production, (ii) real cash balance effect ensuing an increase in import prices and (iii) the price expectations implication of higher world prices.

The Italian literature on cost-push is too long to be discussed here in full. Spinelli (1978) offers a potted history of this literature which includes Sylos Labini (1967, 1972), Tarantelli (1970) and Modigliani and Tarantelli (1972, 1976) as the most influential writers.

b) *A Test of the Cost-Push Hypothesis*

The fundamental test implication of the cost-push theory of inflation in an open economy is given by (1):

(1) $\Delta P = C_1 + C_2\,\Delta(W - PR) + C_3\,\Delta PM$

where

P = log of the domestic price level
W = log of the money wage rate in industry
PR = log of the average productivity in industry
PM = log of the import price level in domestic currency

The industrial sector of the economy, with its allegedly oligopolistic structure, is the driving force in the hypothesis: the ultimate impact of $\Delta(W - PR)$ on ΔP occurs via a domino effect on all other sectors of the economy. The import price PM is recognized to be an inflationary force through its effect on the supply of output. To stack the cards in favour of the cost-push theory I shall concede that the other channels through which PM can influence the economy can be ignored.

Equation (1) was estimated with OLS using annual data from 1951 to 1977; the description and sources of data can be found in Appendix I. The estimates are shown in Table 1 and indicate that a one percent increase in both wages in excess of productivity and import prices raises the rate of inflation, ΔP, by .62 percent. Since

Table 1

OLS ESTIMATES OF EQ. (1)

	$\hat{C}_1$	$\hat{C}_2$	$\hat{C}_3$	R^2	SE (standard error)	D.W.
	.023	.37	.25	.87	.021	1.3
t-values	(4.1)	(5.7)	(2.7)			

W-PR and PM account for all systematic inflation (1) should be estimated under the constraint that $C_2 + C_3 = 1$ or, more simply, in the form

(2) $\Delta P - \Delta PM = C_4 + C_2\,\Delta(W - PR - PM)$

The estimate of C_2, shown in Table 2, reflects the relatively high degree of openness of the Italian economy: the imported component of inflation has an impact of .3 on ΔP while the domestic component an impact of .7.

Table 2

OLS ESTIMATE OF EQ. (2)

$\hat{C}_4$	$\hat{C}_2^1$	R^2	SE	D.W.
–.0016	.71	.8	.036	1.3
(0.21)	(9.52)			

III. The Relation Between Wages and Prices

The pristine form of the cost-push hypothesis analyzed in the previous section has it that wages do not respond to market conditions but depend on a complex array of non-economic factors. This version of the cost-push theory of inflation—which I shall label "sociological"—is to be sharply distinguished from cost-push phenomena which are consistent with the implications of relative price theory [Brunner (1976) and Brunner et. al. (1973)]. A monetary, fiscal or Wicksellian explanation of inflation may be consistent with wages adjusting to prices and prices adjusting to wages [see for example, Anderson and Karnosky (1977)]. Both variables respond endogenously to evolving market conditions and ultimately to systematic exogenous stimuli or policy variables.

The dependence of wages on prices can be investigated by applying causality tests in the Granger (1969) and Sims (1972) sense. The nature and basic tenets of these tests are explained in Appendix II. Suffice it to say that causality here is to be interpreted as the ability of current and past values of ΔW and ΔP to predict future movements of ΔP and ΔW, respectively.

Quarterly time series of ΔW and ΔP, ΔW_q and ΔP_q, for the period 1952-1977 were whitened with moving-average models which are given by equations §6 and §7 in Table 8. Table 3 shows the values of the cross correlation coefficients between the white-noise residuals of these two equations. As expected, there is a strong and significant concomitant interdependence between the error terms of ΔW_q and ΔP_q. In addition, the impact of wages lagged one quarter on current prices and that of prices lagged four quarters on current wages are similarly significant. To test more precisely the null hypothesis that the sum of all lagged coefficients is zero I have computed

$$Q(8)=T \sum_{k=1}^{8} (\rho_k)^2$$

T = number of observations

ρ_k = cross-correlation coefficient in the kth lagged period.

which has a X^2 distribution. The values of Q(8), reported in Table 3, suggest that the null hypothesis can be rejected at the 5 percent level of significance for prices lagged and at about 10 percent for wages lagged. In other words, there is a bi-directional causality between ΔW_q and ΔP_q. The sociological view of wage push is disconfirmed.

