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INFLATION AND ITS VARIABILITY: A NOTE?

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I. INTRODUCTION

In a recent paper in this journal, Chowdhury (1991) reconsiders the empirical relationship between inflation rates and inflation variability. His motivation arises from the fact that numerous studies of this issue have yielded contradictory results. Using data for sixty-six countries over the sample period 1955-85, Chowdhury finds there exists a positive relationship between the rate of inflation and its variability. He concludes that "... the results provide strong evidence to show that countries with high inflation rates are more likely to face the additional possibility of a more variable and uncertain rate (Chowdhury, 1991 pp. 1002)".

The purpose of this note is twofold. The first is to direct the reader's attention to recent studies, omitted from Chowdhury's review of the literature, which distinguish between inflation variability and inflation uncertainty. The recent literature indicates that inflation variability is unlikely a satisfactory proxy for inflation uncertainty. Thus, Chowdhury's conclusions, especially from a policy perspective, may not hold. Inflation variability does not necessarily imply inflation uncertainty, nor the damaging effects on economic activity associated with inflation uncertainty.[1]

The second purpose of this study is to present an alternative specification of the relationship between inflation and inflation variability. Chowdhury's results, as well as those of others, imply that at even moderate rates of inflation, the standard deviation of inflation will be negative. The

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[1] Throughout the article, Chowdhury treats inflation variability and inflation uncertainty as synonymous. Therefore, based purely on an analysis of variability, he reaches conclusions such as "... there appears to be an optimum zone of inflation rates within which the predictability of inflation is at its highest and hence uncertainty is at its lowest (Chowdhury 1991, pp. 1002)."

results in this note indicate that specifying the standard deviation of inflation as a nonlinear function of the level of inflation eliminates this problem and results in a superior model in terms of both explanatory power and diagnostic statistics.

This note is organized as follows. First, issues about the relationship between inflation variability and inflation uncertainty are discussed. Then, an alternative empirical specification of the relationship between inflation variability and inflation is laid out. Section four presents results and the conclusions follow.

II. INFLATION VARIABILITY VERSUS INFLATION UNCERTAINTY

Until recently, empirical studies of the effects of inflation uncertainty have used measures of inflation variability to proxy for inflation uncertainty.[2] These studies typically gather data for a number of countries and calculate sample means and variances of inflation for each country.[3] Using regression analysis, these studies then examine whether there is a positive correlation between inflation means and inflation variances.

The main problem with this approach is that variance proxies do not distinguish between predictable and unpredictable changes in inflation. In other words, these studies do not specify a parametric model of inflation. If a parametric model of inflation is specified, error variances can be estimated and then used as proxies for inflation uncertainty. Still, just specifying a

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[2] These studies include, among others, Okun (1971), Logue and Willett (1976), Logue and Sweeney (1981), Taylor (1981), and Chowdhury (1991).

[3] In contrast to the other studies, Katsimbris (1985) constructs time-varying means and variances of inflation as eight-quarter, non-overlapping moving averages.

traditional parametric model of inflation will likely be unsatisfactory because inflation uncertainty will usually vary over time.

In attempt to overcome the deficiencies of these studies, recent studies have specified parametric models of inflation and also allowed the error variances to change over time. Specifically, beginning with Engle (1983), a number of studies have used autoregressive conditional heteroscedasticity (ARCH) models of inflation which parameterize the mean and variance relationships under investigation.

Somewhat surprisingly, these studies (Engle 1983, Holland 1984, Cosimano and Jansen 1988, and Jansen 1989) find little support for the hypothesis that either the rate of inflation or inflation variability is related to uncertainty about future inflation in the United States. However, Evans (1991), using an ARCH model of inflation, and at the same time allowing the parameters generating the inflation process to vary over time, finds support for the hypothesis that the level of inflation and inflation uncertainty are linked in the U.S..

The conclusions to draw from recent studies are twofold. First, they indicate that the issue of whether the level of inflation is linked to uncertainty about future inflation remains open. Second, using inflation variability measures as proxies for inflation uncertainty is unsatisfactory.

While the literature has established that using inflation variability to proxy for inflation uncertainty is problematic, the issue of whether inflation variability is related to the level of inflation remains a significant issue. For instance, while inflation variability may not be related to inflation uncertainty, it still may be the case that inflation variablility imposes damaging effects on economic growth. These effects could operate through such

channels as increased menu costs or increased noise in relative price movements. Additionally, Okun's (1971) formulation of the inflation variability hypothesis rests on the idea that policymakers operate on the steep portion of the Phillips curve.

III. INFLATION AND INFLATION VARIABILITY: AN ALTERNATIVE SPECIFICATION

After noting the contradictory results of existing studies, Chowdhury re-examines the relationship between inflation and inflation variability using a longer sample period and a larger number of countries than previous studies. The potential relationship is examined by regressing the standard deviations of inflation on the means of inflation over different sample periods.[4] Table 1 presents his results for the entire group of countries over three different sample periods.

While Chowdhury's results support the existence of a positive relationship between inflation and inflation variability, a puzzling result is the sign and size of the estimated intercepts in these regressions. For instance, over the 1955-85 period, the estimated intercept of -34.7 implies that the predicted standard deviation of inflation does not become positive until countries have greater than 8.0-percent average annual inflation.

This puzzling aspect of Chowdhury's results is not specific to his study. In fact, in many studies, over different sample periods and different countries, the estimated intercept term is often negative and statistically significant (see Chowdhury 1991, Table 4).

