INFLATION, INFLATION UNCERTAINTY, AND MONETARY POLICY IN TURKEY: 1960–1998

TEVFIK F. NAS AND MARK J. PERRY*

The authors constructed a time series of monthly inflation uncertainty in Turkey from 1960 to 1998 using GARCH models and investigated the link between inflation and inflation uncertainty using Granger tests. The authors found strong statistical support that inflation significantly raised inflation uncertainty in Turkey over the full sample period and three subsamples. The evidence on the effect of inflation uncertainty on average inflation is mixed and depends on the time period examined. An analysis of the political conditions and the record of macroeconomic policymaking in Turkey between 1960 and 1998 reveal institutional and political factors that can help explain the empirical results. (*JEL* E310, 1342, 1340)

I. INTRODUCTION

An extensive body of both empirical and theoretical literature focuses on the relationship between the rate of inflation and inflation uncertainty. Recent studies by Brunner and Hess (1993), Evans and Wachtel (1993), and Ball and Cecchetti (1990) found statistical support for a positive association between the rate of inflation and inflation uncertainty in the United States. Theoretical studies by Cukierman and Meltzer (1986), Cukierman (1992), and Ball (1992) address the issue of the direction of causality between inflation and inflation uncertainty. Ball claims that higher inflation creates greater inflation uncertainty, while according to Cukierman and Meltzer inflation uncertainty leads to higher average inflation due to opportunistic central bank behavior (politically motivated expansionary policy). Recent empirical work focuses specifically on the direction of causality between inflation and inflation uncertainty. Holland (1995) found that inflation raises inflation uncertainty in the United States and that higher inflation uncertainty leads to lower average inflation due to stabilization motives of policymakers. Grier and Perry (1998) showed that inflation significantly raises inflation uncertainty in all G-7 countries but that increased inflation uncertainty raises inflation only in Japan and France. Evidence of stabilizing behavior is found in the United States, United Kingdom, and Germany, where increased inflation uncertainty lowers average inflation.

In the present study, following the methodology used in Grier and Perry (1998), we constructed a time series of monthly inflation uncertainty in Turkey from 1960 to 1998 using generalized autoregressive conditional heteroskedastic (GARCH) models and investigate the link between inflation and inflation uncertainty using Granger tests. This article found strong statistical support that inflation significantly raises inflation uncertainty in Turkey over the full sample period and three subsamples, confirming the prediction of Ball (1992). Test results for whether inflation uncertainty lowers or raises subsequent inflation are mixed and depend on the time period tested. Overall, stabilizing policy behavior seems to prevail, especially in the long run, since higher inflation uncertainty is associated with lower average inflation at some lag lengths in each sample period investigated. This article found evidence of opportunistic policy behavior in the short run during the late 1980s and 1990s, when inflation uncertainty raised average inflation. An examination of the political conditions and the record of macroeconomic

*Nas: Professor of Economics, University of Michigan-Flint, Fax 1-810-762-3281, Email tnas@umich.edu
Perry: Assistant Professor of Economics, University of Michigan-Flint, Fax 1-810-762-3281, Email mjperry@umich.edu

ABBREVIATIONS

CB: Central Bank
GARCH: Generalized Autoregressive Conditional Heteroskedastic

Contemporary Economic Policy
(ISSN 1074-3529)
Vol. 18, No. 2, April 2000, 170–180

policy making in Turkey between 1960 and 1998 reveal institutional and political factors that explain our empirical results.

Section II reviews the theoretical and empirical literature on the relationship between inflation and inflation uncertainty. Section III discusses measures of inflation uncertainty and shows how GARCH models can be used to construct a time series measure of inflation uncertainty. In sections IV and V the authors present empirical results and discuss how the policy environment in Turkey over this period can help explain these findings. Conclusions are presented in section VI.