These findings accord with those reported by other researchers. Laidler (1976), for example, tests three competing views of inflation using data from six industrialized countries, including Italy. One of his main conclusions is that excess demand in the output market exerts a strong and positive effect on wage inflation, evidence which is very damaging to the sociological view of inflation. Spinelli (1978) has written an extensive and critical review of the

TABLE 3

CROSS CORRELATION BETWEEN RESIDUALS OF ΔW_q AND RESIDUALS OF ΔP_q

Time Period	Prices Lagged	Wages Lagged	$90X^2_{df=8}$	$97.5X^2_{df=8}$
t	.381	.381		
t-1	−.121	.353		
t-2	.211	−.038		
t-3	.078	−.062		
t-4	−.294	.001		
t-5	−.022	−.073		
t-6	.194	−.034		
t-7	.077	.008		
t-8	.189	−.192		
	Q(8)=16.21	Q(8)=12.13	13.36	17.53

Underlined values indicate that the coefficient is statistically different from zero.

Italian literature bearing on "autonomous" cost push. His findings are that this literature is flawed with a great deal of ad hocery and that the evidence does not support the claim made by their proponents.

IV. The Dominant Impulse Hypothesis

DIH, as presented in Fratianni (1978), consists of the following three equations:

(3) $y^d=\beta_1(M-\bar{P})+\beta_2(PM-P)+\beta_3F+\upsilon_d$

(4) $y^s=\bar{y}+\alpha(P-\bar{P})+\upsilon_s$

(5) $y^d=y^s$

where y^d = log of the demand for output

y^s = log of supply of output

$\bar{P}$ = the expected price level

PM = the log of the foreign price level expressed in domestic currency

ΔF = the fiscal impulse

$\tilde{y}$ = the log of the expected level of output

υ_d, υ_s = error terms

Equation (3) is an aggregate demand for output which responds to the expected real cash balance, a fiscal impulse and relative prices. Equation (4) is the Lucas-Sargent aggregate supply of output which states that current output deviates from normal output to the extent that the current price level deviates from the expected price level.

Succintly DIH states that changes in inflation and output are proximately determined by an excess demand for output and inflationary expectations; that the ultimate determinants of excess demand are systematic impulses and not random shocks; and that financial impulses dominate real impulses. A monetarist solution requires that the monetary impulse dwarf all other systematic impulses, a condition which is extremely demanding on the data. Formally, the implications of the hypothesis are extracted by first solving (3) through (5) for ΔP, the rate of inflation.

$$(6) \qquad \Delta P = a_1 \Delta\bar{y} + a_2 \Delta\bar{P} + a_3 \Delta M + a_4 \Delta PM + a_5 \Delta F + \upsilon$$

where

$$a_1 = -\frac{1}{\alpha+\beta_2} < 0$$

$$a_2 = \frac{\alpha-\beta_1}{\alpha+\beta_2} \gtreqless 0 \text{ depending on whether } \alpha \gtreqless \beta_1$$

$$a_3 = \frac{\beta_1}{\alpha+\beta_2} > 0$$

$$a_4 = \frac{\beta_2}{\alpha+\beta_2} > 0$$

$$a_5 = \frac{\beta_3}{\alpha+\beta_2} > 0$$

$$\upsilon \equiv \upsilon_d - \upsilon_s$$

The expected rate of inflation is obtained by taking the expected value of (6).

$$(7) \qquad \Delta\bar{P} = \frac{1}{\beta_1+\beta_2} \left[-\Delta\bar{y} + \beta_1 \Delta\bar{M} + \beta_2 \Delta\overline{PM} + \beta_3 \Delta\bar{F} \right]$$

Noting that $a_2 + a_3 + a_4 = 1$ and that the coefficients of ΔM and ΔPM sum to unity in (7), the last two equations can be written in the constrained form

$$(6b) \qquad \Delta P - \Delta\bar{P} = a_1 \Delta\bar{y} + a_2(\Delta PM - \Delta\bar{P}) + a_3(\Delta M - \Delta\bar{P}) + a_5 \Delta F + \upsilon$$

$$(7b) \qquad \Delta\bar{P} - \Delta\overline{PM} = \frac{1}{\beta_1+\beta_2} \left[-\Delta\bar{y} + \beta_1(\Delta\bar{M} - \Delta\overline{PM}) + \beta_3 \Delta\bar{F} \right]$$

Finally, the unexpected rate of inflation can also be obtained as (6) minus (7):

$$(8) \qquad \Delta P - \Delta\bar{P} = a_3(\Delta M - \Delta\bar{M}) + a_4(\Delta PM - \Delta\overline{PM}) + a_5(\Delta F - \Delta\bar{F}) + \upsilon$$

