The Double Whammy of Stagflation and Uncertainty

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I. Introduction and Overview

The neutrality of inflation, as characterized by the invariance of relative prices to changes in the general price level, is one of the central postulates of neo-classical economics. *Lucas* (1973), in a modern expression of this neo-classical postulate, asserts that the relative price change and the general price-level change are both normally distributed random variables, independent with each having constant variances. The same argument can also be made for their respective rates of change.

Several empirical studies have examined this neutrality hypothesis and have found evidence to the contrary. *Glejser* (1965) used international cross-section data and found a relation between the variance of relative price change and the average rate of inflation. *Vining-Elwertowski* (1976) used U.S. time-series data and found a relation between the variance of relative price change and general price-change instability. They also found that the distribution of relative price change was non-normal as well as indications that the direction of skewness was the same as the direction of change in the general rate of inflation. *Parks* (1978) also used U.S. time-series data and found a relation between the variance of relative price change on the one hand and real economic growth and unanticipated inflation on the other. These estimated relationships raise the question – are all these right-hand-side variables all correlated in some systematic manner?

There is good reason to expect a correlation amongst them. Coinciding with these studies of the relation between the relative and general variabilities of inflation another group of studies examined the relation between the mean and the variability of inflation. These cross-section studies have provided us with some interesting but mixed evidence concerning the relation between the rate and the variability of inflation. *Okun* (1971) provides evidence of a positive relation between the mean and the variance of inflation for seventeen OECD countries for the period 1951 - 1968. *R. Gordon* (1971) provides evidence of a weaker (statistically insignificant) positive relation for the seventeen OECD countries for the period 1960 - 1968. *Logue-Willet*

(1976) examines a much larger sample of countries and also found a significant positive relationship for all groups except the highly industrialized countries. This absence of a relation between the mean and the variability of inflation for the highly industrialized countries is surprising and points to a possible limitation of the cross-section evidence, especially since, as suspected by *Logue-Willett,* particular macroeconomic stabilization policies may have been an important cause of the variability and these policies are supposedly executed with greater vigor in the highly industrialized countries.

Different countries may have different socio-economic goals and constraints. Conceivably, the inferences from the evidence based on cross-section data may not carry over to the experience of a particular country over time. Further, the ability to accurately predict inflation, as well as the ability to hedge against inflation-related adverse redistribution effects, depends on time in an essential way. Time series evidence is therefore a highly useful supplement to the cross-section evidence.

The phenomenon of stagflation – the inverse relation between inflation and real economic growth – has characterized the behavior of the U.S. economy for the post-Korean War period.[1] This phenomenon of stagflation raises yet another set of questions. If economic growth has not been constant has its variability been constant? If the variability of economic growth has not been constant has it been related in any systematic manner to the rate of economic growth and to the rate and variability of inflation?

Thus the initial question concerning the intercorrelation amongst the variables explaining the relative variability of inflation raises a host of other related questions. These questions take on added significance because the neutrality of inflation is also characterized by the invariance of aggregate real economic growth to changes in the general rate of inflation. Accordingly, this paper extends the focus of this segment of the inflation literature by examining the intercorrelation amongst the right-hand-side variables explaining the relative variability of inflation, as well as the intercorrelation amongst the means and variabilities of general inflation and aggregate economic growth. It also examines some of the potential causes and implications of the empirical results. This paper is not concerned with once again explaining the behavior of the relative price change variable.

In extending the body of empirical evidence pertaining to the variability of inflation we find that the general variability of inflation has not been constant over time but to have been systematically related to its mean. Further, this relationship has been subject to a significant structural shift.

[1] This inverse relation also holds over several sub-periods.

Next, we examine the relation between inflation and economic growth, which is found to be negative, as well as the relationship between their respective variabilities, which is found to be strongly positive. The instrument most widely used in the U.S. to influence both prices and output is the quantity of money. Thus it is natural to examine its behavior as a possible cause of these estimated associations. We then examine the effect of these estimated relationships on market uncertainty. Finally, we assess the empirical significance of the now common and analytically useful distinction in theoretical models between anticipated and unanticipated inflation, as well as the implications of our findings for macroeconomic rational expectations modelling in particular and the inflation-unemployment relation in general. The empirical evidence is presented in Section II and Section III provides a summary.

II. The Empirical Evidence

This study uses quarterly U.S. data covering the period 1947.1 - 1976.3 to compute seven-period moving means and standard deviations of the relevant variables. The seven-period lag length corresponds to half the average trade-cycle-period. Alternative shorter and longer lag lengths were also tried and they did not change our results. The use of moving means and standard deviations increases the number of observations and minimizes any bias due to an arbitrary breakdown of the sample period into different sub-periods. However, the use of non-overlapping periods also produced similar overall results. Because of our seven-period lag length the first observation will be that of 1948.3. The implicit deflator for GNP is used to estimate the annual inflation rate, p, real GNP is used to estimate real economic growth, y, and $M1$ is used to estimate the rate of monetary growth, m.[2] All regressions are run using the generalized-least-squares procedure of *Cochrane-Orcutt* (1949). The prefixes *MN* and *SD* are used to respectively represent the means and standard deviations of the different variables.