II. INFLATION AND INFLATION UNCERTAINTY

Okun (1971) first argued that inflation is positively associated with inflation uncertainty because monetary policy becomes more unpredictable during periods of high inflation. Friedman (1977) emphasized the positive link between inflation and inflation uncertainty, because of the stop-and-go monetary policy that accompanies inflationary periods. According to Okun and Friedman, high inflation produces political pressure to reduce it, but policy makers may be reluctant to disinflate because they fear the recessionary effects of contractionary monetary policy. Because future monetary policy is more difficult for the public to predict in high inflationary periods, higher average inflation results in greater uncertainty about future inflation.

Ball (1992) formalizes the insights of Okun and Friedman. In Ball's model, there are two types of policy makers who rotate in office: one is willing to tolerate a recession to reduce inflation, and the other is not. When inflation is low, both types of policy makers will attempt to keep it low, but when inflation is high, only the anti-inflation policy maker will bear the economic costs of disinflation. A repeated game takes place between the public and the monetary authority as policy makers rotate in office. During periods of high inflation, there is greater uncertainty about future monetary policy since the public does not know how long it will take for an anti-inflation policy maker to come into power and lower inflation. Ball's model provides theoretical support that higher inflation creates greater uncertainty about future inflation.

In contrast, Cukierman and Meltzer (1986), and Cukierman (1992) argue that the causality runs in the other direction, that greater uncertainty about inflation causes higher average inflation. The central bank faces a trade-off because it dislikes inflation but values the higher employment from monetary surprises. If monetary policy is discretionary and there is a lack of a commitment mechanism, Cukierman and Meltzer's model predicts an inflationary bias during periods of increased uncertainty. Since it is harder to assess policymaking when uncertainty is high, there is an increased incentive for the central bank to act opportunistically and create inflation surprises during periods of increased inflation uncertainty.

However, Holland (1995), Grier and Perry (1998), and Balvers and Cosimano (1994) argue that short-term opportunistic behavior in periods of inflation uncertainty is not the only possible policy response by the central bank. Policy makers could either (a) have long-term stabilizing motives, (b) be governed by some commitment mechanism that requires price level stability, or (c) be influenced by International Monetary Fund–aided shifts toward stabilization and attempt to reduce the welfare costs of inflation by disinflating when inflation uncertainty is high. In these cases, there would be a negative relationship between inflation uncertainty and average inflation, due to the long-term stabilization motives of the monetary authorities.

III. MEASURING INFLATION UNCERTAINTY

Early researchers measured inflation uncertainty as the standard deviation of inflation, and conducted international studies showing that countries with higher average inflation have more variable inflation. Two time series measures of inflation uncertainty were later developed: (1) the cross-sectional dispersion of inflation forecasts from surveys of professional economists and (2) the moving standard deviation of the inflation rate.

These measures of inflation uncertainty do not necessarily capture the type of uncertainty modeled by Ball (1992) or Cukierman and Meltzer (1986), where uncertainty is the variance of the unpredictable component of inflation. Survey-based measures of inflation summarize the dispersion among forecasters at a point in time, but do not measure each forecaster's certainty about their inflation forecast. It is possible that, in a given period, each forecaster could be extremely uncertain about inflation and yet submit similar point estimates of future inflation. The survey-based measure of inflation uncertainty would then significantly underestimate the actual level of uncertainty about future inflation. Likewise, the predictable fluctuations in inflation will show up in a standard deviation measure of inflation uncertainty even though there may be no actual uncertainty. In that case, the moving standard deviation of inflation could significantly overstate the actual level of uncertainty.