In Fratianni (1978) DIH was tested by first regressing ΔP on the right-hand side variables of (7) which were measured by either simple two-year averages or, alternatively, by ARIMA models. The fitted value of (7) was taken to be $\Delta\bar{P}$. Subsequently, ΔP was regressed on $\Delta\bar{P}$, the estimate of (7), plus the right-hand side variables of (8). The empirical findings can be summarized as follows: only the coefficients of $\Delta\bar{M}$ and $\Delta\overline{PM}$ in (7) were significantly different from zero, with values of .66 and .34, respectively. All inflation turned out to be entirely expected in the sense that the coefficient of $\Delta\bar{P}$ in (8) was not significantly different from unity and a_3, a_4 and a_5 were not statistically different from zero.

Two criticisms can be raised against the statistical procedure adopted in the earlier article. First, estimation was performed on (7) and the unconstrained form of (8) rather than on (7b) and (8). Second, the method of setting $\Delta\bar{P}$ equal to the estimate of ΔP in (7) biased the coefficient of $\Delta\bar{P}$ in (8) towards unity. These shortcomings are here overcome by the use of constrained estimation and by quantifying $\Delta\bar{P}$ as an AR (1) of ΔP (cf. §5 of Table 8). Indeed, all expected values, as I have already mentioned, are the non white-noise component of the relevant time series.

OLS estimates of (6b), (7b) and (8) for period 1952-77 are

(6b est.)

$$\Delta P - \Delta\bar{P} = \underset{(2.71)}{-.023} \underset{(0.35)}{-.34} \Delta\bar{y} + \underset{(3.39)}{.28}(\Delta M - \Delta\bar{P}) + \underset{(7.05)}{.22}(\Delta PM - \Delta\bar{P}) + \underset{(1.51)}{.0017}\Delta F$$

$$SE = .013,\ R^2 = .78,\ D.W. = 2.43$$

(7b est.)

$$\Delta\bar{P} - \Delta\overline{PM} = \underset{(6.45)}{-.010} \underset{(1.57)}{-.14} \Delta\bar{y} + \underset{(10.31)}{.62}(\Delta\bar{M} - \Delta\overline{PM}) + \underset{(4.99)}{.019} \Delta\bar{F}$$

$$SE = .014,\ R^2 = .83,\ D.W. = 2.13,\ \rho = .42$$

(8 est.)

$$\Delta P-\Delta\bar{P}=0.14+\underset{(3.92)}{} .15(\Delta M-\Delta\bar{M})+.24(\Delta PM-\Delta\overline{PM})+.0041(\Delta F-\Delta\bar{F})$$

(3.92) (1.63) (8.41) (4.3)

$SE=.014$, $R^2=.71$, $D.W.=1.82$, $\rho=-.54$

Note that all coefficients have the desired theoretical sign and are significant except for the expected rate of growth of output, the fiscal impulse in (6b) and the unexpected growth rate of money in (8). The novel findings with respect to Fratianni (1978) are the relevance of the expected fiscal impulse and of unanticipated money, import price and the fiscal impulse in the inflation process. However, it still holds that money and import prices drive the systems, with the contribution of ΔF being very small.

There are two ways of obtaining the final equation of inflation: combining (7b est.) either with (6b est.) or with (8 est.). Recalling that $\Delta M = \Delta\bar{M} + (\Delta M - \Delta\bar{M})$ and setting the coefficient of $\Delta\bar{y}$ in (6b est.) equal to zero the two pairs of equations yield respectively

(9) $$\Delta P=.59\,\Delta\bar{M}+.41\,\Delta\overline{PM}+.0112\,\Delta\bar{F}-.07\,\Delta\bar{y}-.073 +.28(\Delta M-\Delta\bar{M})+.22(\Delta PM-\Delta\overline{PM})+.0017(\Delta F-\Delta\bar{F})$$

(10) $$\Delta P=.62\,\Delta\bar{M}+.38\,\Delta\overline{PM}+.019\,\Delta\bar{F}-.014\,\Delta\bar{y}-.086 +.15(\Delta M-\Delta\bar{M})+.24(\Delta PM-\Delta\overline{PM})+.0041(\Delta F-\Delta\bar{F})$$

The two equations are remarkably similar. The long-run behaviour of inflation is determined by the expected values of the impulses, whereas the unexpected impulses impart a transitory or cyclical movement. Money and import prices, both in the expected and unexpected sense, dwarf the fiscal impulse and output. The main difference between (9) and (10) lies in the impact of unexpected money and the fiscal impulse, with the coefficient of money being twice as high in (9) than in (10) and the reverse holding for the fiscal impulse.