A graphical examination of the relation between the mean and the variability of inflation revealed a shift in the relationship around 1952. Accordingly, equations (1) and (2) respectively present estimates for the periods 1948.3 - 1952.1 and 1952.2 - 1976.3

$$(1) \qquad SD(p) = \underset{(1.93)}{0.20}\, MN(p) + \underset{(9.22)}{3.61} \qquad R^2 = 0.52,\ SE = 0.56,\ DW = 1.85,\ \varrho = 0.36$$

[2] All data were obtained from the Survey of Current Business.

(2) $SD(p) = 0.20\ MN(p) + 0.46$ $R^2 = 0.86$
(3.81) (1.67) $SE = 0.25$
$DW = 1.79$
$\varrho = 0.87$

There is a statistically significant positive relation between the mean and the variability of inflation in both the sub-periods with the relationship being much tighter in the later period. The constant term in equation (2) is not quite significant; this statistically significant downward shift in the relationship around 1952 apparently reflects the readjustment of the economy to to dislocations caused by World War II and the Korean War.

The next set of regressions provide estimates of the phenomenon of stagflation, the relation between the mean and the variability of economic growth, and the relation between the variabilities of inflation and economic growth. Because of the evident shift in the relation between the mean and the variability of inflation around 1952, and also because data on the index of consumer sentiment, used later, first became available only in 1952.4, all subsequent regressions are run for the period 1952.4 - 1976.3

(3) $MN(y) = -1.29\ MN(p) + 8.64$ $R^2 = 0.88$
(6.68) (3.70) $SE = 0.80$
$DW = 1.58$
$\varrho = 0.46$

(4) $SD(y) = -0.17\ MN(y) + 4.52$ $R^2 = 0.84$
(2.21) (5.53) $SE = 0.70$
$DW = 1.60$
$\varrho = 0.91$

(5) $SD(p) = 0.17\ SD(y) + 0.49$ $R^2 = 0.87$
(4.88) (1.68) $SE = 0.24$
$DW = 1.71$
$\varrho = 0.65$

Equation (3) shows a statistically highly significant strong negative relation between inflation and economic growth.[3] However, unlike the positive relation between the mean and the variability of inflation, the relation between the mean and the variability of economic growth is negative (eq. 4). These positive and negative relations between the respective means

[3] The relation between inflation and economic growth is quite complex and our bi-variate regression does not separate the influence of inflation on economic growth from other growth-promoting and growth-inhibiting influences. Further, causality can be bi-directional or mutual.

and variabilities of inflation and economic growth, combined with the estimated phenomenon of stagflation, imply a positive relation between the variabilities of inflation and economic growth. The estimated positive relation appears as equation (5).

The monetary instrument was the tool of economic policy most widely used to promote the twin goals of price stability and high economic growth. But stop-go monetary growth has also been a striking characteristic of the postwar conduct of monetary policies. It was this single instrument that was mainly used, at times to promote economic expansion and at other times to fight inflation. But, Figure 1 seems to suggest that these typically temporary monetary contractions used to fight inflation had a relatively small impact on the inflation rate and a large impact on the growth rate. This asymmetric effect of monetary expansions and contractions on inflation and economic growth may have been due to evident (downward) wage-price stickiness (*Hall* 1975).[4] We observe also in Figure 1 that as inflation accelerated, due at least in part to prior monetary acceleration, swings in monetary growth became wider, as did the subsequent swings in inflation and economic growth. The above described behaviour of monetary growth reflects itself in the estimated significant positive relation between the mean and the variability of monetary growth (eq. 6).

$$(6) \qquad SD(m) = \underset{(2.02)}{0.15}\, MN(m) + \underset{(3.89)}{1.80} \qquad R^2 = 0.80,\ SE = 0.52,\ DW = 1.41,\ \varrho = 0.64$$

We have tentatively attributed the estimated intercorrelations amongst the means and variabilities of inflation and economic growth to stop-go monetary policies operating in a regime of some wage-price stickiness.[5] It is necessary to go further and enquire, however, into possible reasons for such money growth behavior. The monetary authority cannot be considered exogenous to the economic system; an understanding of the behavior of monetary growth seems to require an understanding of the monetary policy reaction function. *R. Gordon* (1975, 1976), for example, has pointed to the

[4] Note that if wages and prices are sticky then anticipated changes in money will have an effect on output even if expectations are rational (see *Phelps-Taylor* 1977 and *Fischer* 1977). With wages and prices sticky (downward) quantities will have to do most of the adjusting. Hence, the greater impact of monetary contractions on economic growth than on inflation.

[5] Monetary policy not only affects inflation and economic growth but also responds to them. We make the consensus assumption that the former relationship is dominant.