These results suggest that the standard deviation of inflation may be

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[4] Chowdhury also uses the average annual absolute change in the inflation rate as the dependent variable with no qualitative change in results.

related to the mean of inflation in a nonlinear manner. An alternative formulation is one in which the standard deviation of inflation depends on the mean of inflation squared, as well as the mean of inflation. This specification can be motivated in several ways. First, Okun's (1971) original hypothesis was formulated on the basis of policymakers operating on the steep portion of a *nonlinear* Phillips curve. This formulation suggests that, on the margin, inflation variability's response to changes in average inflation will depend where on the Phillips curve a policymaker is operating.

Second, the proposed alternative specification is equivalent to specifying the *coefficient of variation* as a function of the level of inflation. To see this consider the nonlinear model

$$(1) \qquad SD = \beta_0 \bar{X} + \beta_1 \bar{X}^2$$

where SD is the standard deviation of inflation and $\bar{X}$ is the mean of inflation. Since the coefficient of variation equals the standard deviation of inflation divided by the mean of inflation, equation (1) can be rewritten as

$$(2) \qquad CV = \beta_0 + \beta_1 \bar{X}$$

where CV equals the coefficient of variation. Thus, equation (2) specifies the coefficient of variation as a linear function of mean inflation.

The coefficient of variation may be preferred to the standard deviation if the variability measure is used to proxy for inflation uncertainty. This is the case because the *percentage* deviation of inflation from its expected rate determines the impact of inflation variability on the real value of nominal assets, the value of nominal contracting, and the uncertainty

associated with pricing decisions.[5] Because the coefficient of variation is basically the standard deviation of inflation corrected for the mean of inflation, it may provide a better proxy for inflation uncertainty than does the standard deviation.

IV. RESULTS

Table 2 presents the results from estimating the alternative specification using ordinary least squares. For the entire sample period 1955-85, the mean inflation-squared term is positive and very significant. Additionally, the intercept term is now positive, but not statistically significant, and the adjusted R^2 has increased to 0.99. Diagnostic statistics indicate neither the presence of autocorrelation nor heteroscedasticity. The absence of autocorrelation contrasts with the Chowdhury specification using only mean inflation as a right-hand-side variable. Under the Chowdhury specification, both Chi-Square and F-tests indicate the presence of autocorrelation, suggesting misspecification.

For the 1972-85 sample period, the results are similar. Compared with the conventional specification, the explanatory power is higher, the inflation-squared term is very significant, and the estimated intercept has a positive sign under the alternative specification. Again, in contrast to the traditional specification, there is no evidence of autocorrelation which might indicate misspecification.

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[5] For example, consider two countries with different mean inflation rates and the same standard deviations. A one-standard-deviation change from the mean in the lower-inflation country represents a larger percentage change from that mean than does a one-standard deviation change from the mean in the high-inflation country. Thus, a one-standard deviation change in inflation in the high-inflation country will have less of an impact on wealth which is denominated in nominal terms.

However, for the 1955-71 sample period, the traditional linear specification appears to be superior to the alternative specification. The traditional specification provides more explanatory power and the estimated intercept is negative, but not significant. Additionally, the inflation-squared term in the nonlinear specification is not significant. There is no evidence of autocorrelation or heteroscedasticity in either specification.

For the 1955-71 sample period, simple statistics indicate why the traditional specification is superior. During this period, average annual inflation across the 66 countries was only 5.2 percent. In contrast, during the 1972-85 sample period, the average annual inflation rate across the 66 countries was 34.8 percent. Thus, the results indicate that at low levels of inflation there is little evidence of nonlinearity. However, once the sample of countries includes a significant number of moderate to high inflation countries the nonlinearity becomes very evident.

V. CONCLUSIONS

In response to Chowdhury (1991), this note reviews recent studies which indicate that inflation variability is an unsatisfactory proxy for inflation uncertainty. The problem with variance proxies is that they do not distinguish between predictable and unpredictable changes in inflation. Still, despite the problems associated with using inflation variability measures as proxies for inflation uncertainty, understanding the determinants of inflation variability remains an important topic.

The second part of this note examines whether the standard deviation of inflation is a function of the level of inflation squared, as well as the level of inflation. The motivation for examining this nonlinear specification

results from a puzzling finding of other studies. In these studies, the standard deviation of inflation is often predicted to be negative. This study's findings indicate that in terms of both explanatory power and standard diagnostic statistics, the alternative nonlinear specification is superior to the traditional linear specification. The results here show that the variability of inflation increases exponentially with the inflation rate.

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Table 1

Chowdhury's (1991) Results

Regressing Standard Deviation of Inflation on Mean Inflation
(66 countries)

Sample	Intercept	Coeff. on Std. Dev	Adj. R^2	$\chi^2(1)$	F(1,63)
1955-85	-34.72 (7.23)	4.26 (45.00)	0.97	11.27	12.97
1955-71	-0.723 (1.56)	1.10 (17.88)	0.83	1.96	1.93
1972-85	-43.20 (6.53)	2.97 (47.73)	0.97	10.29	11.64

t-statistics in parentheses
Chi-Square and F-tests for autocorrelation: $\chi^2(1)_{.05}=3.84$ $F(1,60)_{.05}=4.00$

Table 2

OLS Estimates of Regressing Standard Deviation of Inflation
on Mean Inflation and Mean Inflation Squared
(66 countries)

Sample	Intercept	Coeff. on Mean	Coeff.on Mean^2	Adj. R^2	$\chi^2(1)$	F(1,62)
1955-85	3.49 (1.10)	0.46 (7.03)	0.009 (62.49)	0.99	0.005	0.005
1955-71	-.05 (0.86)	0.91 (4.00)	0.005 (0.71)	0.80	1.80	1.74
1972-85	3.15 (2.62)	0.29 (7.58)	0.003 (74.51)	0.99	0.041	0.038

t-statistics in parentheses
Chi-Square and F-tests for autocorrelation: $\chi^2(1)_{.05}=3.84$ $F(1,60)_{.05}=4.00$

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