V. DIH and Phillips Curve: A Comparison

It is instructive to compare at this point DIH with a more traditional explanation of inflation, the joint hypothesis of a Phillips curve and mark-up pricing, labelled for brevity PCMP.

Postulating that changes in wages respond positively to excess demand in the labour market, E, and the rate of expected inflation, $\Delta\bar{P}$, the current rate of price inflation is determined in the PCMP by the following two-equation system:

(11) $\Delta W=h+fE+g\Delta\bar{P},\ f>o$

(1) $\Delta P=c_1+c_2\,\Delta(W-PR)+c_3\Delta PM$

or

(2) $\Delta P-\Delta PM=c_4+c'_2\,\Delta(W-PR-PM)$

Equations (1) and (2) were analyzed in Section II; equation (11) is the Phillips curve modified to incorporate inflationary expectations. Variable E has been traditionally quantified by the inverse of the global rate of unemployment. Modigliani and Tarantelli (1972) have argued that the latter is not the relevant proxy in a developing economy such as Italy. They have proposed instead a redefined (inverse) rate of unemployment, u′, which takes into account the heterogeneity of the labour force.

(12) $$u'=\frac{1-\beta\frac{(u_m-\gamma)}{100}}{u-\beta(u_m-\gamma)}$$

where u = the rate of unemployment

u_m = the minimum rate of unemployment previously achieved

β = weight attached to unskilled workers

γ = "frictional" level of unemployment

The empirical work done by Modigliani and Tarantelli suggests that $\hat{\beta} \simeq .5$ and $\hat{\gamma} \simeq 2.0$, values which I shall take as parametrically given in this paper. The Phillips curve equation subject to estimation was

(11b) $\Delta W=h+fu'+g\Delta P+dS70+\text{error term}$

S70 is a dummy variable which intends to capture an exogenous push on wages in 1970 and ΔP is a measure of the expected price change. The reason for setting $\Delta\bar{P}$ equal to ΔP was partly to make (11b) - (1) or (2) an interacting system with ΔW and ΔP influencing each other but, more importantly, to compare my estimate of g with that obtained by Modigliani and Tarantelli (1976) who set $\Delta\bar{P}=\Delta P$.

TABLE 4

TSLS ESTIMATES OF EQUATIONS (11b), (1), AND (2)

Dependent variable	$\hat{h}$	$\hat{f}$	$\hat{g}$	$\hat{d}$	$\hat{c}_1$	$\hat{c}_2$	$\hat{c}_3$	$\hat{c}_4$	$\hat{c}_2'$	R^2	SE	DW
ΔW Eq. (11b)	−2.5 (1.40)	24.23 (4.1)	1.03 (12.65)	9.5 (4.44)						.91	2.08	1.96
ΔP Eq. (1)					2.51 (4.48)	.344 (4.91)	.26 (5.8)			.86	2.07	1.23
ΔP-ΔPM Eq. (2)								−.0776 (.10)	.72 (9.49)	.79	3.6	1.29

Instrumental variables: u', u_m, ΔPR, ΔPM, ΔF, ΔM, Δy, S70.

System (11b) - (1) or, alternatively, (11b) - (2) was estimated with an instrumental variable technique; the results are shown in Table 4. There is a small but statistically significant short-run trade off between tightness in the labour market and wage increases: a drop of the unemployment rate from 8 to 7 percent lowers wage inflation by .55 percentage points. In addition, wages fully adjust to changes in the expected price level. This result, which is in accord with monetarist implications, differs somewhat from the estimate of $\hat{g} \simeq .8$ obtained by Modigliani and Tarantelli [1976, eq. (c), Table 3].[1] It should be recalled that the institutionalization of price-indexed wage contracts in the 1970's tends to push g towards unity. Finally, the political turmoil of 1970 implied a wage increase of almost ten percentage points.

The estimates of equation (11b) and (2) yield the price inflation equation

(13) $\Delta P = -7.5 + 68.62(u') + 26.96(S70) - 2.83(\Delta PR) + 1.08\Delta PM$

It is difficult to accept that changes in productivity may exert more than a proportional effect on the change in the price level. Equally difficult to explain is the once-for-all increase of 26 percentage points in ΔP generated by 1970 events. Finally, (13) suggests that relative purchasing power holds: domestic price inflation adjusts to price inflation abroad once allowance is made for devaluations and appreciations of the lira.