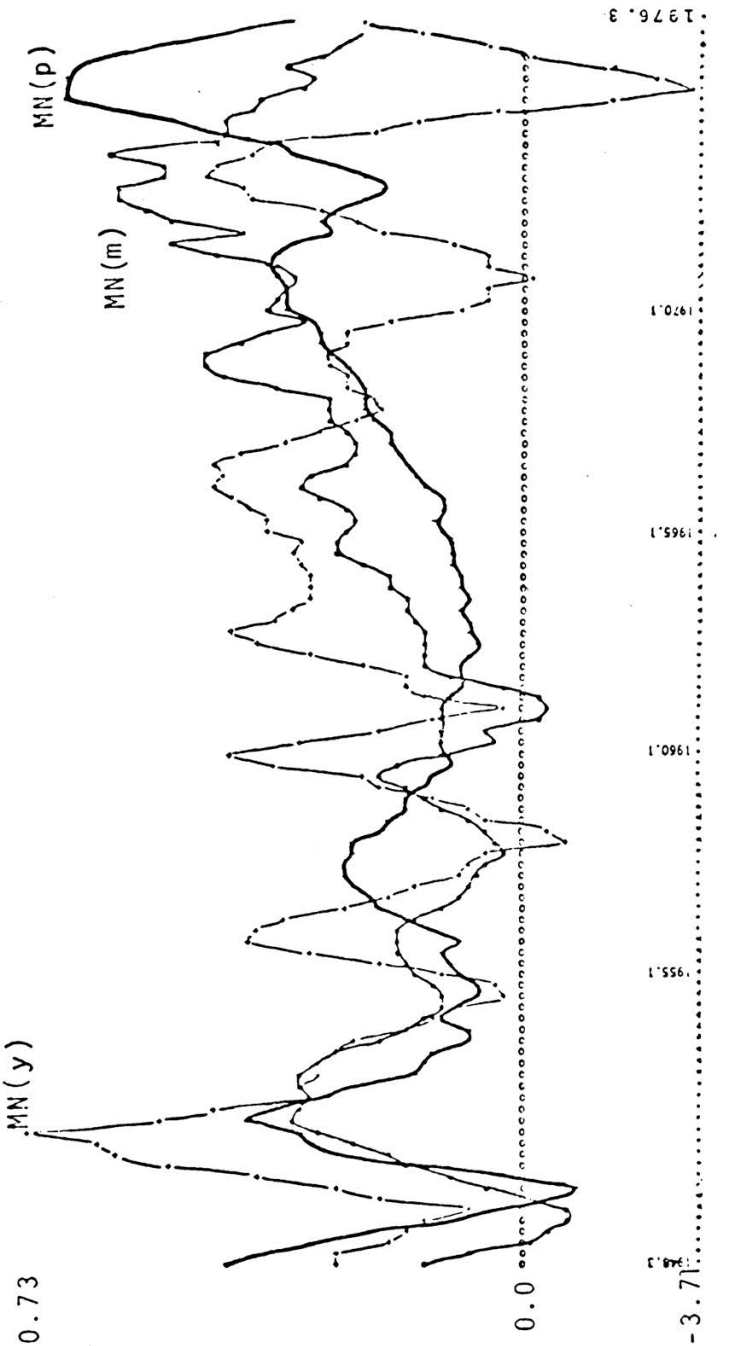

Fig. 1. Inflation and Monetary and Output Growth

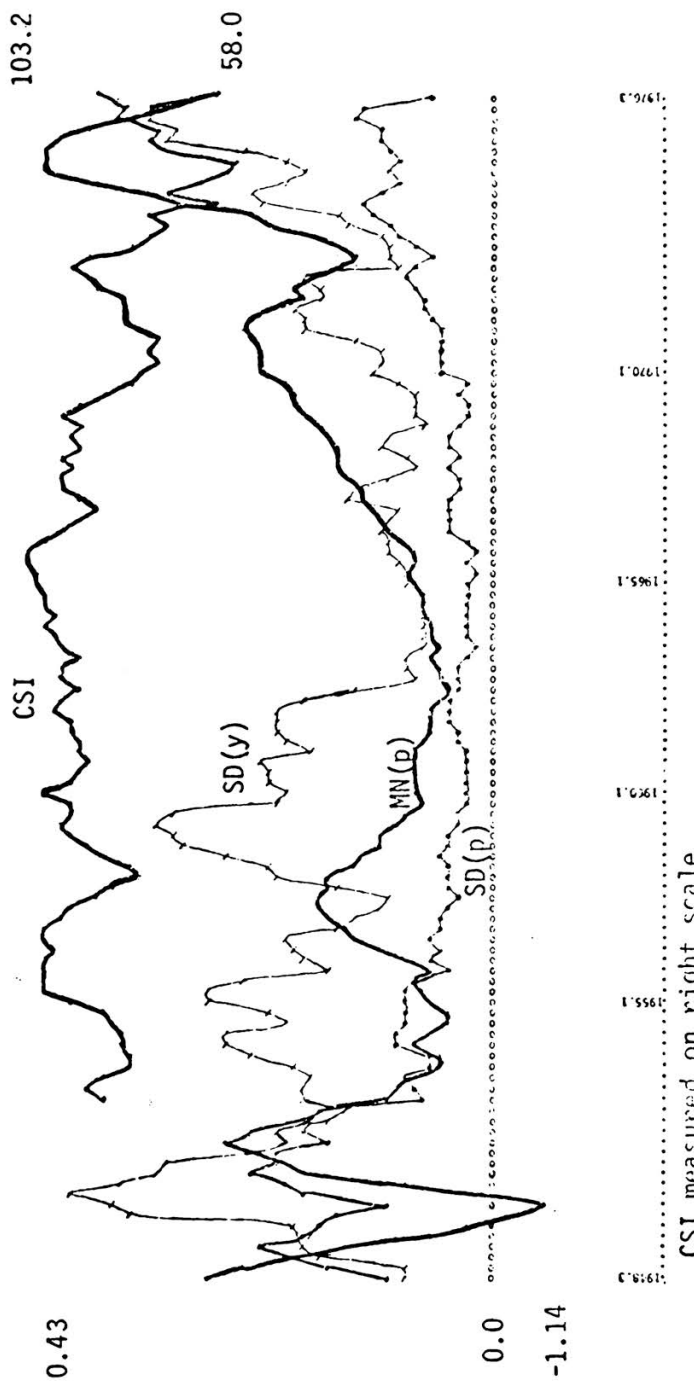

Fig. 2. Inflation and Uncertainty

interdependence of economic experience and political developments (and constraints).[6]

We find then that increases in inflation have been associated with declines in economic growth and increases in the variabilities of both inflation and economic growth. Since price stability and high economic growth are two of our important social goals the phenomenon of stagflation can be expected to adversely affect public sentiment. Further, standard mean-variance theory suggests that inflation-related increases in the variabilities of inflation and economic growth will increase uncertainty and also adversely affect public sentiment (*Tobin* 1958). We do indeed find that the University of Michigan Survey Research Center index of consumer sentiment, *CSI*, is negatively related to the rate of inflation (eq. 7).

$$CSI = \underset{(4.49)}{-3.14\, MN(p)} \quad \underset{(29.83)}{+99.58} \qquad R^2 = 0.85,\ SE = 3.90,\ DW = 1.83,\ \varrho = 0.82 \tag{7}$$

The above argument suggests though that consumer sentiment may be affected not only by the anticipated inflation rate, represented by $MN(p)$, but also by the other variables $(MN(y), SD(y), SD(p))$. However, the intercorrelation amongst the means and variabilities of inflation and economic growth poses estimation problems if they are all included as explanatory variables in the same equation. One possible, albeit imperfect, way out of this difficulty is to examine the relation between consumer sentiment and the principle components of the means and variabilities of inflation and economic growth. The relevant information is shown in Table 1. It suggests only three "independent sources of information" provided by these four original variables. The first two principal components cumulatively account for seventy nine percent of their variance and the first three principal components cumulatively account for ninety five percent of their variance. The last principal component is computationally not

[6] *Friedman* (1978) has described our stagflation experience as follows: "Each scenario has been the same: rapid growth in the quantity money followed by economic expansion and then, much later, by rising inflation; a public outcry against inflation, leading the authorities to reduce monetary growth sharply; some months later the beginning of expansion along with a decline in inflation. Back to the starting