In contrast to these ad hoc measures of inflation uncertainty, recent econometric advances in ARCH and GARCH time series estimation provide a more sophisticated method of estimating time-varying uncertainty (see Engle [1983] for further details on ARCH models and Bollerslev [1986] for GARCH models). GARCH models can parametrically estimate the variance of stochastic innovations in a variable, rather than simply constructing a variability measure from past outcomes (moving standard deviation) or the dispersion of individual inflation forecasts. Note that, in a parametric model, the distribution and characteristics of a population are assumed to be known and statistical inferences are made based on these assumptions. A GARCH model estimates a time-varying conditional error variance that corresponds well to the uncertainty in the theoretic models of Ball (1992) and Cukierman and Meltzer (1986).[1]

Furthermore, since GARCH models provide a parametric measure of inflation uncertainty, an explicit test can be conducted to determine if the conditional variance is statistically significant. Therefore, we can conduct a statistical test of the null hypothesis that inflation uncertainty is constant over the sample period. While the survey- or variability-based measures of inflation uncertainty previously used do fluctuate over time, there is no way to test whether those fluctuations are statistically significant. GARCH models, therefore, represent a significant advancement in the estimation of uncertainty and are now used extensively in the economic and finance literature.

In the present study, we estimate GARCH(1,1) models for Turkish inflation and then use the time-varying residual variance ($\sigma_{\epsilon t}^2$) as a time series of inflation uncertainty. A general ARMA-GARCH(1,1) model for inflation is

$$(1)\quad \pi_t = \beta_0 + \sum_{i=1}^{n} \beta_i \pi_{t-i} + \delta\epsilon_{t-i} + \epsilon_t,$$

$$(2)\quad \sigma_{\epsilon t}^2 = \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + \alpha_2 \sigma_{\epsilon t-1}^2.$$

Equation (1) is a standard, time-series model of inflation, where the conditional mean of Turkish inflation is assumed to follow an autoregressive, moving average (ARMA) process. Inflation at time t is simply a function of past values of inflation (AR terms) and past values of the error term (MA terms). Following the standard approach used in the time-series literature to model macroeconomic variables over time, the optimal lag length (n) in equation (1) is selected based on (a) an inspection of the inflation correlogram of the autocorrelations and partial correlations, (b) Q tests for serial correlation in the subsequently estimated inflation equations, and (c) an inspection of the correlograms of the inflation residuals from estimated ARMA equations for inflation. An ARMA specification for inflation should adequately capture all serial correlation to ensure that the residuals are white noise.

Equation (2) is a GARCH(1,1) representation of the conditional variance of inflation, and $\sigma_{\epsilon t}^2$ is our GARCH measure of inflation uncertainty. We consider other representations of the GARCH process, but find that GARCH(1,1) is the best. The GARCH(1,1) model of $\sigma_{\epsilon t}^2$ in equation (2) implies that the conditional error variance of inflation at time t depends on the squared error from the inflation equation in time period $t-1$ and the conditional variance from time period $t-1$. In periods when inflation uncertainty is low (high), the error term ϵ_{t-1} will be small (large), the squared error term ϵ_{t-1}^2 in next period's conditional

1. In another area of the inflation-inflation uncertainty literature, an attempt is made to separate long-run from short-run inflation uncertainty. For example, see Ball and Cecchetti (1990) and Evans and Watchel (1993).

variance will be small (large), and the conditional error variance in time period t will be small (large). Since a large error in one period (a high level of uncertainty) could affect more than one future period, the lagged conditional variance of inflation ($\sigma^2_{\epsilon t-1}$) enters as a regressor to allow for inflation uncertainty to persist through time.

IV. EMPIRICAL RESULTS

This section examines the relationship between inflation and inflation uncertainty in Turkey using the monthly consumer price index from January 1960 through March 1998. We begin with the time series model described in equations (1) and (2) to jointly estimate the conditional mean and conditional variance of Turkish inflation and to generate a parametric, times series measure of inflation uncertainty. Next we conduct Granger-causality tests to provide statistical evidence of the relationship, including the direction of causality, between inflation and inflation uncertainty. Three subsample periods are also investigated. The results of these tests allow us to determine whether opportunistic policy behavior or stabilizing behavior prevails in Turkey.