The constrained form of the price equation (2) may well be responsible for the implausibly large coefficients referred just above. In fact, combining (11b) with (1) one obtains

(14) $\Delta P = 1.64 + 12.89u' + 5.06S70 - .53\Delta PR + .40\Delta PM$

which drastically lowers the coefficients of ΔPR, S70, and ΔPM in relation to (13). For no change in ΔPR and u′ (14) implies that the Italian rate of price inflation adjusts less than proportionately to changes in the world rate of inflation.

At the broadest level of abstraction it should be noted that PCMP and DIH need not be mutually exclusive hypotheses: both

[1] Eq. (11b) was also estimated by setting $\Delta\bar{P}$ equal to the autoregressive scheme shown in Table 8. While the explained variance of this regression was smaller than that reported in Table 4, $\hat{g}$ remained unchanged.

explanations accept the notion that changes in wage and price levels respond to systematic policy or exogenous variables rather than vaguely defined sociological phenomena; both explanations acknowledge the role of aggregate demand and inflationary expectations as important forces in determining the rate of current price and wage inflation. The two hypotheses differ, however, in two respects. Firstly, the principal implications of DIH are extracted from the reduced-form equation of the output market, whereas PCMP concentrates on the price behaviour of firms and on the reaction of money wages to excess demand for labour in the economy. PCMP offers more structural information than DIH. This difference is muted, however, by the common theoretical foundation, namely the expectation-augmented Phillips curve can be thought of as an alternative manner of writing the aggregate supply function (4).[2] Secondly, PCMP and DIH shed different amount of information concerning the nature of the shocks. PCMP is generic about what changes aggregate demand; DIH, on the contrary, identifies a selected number of policy variables as being largely responsible for shifts in aggregate demand.

Moving from theory to relative forecasting power, Figures 1 and 2 plot ΔP and $\Delta\hat{P}$ predicted by the two hypotheses. Equation (10) was selected to represent DIH: the unbroken line " $\Delta\hat{P}$ long run " was calculated by subtracting from $\Delta\hat{P}$ the unanticipated component of the inflation rate. Equation (14) was selected to represent PCMP, for the constrained version of this explanation yields, as already noted, implausibly high coefficients for ΔPR and S70. DIH tracks more accurately than PCMP which grossly underestimates the rate of inflation in 1958, 1976, and 1977 while grossly overestimating it in 1970. The better forecasting ability of DIH over the sample period can be assessed more formally by calculating Theil's (1958) coefficient of inequality.

$$(15) \qquad CI = \frac{\sqrt{\frac{1}{T}\Sigma\,(Z_t - \hat{Z}_t)^2}}{\sqrt{\frac{1}{T}\Sigma\,Z_t^2} + \sqrt{\frac{1}{T}\Sigma\,\hat{Z}_t^2}}$$

[2] Laidler (1980) gives a lucid account of the evolution of the Phillips curve literature and its underlying theoretical foundation.