point." Implicit in such policy reactions would have to be some assumption about the public's rate of time preference (*Phelps* 1967), as well as the political feasibility of monetary non-accommodation when wages and prices are sticky. Such monetary policy reactions are likely to prevail as long as the public perceives the cost of (now generally accelerating) inflation to be less than the cost of higher unemployment.

Table 1
Explained Variation, Characteristic Roots and Correlation Matrix
Correlation Matrix

Original Variables / Principle Components	$MN(p)$	$SD(p)$	$MN(y)$	$SD(y)$	CR	$CFVE$
$P1$	0.79	0.82	−0.77	0.71	2.39	0.60
$P2$	0.56	0.04	−0.01	−0.67	0.76	0.79
$P3$	0.03	0.53	0.61	0.03	0.65	0.95
$P4$	−0.25	0.24	−0.19	−0.20	0.19	1.00

CR = Characteristic roots.
$CFVE$ = Cumulative Fraction of Variance Explained.

well defined and accounts for only five percent of the variance. Its characteristic root is only eight, twenty five and twenty nine percent respectively of the characteristic root of the first, second and third principal components. A similar general picture emerges from the generalized least squares regression of the consumer sentiment index on the four principal components. The last principle component can be safely ignored; its inclusion was found to lower the adjusted R^2, though only very slightly. As expected,

$$(8)\quad CSI = \underset{(5.07)}{-6.03\,P1} \quad \underset{(2.88)}{-3.35\,P2} \quad \underset{(1.55)}{+1.29\,P3} \quad \underset{(0.52)}{-0.41\,P4} \quad \underset{(48.65)}{+88.73}$$

$$R^2 = 0.87 \qquad SE = 3.70$$
$$DW = 1.94 \qquad \varrho = 0.79$$

the adjusted R^2 of equation (8) of 0.865 is higher than the adjusted R^2 of equation (7) of 0.848. If we retain the first three principal components and transform back from the regression coefficients on the principal components we obtain equation (9).[7]

$$(9)\quad CSI = -1.72\,MN(p) \quad -1.13\,SD(p) \quad -0.50\,SD(y) \quad +0.32\,MN(y)$$

All the coefficients in equation (9) have the expected signs. If we assume that $MN(p)$ is an adequate proxy for anticipated inflation then it may be

[7] The respective coefficients on $P1$, $P2$ and $P3$ are −6.24, −3.60 and 1.27.

inferred that the anticipated inflation-related decline in economic growth on the one hand, and the anticipated inflation-related increases in the variabilities of inflation and economic growth on the other, increased uncertainty, with corresponding increases in the risk perceptions of the public, which then manifested itself in the decline in consumer sentiment.