A. A GARCH Time Series Model for Turkish Inflation

It is necessary first to establish that Turkish inflation is stationary, that the residuals of the time-series model of inflation are uncorrelated, and that the conditional variance of inflation is significantly time-varying. We use Phillips-Perron and augmented Dickey-Fuller (ADF) tests of the null hypothesis that Turkish inflation has a unit root. Both tests reject the null hypothesis of a unit root in Turkish inflation at the 0.01 level, indicating that the inflation rate in Turkey is stationary.

Table 1A shows the results of a times series model for the inflation rate that includes eight lags of inflation and a 12th order moving average term. Using standard Box-Jenkins techniques, we find that this specification is the best-fitting time series

TABLE 1
Time Series Models of the Turkish Inflation Rate

A. *Least Squares Results*

$$\Pi_t = \underset{(3.21)}{7.425} + \underset{(8.00)}{0.375}\,\Pi_{t-1} + \underset{(1.27)}{0.063}\,\Pi_{t-2} + \underset{(3.84)}{0.192}\,\Pi_{t-3} - \underset{(1.35)}{0.068}\,\Pi_{t-4} - \underset{(0.62)}{0.032}\,\Pi_{t-5} -$$

$$\underset{(0.07)}{0.003}\,\Pi_{t-6} + \underset{(0.075)}{0.037}\,\Pi_{t-7} + \underset{(4.29)}{0.200}\,\Pi_{t-8} + \underset{(3.02)}{0.146}\epsilon_{t-12} + \epsilon_t$$

Log-likelihood = −2122

$R^2 = .390$

$Q(4) = 1.25$ $Q(8) = 4.7$ $Q(12) = 11.4$

$Q^2(4) = 24.0$ $Q^2(8) = 24.1$ $Q^2(12) = 24.3$

Chow test for structural stability of estimated coefficients (Breakpoint: 1980.01): $F = 13.2$, $p = .192$

B. *GARCH(1, 1) Results*

$$\Pi_t = \underset{(3.13)}{6.549} + \underset{(8.12)}{0.556}\,\Pi_{t-1} - \underset{(0.93)}{0.059}\,\Pi_{t-2} + \underset{(2.38)}{0.166}\,\Pi_{t-3} - \underset{(0.39)}{0.024}\Pi_{t-4} - \underset{(0.34)}{0.019}\,\Pi_{t-5} -$$

$$\underset{(0.30)}{0.018}\,\Pi_{t-6} + \underset{(0.27)}{0.013}\,\Pi_{t-7} + \underset{(3.30)}{0.165}\,\Pi_{t-8} + \underset{(3.90)}{0.114}\epsilon_{t-12} + \epsilon_t$$

$$\sigma^2_{\epsilon t} = \underset{(6.21)}{211.5} + \underset{(7.09)}{0.355}\epsilon^2_{t-1} + \underset{(5.52)}{0.378}\,\sigma^2_{\epsilon t-1}$$

Log-likelihood = −2070

$R^2 = .365$

$Q(4) = 6.2$ $Q(8) = 8.2$ $Q(12) = 16.0$

$Q^2(4) = 43.8$ $Q^2(8) = 5.17$ $Q^2(12) = 6.17$

Numbers below the coefficients are t-statistics. Sample is monthly from 1960.01 through 1998.03. $Q(x)$ is the Ljung-Box statistic for xth order serial correlation in the residuals, and $Q^2(x)$ is the statistic xth order serial correlation in the squared residuals. Critical values at the 0.05 level of significance are 9.4, 15.51, and 21.0 for 4, 8, and 12 lags, respectively. Data were obtained from *Global Financial Data* (Los Angeles, Calif.).