FIGURE 1

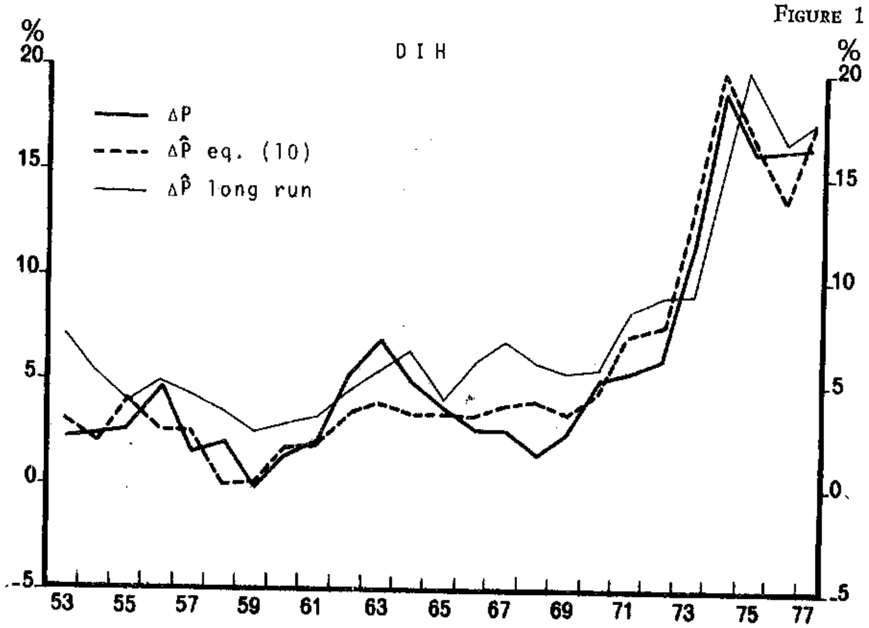
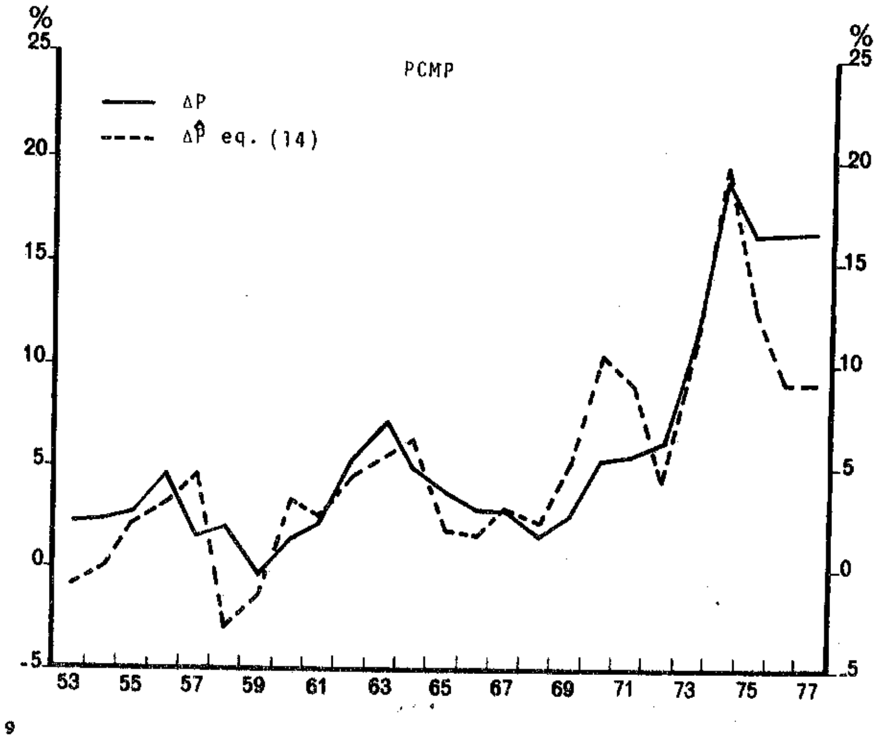


FIGURE 2



where Z_t = values of observations
$\hat{Z}_t$ = values predicted by the hypothesis
T = number of observations

The lower the value of CI, the more powerful is the forecasting ability of the hypothesis. The naïve model $\Delta\hat{P} = \Delta P_{-1}$ is used as a benchmark to judge the quality of the two other models. The values of CI shown in Table 4 confirm what already transpired from Figures 1 and 2. The Dominant Impulse Hypothesis reduces the coefficient of inequality of the PCMP by 50 percent. The naïve model, on the average, tracks more accurately than PCMP.

TABLE 5

COEFFICIENTS OF INEQUALITY

Naïve model: $\Delta\hat{P}=\Delta P_{-1}$	.177
DIH: eq. (10)	.101
PCMP: eq. (14)	.197

VI. Does the Money Stock Respond to Price and Wage Changes?

So far in the paper wage changes were taken to be dependent on price changes whereas changes in money were not. Since the issue of the relative price dependence of wages and price independence of money is deeply debated between Keynesians and monetarists, it behooves me to look into it with some care. Again, as in the case of the price-wage relationship analyzed in Section III, I shall rely on the Granger-Sims causality tests.

The time-series models used to whiten quarterly observations of ΔP and ΔM, ΔP_q and ΔM_q, are given by equations 7 and 8, respectively, shown in Table 8. The cross correlation of the error terms of the equation is presented in Table 6. The null hypothesis that the sum of the lagged coefficients is equal to zero can be rejected for "money lagged" but not for "prices lagged," thus suggesting unidirectional causality from ΔM_q to ΔP_q. This evidence justifies treating ΔM as an independent variable in DIH.