As further evidence of this hypothesis of an anticipated inflation-related increase in uncertainty we can examine the structure of forecast errors emanating from "partly rational" unbiased ARIMA (1, 1, 1,) forecasts of the inflation rate (*Box-Jenkins* 1976).

$$(10) \qquad |\varepsilon_t| = \underset{(2.67)}{0.14\, p_t^e} + \underset{(3.06)}{0.72} \qquad \begin{aligned} R^2 &= 0.35 \\ SE &= 0.98 \\ DW &= 1.91 \\ \varrho &= 0.30 \end{aligned}$$

Equation (10) is a regression of the absolute value of the forecast errors, $|\varepsilon_t|$, on the ARIMA forecast of the inflation rate, p^e. the significant positive relation suggests that it became increasingly difficult to accurately anticipate inflation at higher rates and that uncertainty can be expected to increase with increases in the anticipated inflation rate even if inflation expectations are unbiased. This is likely to be the case even in the longer run because p^e and $|\varepsilon|$ have similar *U*-shaped trends over the sample period. With the exception of *MN* (*y*) and *CSI*, which have inverted *U*-shaped trends, all the variables examined have similar *U*-shaped trends over the post-Korean War period (Figures 1 and 2).[8]

It is now not uncommon to make a distinction in macroeconomic theoretical studies between anticipated and unanticipated rates of inflation (*Lucas* 1972, *Sargent* 1973, *Barro* 1976); as is to be expected such a distinction is also being made in empirical studies (for example, *Parks* 1978). With expectations being unbiased and markets clearing virtually instantaneously through perfect wage-price flexibility (*R. Gordon* 1976), these flex-price macroeconomic rational expectation models produce the result that real variables are unaffected (even in the short run) by anticipated changes in the

[8] Investment demand, and hence capital formation and aggregate supply (*Klein* 1978), is influenced by income expectations and uncertainty. Thus, we can expect the twin phenomena of stagflation and inflation-related uncertainty to adversely affect investment expenditures and capital formation. This will tend to exacerbate the fluctations in output. As might thus be expected, we found, as in the case of economic growth, a negative (statistically significant) relation between the mean and the variability of the rate of growth of real gross private domestic investment. Further, like economic growth, its variability was found to be positively related to the mean and the variability of inflation.

inflation rate, which is in turn due to anticipated movements in monetary growth. Only unanticipated inflation (and unanticipated monetary growth) can produce any real effects.

Forecast errors, say v, in these rational expectation models are normally distributed random variables with zero means (i.e. unbiased) and constant variances (i.e. $v = N(0, \sigma_v^2)$). with the exception of *Lucas* (1973) and *Barro* (1976) macroeconomic rational expectation models focus only on the zero mean characteristic of the forecast errors and ignore the economic implications of the behavior of σ_v^2. We have shown that there exists a statistically significant positive relation between the mean and the variability of inflation (and to an approximation between anticipated and unanticipated inflation respectively) further, even the variance of forecast errors (approximated by $|\varepsilon|$) stemming from "partly rational" unbiased zero mean forecasts increase with increases in the anticipated inflation rate (and hence also with anticipated monetary growth in these macroeconomic rational expectation models). The implied anticipated inflation-related increase in uncertainty can be expected to adversely affect real investment expenditures and capital formation in particular with predictable output effects (for example, *Nickell* 1977). The invariance conclusions of classical macroeconomic rational expectation models stems from the omission in these models of the responses of rational risk averse economic agents to higher moments of the distribution of forecast errors. It was argued above that this pattern of forecast errors is due, at least in part, to the absence of perfect wage-price flexibility (*Hall* 1975). *Fischer* (1977) and *Phelps-Taylor* (1977) have shown that if wages and prices are allowed to be sticky then systematic monetary policy changes will have real effects even if expectations are *Muth*ian rational (*Muth* 1961). We have argued that there is reason to expect an additional non-neutral risk effect.