model for Turkish inflation over the full sample period and results in residuals that are white noise.[2] Ljung-Box Q-tests on the residuals show no sign of autocorrelation at 4, 8, or 12 lags, indicating that this model accounts for any serial correlation in the error terms. However, Q^2 test statistics on the squared residuals are significant at the 0.05 level for 4, 8, and 12 lags, indicating that the inflation error variance is significantly time varying. The AR(8) 12th order moving average regression model captures any pattern in the conditional mean of inflation, but does not account for the strong pattern in the conditional error variance. In addition, a Chow test of the null hypothesis that the estimated parameters are stable over time is insignificant, indicating that the model is structurally stable.[3]

Table 1B adds a GARCH(1,1) model of the conditional variance of inflation to the time series model of the conditional mean of inflation. Q-statistics for the residuals reveal no pattern in either the residuals or the squared residuals. The AR(8), MA(12)-GARCH(1,1) model is the best-fitting times series model of both the conditional mean and variance of Turkish inflation.[4] The residuals and squared residuals are white noise, and no other model results in a higher log-likelihood function. $\sigma^2_{\epsilon t}$ is used as our time series measure of inflation uncertainty in subsequent Granger tests of the relationship between the rate of inflation and inflation uncertainty.

2. Our main results in the paper do not depend on the exact times series model of inflation [AR(8) MA(12)]. For example, the following models yield similar results: (a) AR(12); (b) AR (8), AR (12), and an AR(8) MA(12) model where the insignificant regressors are dropped.

3. Evans (1991) uses an ARCH specification for inflation uncertainty and also allows for time-varying parameters to capture structural changes in U.S. inflation over time. Since we find that our basic model of Turkish inflation is structurally stable over the full sample period according to the Chow test, we do not attempt to estimate a time-varying parameter model.

4. The estimated coefficients in the variance equation are significant at the 0.01 level, as can be seen by their individual t-statistics as well as by noting that the log of the likelihood function increases from -2122 to -2070 from panel A to panel B. The two estimated slope coefficients in the GARCH equation sum to less than 1.0 (.733), which is a requirement for stability of the GARCH process. Specifications other than GARCH(1, 1) were estimated, but no other model had a higher log-likelihood function.

B. Granger-Causality Tests

Given our time series measure of inflation uncertainty in Turkey, we can now examine the relationship between inflation and inflation uncertainty using Granger-causality tests.[5] The results of these tests are reported in Table 2. Over the full sample period (1960.1–1998.3), the null hypothesis that inflation does not Granger-cause inflation uncertainty is rejected at the 0.01 level using 4, 8, 12, 16, or 24 lags. Furthermore, since the sum of the coefficients is positive in all cases, these results indicate that an increase in the Turkish inflation rate "Granger-causes" greater inflation uncertainty.[6] The null hypothesis that uncertainty does not Granger-cause inflation is also rejected at the 0.01 level for all lags. The sum of the coefficients on lagged uncertainty in the inflation equation is negative, indicating that increased inflation uncertainty leads to lower future inflation over the full sample period.

The Granger tests reveal that there is bidirectional causality between inflation and inflation uncertainty. The first set of Granger tests in Table 2A show that increased infla-

5. The Granger approach allows us to examine the questions of interest in this article—whether inflation (INF) "Granger-causes" inflation uncertainty (UNC) and whether UNC "Granger-causes" INF. The equations to be estimated in the pairwise Granger-causality test are

$$(3)\quad UNC_t = \sum_{i=1}^{k} \alpha_i\, UNC_{t-i} + \sum_{i=1}^{k} \beta_i INF_{t-i} + \epsilon_t,$$

$$(4)\quad INF_t = \sum_{i=1}^{k} \alpha_i + INF_{t-i} + \sum_{i=1}^{k} \beta_i UNC_{t-i} + u_t,$$

where k is the number of lags specified, and we test the null hypothesis that INF (UNC) does not cause UNC (INF) in equation (3) [Equation (4)]. INF will Granger-cause UNC in equation (3), if after controlling for k lags of uncertainty, the k lags of inflation have explanatory power as a group in predicting uncertainty using an F-test of joint significance of the inflation lags. Likewise, inflation uncertainty will Granger-cause inflation in equation (4), if the lags of uncertainty have significant explanatory power as a group.