There remains, however, the possibility that current money changes may react to past wage changes. This is a direct implication of the "labour standard" hypothesis according to which monetary

TABLE 6

CROSS CORRELATION BETWEEN RESIDUALS OF ΔP_q AND RESIDUALS OF ΔM_q

	Wages Lagged	*Money Lagged*
0	−.062	−.062
1	.094	−.245
2	.244	.091
3	−.058	.047
4	−.007	.019
5	−.062	.321
6	.009	.157
7	.060	.235
8	−.04	.074
	Q(8)=5.67	Q(8)=18.15

TABLE 7

CROSS CORRELATION BETWEEN RESIDUALS OF ΔW_q AND RESIDUALS OF ΔM_q

	Wages Lagged	*Money Lagged*
0	−.129	−1.29
1	−.054	−0.85
2	.144	−.235
3	.081	−.154
4	−.224	.102
5	−.203	.205
6	−.033	.129
7	.142	.079
8	−.024	−.005
	Q(8)=10.04	Q(8)=11.305

authorities accomodate wage increases in excess of productivity by appropriately expanding the supply of money. Inflation, to be sure, is a monetary phenomenon, but monetary policy is no longer independent of what goes on in the labour market.

Table 7 presents the cross correlation between the residuals of ΔW_q and ΔM_q.[3] There are significant coefficients in both "wages

[3] Cf. equations 6 and 8, respectively, of Table 8.

lagged" and "money lagged;" the values of the Q statistic are high enough that it is prudent not to reject the null hypothesis of independence. In other words bi-directional causality between changes in wages and changes in the money stock cannot be ruled out. This suggests that the monetary authorities, while not oblivious to developments in the labour market, did not relinquish the management of monetary affairs. The border-line significance of the statistics and the general difficulty of interpreting bi-directional causality warrant that generalizations be taken *cum grano salis*.

VII. Conclusions

Three explanations of inflation were compared and contrasted using Italian data from 1952 to 1977. The strong form of the cost-push hypothesis, namely that changes in wages cause changes in prices, was rejected based on an examination of the timing patterns of the two series. The application of Granger-Sims tests revealed that there is full feedback between changes in wages and changes in prices. Theoretical considerations as well as the institutionalization of the indexation system suggest that an acceptable form of the cost-push hypothesis be complemented by a price-augmented Phillips-Curve to explain changes in wages. This explanation was called PCMP the ultimate determinants of which are import prices, productivity, and the unemployment rate.

According to the third hypothesis, the Dominant Impulse hypothesis (DIH), the Italian rate of inflation was found to respond primarily to changes in the expected growth rate of the money stock and import prices, to a smaller degree to changes in the unanticipated growth rate of these two variables and even to a lesser extent to the expected and unexpected value of the fiscal impulse. DIH and PCMP are not necessarily mutually exclusive explanations of inflation; they differ in structure, emphasis and details concerning the causes of shifts in aggregate demand.

The findings from DIH and the evidence in favour of a monetarist explanation of the world inflation rate (see Fratianni (1978, Table 5)) lead to the conclusion that inflation in Italy during the sample period was largely, but not exclusively, a monetary phenomenon.

Table 8

ARIMA MODELS

§	Dependent variable	δ	Φ_1	θ_1	θ_2	θ_3	θ_4	θ_6	DF	SE	Q(6)	Q(12)
1	ΔM annual	.146 (11.6)	.5 (2.6)						24	.03	1.33	
2	ΔPM annual	.52 (1.2)	.5 (2.6)						24	.109	1.47	
3	ΔY annual	.563 (9.7)				−.71 (6.7)		−1.4 (11.4)	23	.032	2.83	
4	(1−L) F annual	.145 (1.31)		.796 (6.03)					24	2.26	.77	
5	ΔP annual	.25 (.159)	.98 (9.47)						23	.025	1.84	
6	(1−L)ΔWq	.0006 (13.48)		1.09 (86.4)					68	.023		6.76
7	(1−L)ΔPq	.0004 (1.5)		.54 (5.08)	.25 (4.0)				87	.0113		8.85
8	(1−L)ΔMq				−.34 (2.93)		.51 (4.62)	.29 (2.26)	86	.0107		4.42

The general form of the models estimated is
$(1-\Phi_1 L \ldots -\Phi_p L^p)X_t = (1-\theta_1 L \ldots \theta_q L^q)\varepsilon_t + \delta$
where ε_t is the white noise, Φ's the autoregressive (AR) parameters and θ's the moving average (MA) parameters and δ is a constant term. Numbers in parentheses under each coefficient estimates are t-ratios; SE is the standard error of residuals; DF the degrees of freedom and Q(6) and Q(12) are used to test the null hypothesis that the first 6 or 12 autocorrelation coefficients of the residuals are white noise.