The above argument has a direct bearing on the relation between inflation and unemployment. The uncertainty-induced and anticipated inflation-related decline in the rate of growth of investment will produce an increase in unemployment in the short run. And the expected failure of real wages to adjust fully (because the inflation level-related increases in the variabilities of inflation and economic growth make it increasingly difficult to accurately anticipate inflation) implies that unemployment will increase even in the longer run. Moreover, the uncertainty-induced anticipated stagflation-related decline in investment growth will also raise the equilibrium unemployment rate if labor and capital are complements. Witness, for example, the relation between these variables over the post-1955 period. The inflation rate exhibited no marked tendency to accelerate over most of the period 1955.1 - 1969.4, when the *Phillips* Curve was negative; the *Phillips* Curve,

however, became positive over the period 1970.1 - 1976.3, when the inflation rate was higher on average and also more variable. Summary statistics of some of the relevant variables appear in Table 2. The higher unemployment rate in the post-1970 period of higher average and more variable inflation is according to expectation because the stagflation-related increase in uncertainty, due to the increased variabilities of inflation and economic growth, not only reduced investment and output growths but also impaired the ability of real wages to adjust fully, thereby increasing the unemployment rate.[9] Further, if labor and capital are complements, then the reduced investment growth also implies an increase in the equilibrium unemployment rate. This chain of reasoning is consistent with the post-1970 positive slope of the *Phillips* Curve.

Table 2
Means and Standard Deviations*

	p	$\|\varepsilon\|$	CSI	U	i	y	m
1955.1 - 1969.4	2.50 (1.35)	0.76 (0.54)	94.15 (5.33)	4.86 (1.07)	4.15 (21.01)	3.78 (4.11)	2.77 (2.73)
1970.1 - 1976.3	6.21 (2.96)	1.82 (1.15)	77.40 (9.14)	6.11 (1.31)	1.96 (15.69)	2.52 (5.61)	6.42 (3.75)

* Standard Deviations appear in parenthesis.
p = rate of growth of implicit deflator for *GNP*.
$|\varepsilon|$ = absolute error of Box-Jenkins forecast of *DP*.
CSI = University of Michigan, Survey Research Center index of consumer sentiment.
U = unemployment rate of the civilian labor force.
i = rate of growth of real gross private domestic investment.
y = rate of growth of real *GNP*.
m = rate of ($M1$) monetary growth.

The above explanation complements *Friedman*'s (1977) explanation of the recent positive relation between inflation and unemployment. He also uses the inflation level-related increase in its variability (uncertainty) to explain the positive slope of the *Phillips* Curve. He argues, as we have in this study, that the increased variability makes accurate prediction more difficult. This reduces "economic efficiency" and possibly increases the natural rate of unemployment. The reduced efficiency stems first from past contracts being rendered inappropriate, and second, from impairment of the market

[9] Sticky wages, due the contracts, would prevent a prompt adjustment of real wages even if the ability to accurately anticipate inflation was unchanging over this period.

price system as a coordinator of economic activity, due to the increased difficulty in extracting the more relevant information about relative prices from the movement of general prices. *Mullineaux* (1980) and *Levi-Makin* (1980) find that inflation uncertainty has increased the unemployment rate.

The estimated positive relation between the mean and the variability of inflation tends to mitigate the empirical significance of the now common and analytically highly useful distinction between anticipated and unanticipated inflation. If we identify the mean rate of inflation with anticipated inflation, p^e, and its variability with unanticipated inflation, p^u, then the positive relation between the mean and the variability of inflation in equation (2) implies that a large part of unanticipated inflation can be explained by inflation expectations. Further, the insignificant constant term would imply that virtually all of the explained variation of unanticipated inflation was due to the level of inflation expectations; if the average rate of inflation, and by assumption also p^e, were to be zero, then so may inflation surprises p^u, represented by inflation variability. However, equation (2) does not explain all the variation of SD (p) and the pre-1955 estimate (equation (1)) suggests that other sources of variation may at times be very important. Furthermore, increases in inflation variability will influence the size and frequency of inflation surprises but will not be identical to them. Thus it is not surprising that the estimated relation between the absolute value of forecast errors $|\varepsilon|$ and unbiased forecasts of p^e in equation (10) turns up a significant constant term. The overall story is, however, similar in that one is able to explain a substantial part of the variation in inflation surprises p^u by p^e. Furthermore, even though inflation forecasts are unbiased the variable cyclical and secular drifts of the anticipated and unanticipated inflation rate variables are found to be very similar; larger surprises (and higher risk premia) are to be expected at higher inflation rates because of the reduced ability to accurately anticipate inflation.

The inflation level-related variability of inflation is in turn apparently due to the particular monetary policy reactions interacting with a non-classical real world characterized by some wage-price stickiness. This wage-price stickiness is apparently responsible, at least in part, for both the stop-go monetary policy responses as well as for the asymmetric cyclical effects on prices and quantities of expansionary and contractionary monetary policies.[10] The downward stickiness of wages and prices requires