6. Standard Granger-causality models are a test of temporal ordering between two variables and do not reveal the sign of the relationship. That is, variable X could be found to Granger-cause variable Y, but whether X raises or lowers Y would be obvious from a Granger test. Therefore, we also calculate and report the sum of the coefficients from each Granger equation to determine whether the Granger causality, when found, is positive or negative.

tion first raises inflation uncertainty as predicted by Friedman (1977) and Ball (1992). However, inflation and the associated uncertainty create real economic costs, which lead to monetary tightening to lower inflation. This stabilization behavior is reflected in the second set of Granger tests in Table 2A, where increased inflation uncertainty lowers the subsequent rate of inflation.

C. Subsample Periods

We next investigate the relationship between inflation and inflation uncertainty in three subsample periods that were selected based on major changes that took place in the economic and policy environment in Turkey. We examined the 1980–1998, 1986–1998, and the 1990–1998 periods because (a) in 1980 Turkey began its economic stabilization and trade liberalization, (b) in 1986 a series of new legislation was introduced to allow the Turkish Central Bank to conduct open market operations and monitor the newly created interbank market, and (c) in 1990 major steps were taken to increase central bank autonomy. In each sample period, the best time series model for inflation is determined for each period using standard Box-Jenkins techniques. A GARCH(1,1) model is used to generate a time series of inflation uncertainty with information from that time period only.[7] These results are reported in Table 2B–D.

For all three subsample periods, the effect of inflation on inflation uncertainty is consistently positive and significant. At all lag lengths and in all sample periods, we found that higher inflation is associated with higher

7. The results of the inflation time series model for the subsample periods are not reported to save space. Several additional subsample periods were considered, but because of unstable GARCH equations they were not suitable.

TABLE 2
Granger Causality Tests for Inflation and Inflation Uncertainty in Turkey

Number of Lags	H_0: Inflation does not Granger-cause inflation uncertainty	H_0: Inflation uncertainty does not Granger-cause inflation
A. 1960.1–1998.3		
4	30.63***(+)	5.66***(−)
8	16.57***(+)	2.93***(−)
12	11.83***(+)	2.95***(−)
16	9.79***(+)	2.16***(−)
24	8.78***(+)	1.96***(−)
B. 1980.1–1998.3		
4	46.07***(+)	2.14*(−)
8	23.80***(+)	1.08
12	18.22***(+)	1.87**(−)
16	14.49***(+)	1.34
24	9.72***(+)	1.07
C. 1986.1–1998.3		
4	46.31***(+)	4.38***(+)
8	22.89***(+)	3.83***(+)
12	15.63***(+)	2.83***(−)
16	12.08***(+)	2.66***(−)
24	8.73***(+)	2.17***(−)
D. 1990.1–1998.3		
4	43.72***(+)	4.55***(+)
8	22.93***(+)	3.53***(+)
12	14.65***(+)	2.13**(+)
16	11.54***(+)	1.97**(−)
24	8.26***(+)	1.12

A (+) indicates the sum of the coefficients is positive and significant, and a (−) indicates the sum of the coefficients is negative and significant.

***,**, and * indicate significance at the 0.01, 0.05 and 0.10 levels, respectively.

average inflation uncertainty at the 0.01 level of significance. Therefore, we find strong statistical support that higher average inflation raises inflation uncertainty in Turkey over all sample periods investigated.

Test results for whether inflation uncertainty lowers or raises subsequent inflation are mixed. During the 1980–1998 period (Table 2B), we found only limited evidence of stabilizing behavior. Inflation uncertainty lowers inflation at 4 and 12 lags at the 0.10 and 0.05 levels of significance, respectively. At 8, 16, and 24 lags we found no statistically significant relationship between inflation uncertainty and inflation.