This conclusion may not satisfy those who, although accepting money as a necessary condition for inflation, argue that ΔM is not independent of what occurs in the rest of the economy and especially in the real-sector economy. The null hypothesis that changes in the money stock are independent of changes in the price level in the Granger-Sims sense could not be rejected. Some evidence was found that bi-directional causality exists between changes in the money stock and changes in wages. While one cannot exclude that Italian central bankers react to changes in ultimate target variables, the test performed point that money, and not wages, is relatively independent of prices.

Bloomington

MICHELE FRATIANNI

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APPENDIX I

Data Measurement and Sources

P = log of the consumption price deflator (a, b)

P_q = log of the consumer price index, quarterly, end of period (f)

W = log of the wage rate in industry = Wage "dependent" income in industry divided by the number of "dependent" workers in industry (a, b, c)

Wq = log of the hourly wage rate in manufacturing industry, quarterly, end of period (f)

PR = log of labour productivity = value added in industry divided by the number of "dependent" workers in industry (a, b, c)

M = log of broad measure of the money stock = bank demand and time deposits, post office demand and time deposits, averages of end-of-quarter data (d)

Mq = log of broad measure of the money stock, quarterly, end of period (d)

y = log of industrial production (c)

PM = log of import price deflator (a, b)

U = rate of unemployment = unemployed + individuals seeking first job divided by labour force (c)

S 70 = dummy variable equal to one in 1970 and zero for the rest of the sample period.

ΔF = fiscal impulse measured by the annual lire change of discretionary government expenditures minus tax revenues as a proportion of nominal GDP. See Fratianni (1978) for more details.

Sources:

a) ISCO, *Quadri della Contabilità Nazionale Italiana*, Schema SEC, dati fino al 1975, Roma, 1976.

b) Siesto, V. (1975). "I Conti Economici dell'Italia dal 1954 al 1974 secondo il nuovo schema internazionale," *Economia del lavoro*, 2/1975, Ceres (Centro di ricerche economiche e sociali).

c) Istat, *Bollettino Mensile di Statistica*, various issues.

d) Banca d'Italia, *Bollettino*, various issues.

e) IMF, *International Financial Statistics*, various issues.

f) EEC, Statistical Office, *Eurostat*, various issues.

APPENDIX II

Causality Tests

Causality is to be interpreted in the following sense: "a variable X causes another variable Y, with respect to a given universe or information set that includes X and Y, if present Y can be better predicted by using past values of X than by not doing so, all other information contained in the past of the universe being used in either case" (Pierce and Haugh, 1977, p. 266). In other words, causality is linked to predictability. If prewhitened X can explain some of the movement of pre-whitened Y, X causes Y. One way to test for the existence of this type of causality involves regressing prefiltered Y (t) on future values of prefiltered X (t) and then prefiltered X (t) on future values of Y (t). Causality runs from X to Y if the future coefficients of X (t) in the first regression are statistically not different from zero and the future coefficients of Y (t) in the second regression are statistically different from zero.

A more direct, but equivalent, procedure has been suggested by Haugh (1976) and Pierce and Haugh (1977). Let X and Y be described by univariate time series (ARIMA) models

(16) $\Phi'(L).x_t = \theta'(L)u_t + \delta_1$

(17) $\Phi''(L).y_t = \theta''(L)\upsilon_t + \delta_2$

where x and y are the covariance stationary time series of X and Y. Cross-correlations of the residual series u_t and υ_t, $\rho_{uv}(k)$, are used for causality tests where

(18) $$\rho_{uv}(k) = \frac{E(u_{t-k}\upsilon_t)}{[E(u_t^2)\,E(\upsilon_t^2)]^{1/2}}$$

with standard error equal to $(T-|K|)^{-1/2}$, T = number of observations.

Some causality patterns can be identified:

1. there is unidirectional causality from X to Y if $\rho_{uv}(k) \neq 0$ for some $k > 0$ and $\rho_{uv}(k) = 0$ for either all $k < 0$ or all $k \leq 0$;
2. X and Y are independent if $\rho_{uv}(k) = 0$ all k;
3. X and Y are related and only instantaneously if $\rho_{uv}(0) \neq 0$ and $\rho_{uv}(k) = 0$ for all $k \neq 0$;
4. there is feedback between X and Y if $\rho_{uv}(k) \neq 0$ for some $k > 0$ and $k < 0$.

M. F.