[10] Implicit contract theory (*Azariadis* 1975, *Baily* 1974, *D. F. Gordon* 1974, *Okun* 1975, 1979) provides a microeconomic rationalization for wage-price stickiness by assuming that employers exhibit relatively lower risk aversion than employees and by appealing no notions of "fair play and good faith". However, to the extent that this

a larger monetary contraction in order to have a given effect on the inflation rate. But the extent of the consequently larger decline in economic growth (both, because of the stickiness of wages and prices and the larger monetary contraction) has apparently been too great to bear politically. Hence, these temporary monetary contractions have soon been followed by even larger monetary expansions and consequent increases in the inflation rate. The results has been an increased variability of inflation around a steadily increasing mean, and an increased variability of economic growth around a steadily decreasing mean (Figures 1 and 2). This double whammy of stagflation and heightened general uncertainty has reduced the rate of growth of investment and worsened the output-employment picture. Thus there is substantial basis for the widespread demand for more stable rates of monetary growth. Monetarists argue for a constant monetary growth rule, and *Keynes*ians, more fearful of more prolonged and severe output losses, argue for the combined use of (discretionary but more stable) monetary and fiscal policies. Some also argue for the additional use of market-based incomes policies;[11] they recognize its allocation costs but argue that "It takes a heap of Harberger Triangles to fill and Okun Gap" (*Tobin* 1977).

III. Summary

There is virtually no empirical support for the neo-classical proposition that the relative variability of inflation is invariant to changes in the general rate of inflation. Inflation is non-neutral. Empirical studies have uncovered relationships between the relative variability of inflation and the mean rate of inflation (*Glejser* 1965), general price instability or variability (*Vining-Elwertowski* 1976), and the rate of unanticipated inflation and real economic growth (*Parks* 1978). However, all these right-hand-side explanatory variables were found to be highly correlated, in that inflation was associated with a lower rate of economic growth (stagflation) on the one hand and increased variabilities of inflation and economic growth on the other. These associations were in turn due to stop-go monetary policies operating in a world characterized by some wage-price stickiness, which produced relatively greater declines in economic growth over inflation during the typically temporary monetary contractions.

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wage-price stickiness induces stop-go monetary policy responses, the resulting variability of inflation thwarts, at least partially, the desire for sticky (or "stable") wages and prices.

[11] See, for example, the papers in the special issue of, Brookings Papers on Economic Activity, 2, 1978, and also *Fischer* (1978), *Lucas* (1978), *Solow* (1979), *Okun* (1980) and *Brunner* (1980).

These stagflation-related increases in the variabilities of inflation and economic growth predictably made accurate forecasting of the inflation rate increasingly difficult with increases in the inflation rate; this is reflected in the estimated positive relation between inflation surprises (represented by the absolute value of unbiased inflation forecast errors) and unbiased ARIMA inflation forecasts.[12] This positive relation between inflation expectations and inflation surprises mitigates to some extent the empirical significance of the now common and analytically highly useful theoretical distinction between anticipated and unanticipated inflation. As expected, the stagflation-related increases in the variabilities of both inflation and economic growth were found to have an adverse effect on the index of consumer sentiment.

This short and longer run positive relation between inflation expectations and inflation surprises raises a question about the invariance conclusions of flex-price macroeconomic rational expectation models, since the anticipated inflation level-related increase in the variance of even unbiased forecast errors will adversely affect the behavior of risk averse economic agents. Consequently, real variables such as investment and unemployment will also be adversely affected in the short run. Furthermore, because the increased variability makes it more difficult to accurately anticipate inflation, and thus impedes the ability of real wages to adjust fully, the unemployment rate will also increase in the longer run. Moreover, if labor and capital are complements then even the equilibrium unemployment rate will increase with increases in the anticipated rate of inflation. There is some empirical support for these related hypotheses when one examines the behavior of the relevant variables before and after 1970, when the *Phillips* Curve was respectively negative and positive. This body of evidence provides a strong argument for more stable monetary policies, regardless of whether market-based incomes policies are also used to wage the battle against inflation.

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[12] As *Johnson* (1967) has noted, "contrary to the assumptions of the inflation tax model, inflation typically does not proceed at a steady and well anticipated rate, but proceeds erratically with large politically-determined variations in the rate of price increase."

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Zusammenfassung

Die wechselseitige Verstärkung von Stagflation und Unsicherheit

Empirische Untersuchungen konnten die neoklassische Behauptung nicht bestätigen, wonach die relative Variabilität der Inflation von Änderungen der allgemeinen Inflationsrate unabhängig ist. Inflation wirkt nicht-neutral. Und zwar wurden Zusammenhänge zwischen der relativen Variabilität der Inflation und der durchschnittlichen Inflationsrate, einer allgemeinen Instabilität oder Variabilität der Preise sowie der nicht antizipierten Inflationsrate und dem realen Wachstum aufgedeckt. Wir dagegen finden, daß alle diese erklärenden Variablen hoch korreliert sind, indem die Inflation einerseits mit einer geringeren Rate des Wirtschaftswachstums (Stagflation) verbunden ist und andererseits mit einer erhöhten Variabilität von Inflation und wirtschaftlichem Wachstum. Diese Zusammenhänge gehen offenbar auf ein stop-go-Verhalten der Geldpolitik zurück in einer Welt gewisser Lohn-Preis-Starrheit. Dadurch wurde im Verlaufe der typischerweise vorübergehenden monetären Kontraktionen das Wirtschaftswachstum relativ stärker verringert als die Inflation.