Over the 1986–1998 period (Table 2C), we found evidence in the short run of the opportunistic policy behavior. Inflation uncertainty is associated with significantly (0.01 level) higher rates of inflation at four and eight month lags. However, at longer lag lengths of 12, 16, and 24 months, inflation uncertainty significantly (0.01 level) lowers average inflation, indicating stabilizing behavior in the long run.

Similar results are found during the 1990s (Table 2D), where inflation uncertainty first raises average inflation and then leads to lower inflation in the long run. At lags of 4, 8, and 12 months during this period, inflation uncertainty is associated with significantly higher inflation, indicating opportunistic monetary policy behavior in the short run. Evidence of stabilizing behavior is found in the long run, since inflation uncertainty lowers average inflation after a 16 month lag.

V. POLICY DISCUSSION

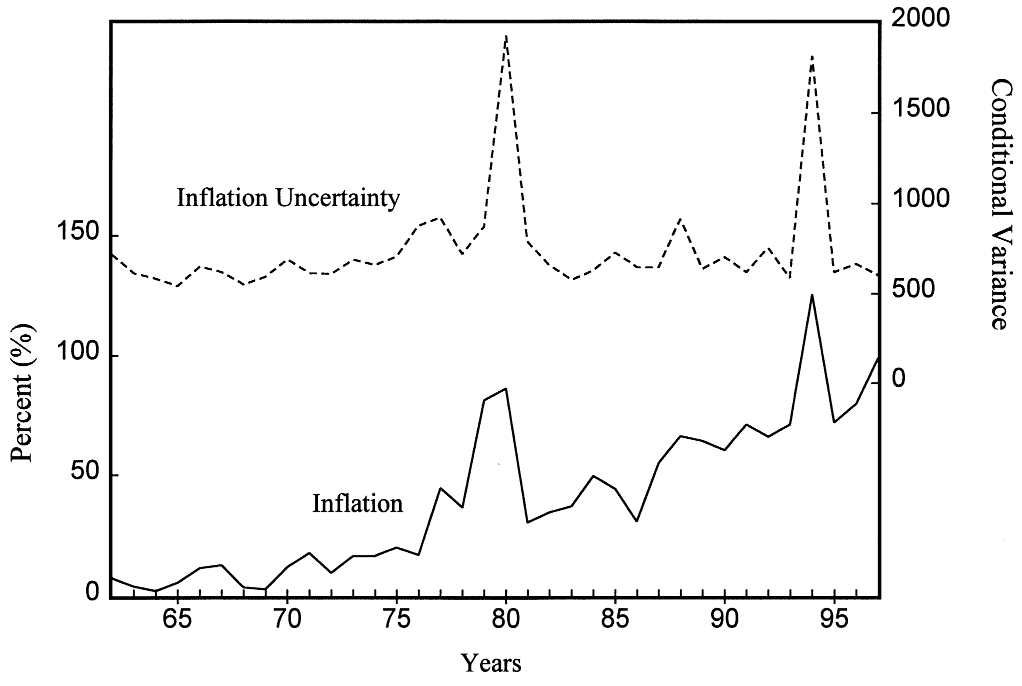
Our empirical results show that while inflation unambiguously raises inflation uncertainty in Turkey, the effect of inflation uncertainty on subsequent inflation depends on the time period considered. In the full sample and in all subsamples, we find at least some evidence of monetary stabilization, since increased inflation uncertainty always leads to lower inflation, especially at longer lags. We also find some evidence of opportunistic central bank behavior at lags of a year and less in the late 1980s and in the 1990s. This variation in monetary policy responses can perhaps be explained by changes in the political and policy climate in Turkey during this period.