Dieser stagflationsbedingte Anstieg der Variabilität von Inflation und Wachstum erschwerte mit steigendem Niveau der Inflation zunehmend ein genaues Prognostizieren der Inflationsrate. Das zeigt sich in der geschätzten positiven Beziehung zwischen Inflationsüberraschungen und unverzerrten Inflationsprognosen. Dieser sowohl kürzer- wie längerfristig positive Zusammenhang stellt die Schlußfolgerung der Invarianz in Frage, die sich aus makroökonomischen Modellen rationaler Erwartungen bei flexiblen Preisen ableitet. Denn die mit dem antizipierten Inflationsniveau verbundene Zunahme der Varianz sogar unverzerrter Prognosefehler wird das Verhalten risikoscheuer Marktteilnehmer ungünstig beeinflussen. Folglich ergeben sich in der kurzen Frist auch negative Auswirkungen auf reale Größen, wie Investitionen und Arbeitslosigkeit. Da es die gestiegene Variabilität erschwert, Inflation zutreffend zu antizipieren, wird darüber hinaus die Fähigkeit der Reallöhne beeinträchtigt, sich vollständig anzupassen. Dies wird auch längerfristig einen Anstieg der Arbeitslosenquote verursachen. Wenn Arbeit und Kapital komplementär sind, dann wird mit der Zunahme der antizipierten Inflationsrate sogar die Gleichgewichtsquote der Arbeitslosigkeit ansteigen.

Summary

The Double Whammy of Stagflation and Uncertainty

Empirical studies have been unable to provide support for the neo-classical proposition that the relative variability of inflation is invariant to changes in the general rate of inflation. Inflation is non-neutral. They have uncovered relationships between the relative variability of inflation and the mean rate of inflation, general price instability or variability, and the rate of unanticipated inflation and real economic growth. However, we find that all these right-hand-side explanatory variables are highly correlated, in that inflation was associated with a lower rate of economic growth (stagflation) on the one hand and increased variabilities of inflation and economic growth on the other. These associations appear to be due to stop-go

monetary policies operating in a world characterized by some wage-price stickiness, which produced relatively greater declines in economic growth over inflation during the typically temporary monetary contractions.

These stagflation-related increases in the variabilities of inflation and economic growth predictably made accurate forecasting of the inflation rate increasingly difficult with increases in the inflation rate; this is reflected in the estimated positive relation between inflation surprises and unbiased inflation forecasts. This short and longer run positive relation between inflation expectations and inflation surprises raises a question about the invariance conclusions of flex-price macroeconomic rational expectation models, since the anticipated inflation level-related increase in the variance of even unbiased forecasts errors will adversely affect the behavior of risk averse economic agents. Consequently, real variables such as investment and unemployment will also be adversely affected in the short run. Furthermore, because the increased variability makes it more difficult to accurately anticipate inflation, the ability of real wages to adjust fully is impeded, causing the unemployment rate to increase also in the longer run. Moreover, if labor and capital are complements then even the equilibrium unemployment rate will increase with increases in the anticipated rate of inflation.

Résumé

Le double cercle vicieux de la stagflation et de l'incertitude

Des recherches empiriques ne purent pas soutenir la thèse néoclassique affirmant que la variabilité relative de l'inflation par rapport aux changements du taux d'inflation général est stable. L'inflation n'est pas neutre. Ces études ont découvert des rapports entre la variabilité relative de l'inflation, le taux moyen d'inflation et la croissance économique réelle. A notre avis, ces variables explicatives traditionnelles sont corrélées à un fort degré: en effet, d'une part, l'inflation va de pair avec une faible croissance économique (stagflation), d'autre part, une plus grande variabilité de l'inflation va de pair avec la croissance économique. Ces développements reposent visiblement sur une politique monétaire de stop & go dans un environnement caractérisé par l'inflexibilité des salaires et des prix. Suite aux restrictions monétaires temporaires, cette inflexibilité a provoqué relativement un plus grand recul de la croissance que de l'inflation.

L'augmentation de la variabilité de l'inflation et de la croissance économique, causée par la stagflation, rend difficiles des prévisions précises sur le taux d'inflation, et ceci d'autant plus que le taux d'inflation s'élève. Ceci se reflète sans distorsion systématique dans la relation positive estimée entre un développement inflationniste surprenant et les prévisions de l'inflation. Cette relation positive à court et à moyen terme entre les attentes inflationnistes et les développements surprenants de l'inflation pose la question des conséquences d'invariance de modèles macroéconomiques rationnels d'attentes avec des prix flexibles. En effet, l'augmentation anticipée de la variance des erreurs prévisionnelles, sans distorsion systématique, par rapport au niveau de l'inflation incfluence en tout cas négativement le comportement des sujets économiques qui évitent les risques. En conséquence, les variables réelles telles que

l'investissement et le chômage sont aussi influencées négativement. La plus grande variabilité complique l'anticipation précise de l'inflation. Pour cette raison, les salaires réels ne peuvent pas s'adapter complètement, de telle manière que le taux de chômage augmente aussi. Si le travail et le capital sont des facteurs de production complémentaires, même le chômage d'équilibre augmentera avec un taux d'inflation prévu croissant.