As depicted in Figure 1, inflation was relatively mild from 1960 until the mid 1970s (less than 20%) despite rising imported input prices (due to the 1973–74 oil crisis) and Turkey's industrialization effort driven by import substitution policies. Import substitution policies were largely funded by increased foreign exchange receipts and Central Bank (CB) credits to the public sector. During this period, the CB relied on sterilization to lessen the expansionary effects of public sector credits. This allowed a moderate monetary expansion and kept inflation relatively low. However, toward the end of the 1970s, inflation and inflation uncertainty increased considerably as a result of a severe foreign exchange shortage (due mainly to the 1973–74 oil crisis and declining export earnings), growing budget and current account deficits, and the debt crisis that followed. To relieve the economy from rising inflationary pressures, austerity measures were implemented in three consecutive years (1978, 1979, and 1980), but none of these International Monetary Fund–supported measures proved successful in lowering inflation variability.

Inflation did decline after the 1980 stabilization program (see Figure 1). Contractionary monetary and fiscal policies lowered inflation from 86% in 1980 to 30% in 1981. A sharp increase in foreign currency inflows as a result of restructuring of the external debt also reduced the need for inflationary finance. But then, in response to declining GDP growth in 1983, monetary policy was relaxed, and in the years that followed the economy began to grow robustly, with inflation remaining stable at around 30% until 1986. The money supply also rose because of the increase in the CB's foreign assets due to liberalization of the external trade and payments system.

Throughout most of the sample period, CB policies were generally accommodative, backing the government's development and industrialization policies and frequently monetizing the fiscal deficits that resulted. Before 1986, the CB used public-sector credits and interest rates as monetary policy instruments. The money supply was determined by total credit expansion, and monetary policy was directed toward controlling private and public spending by setting borrowing limits for the banking system. After

FIGURE 1
Inflation and Inflation Uncertainty, 1962–1997



1986, the CB took important steps toward more autonomy by reorienting the monetary process toward contemporary central bank practices. A switch to monetary reserve targeting was accompanied by a series of new legislation that allowed the CB to conduct open market operations and monitor a newly established interbank market. These reforms were further complemented by accords with the Treasury limiting the short-term credits that the government could use from the CB. However, despite these measures that could be interpreted as a move toward greater central bank independence, inflation and inflation variability continued to surge after 1990.

As shown in Table 2, C and D, we found evidence of the opportunistic central bank behavior predicted by Cukierman and Meltzer (1986) during this period of CB transformation. For both the 1986–1998 and 1990–1998 subsample periods, inflation uncertainty is associated with significantly higher levels of inflation. This is somewhat interesting since the steps taken toward increased central bank autonomy after 1986 should have resulted in stabilization rather than opportunistic behavior. One possible explanation is that our test seems to capture the policy motives of both fiscal and monetary authorities in Turkey rather than specifically those of the CB. Note that the policy response to inflation uncertainty in Turkey should not necessarily be strictly considered in the framework of a stabilizing central bank versus an opportunistic central bank. Cukierman and Meltzer's model makes specific assumptions about Central Bank behavior, including a high degree of independence, which do not conform to many of the unique features of the Turkey's CB. Institutional arrangements allow the Treasury to borrow from the CB and the CB to pursue accommodative policies to finance public deficits. When it becomes necessary to disinflate, the Treasury usually coordinates its efforts with the CB, and sometimes also with the International Monetary Fund.

An assumption of Cukierman and Meltzer (1986) that does fit the Turkish situation is that at times of increased political instability there is more ambiguity about the conduct of monetary policy and a high turnover rate of central bank governors.[8] For example, in an effort to reinstate its credibility as an autonomous monetary authority, the CB had announced a monetary program for 1990. The CB initially met the stated monetary targets, but during the years that followed, political instability, a high turnover of CB governors, and a rapid expansion of public-sector credits lowered the effectiveness of the monetary program. Alternatively, the CB tried to pursue an exchange rate stabilization policy by controlling foreign reserves through open market operations. By 1994 this led to excessive growth of monetary aggregates, rising inflationary expectations, and higher interest rates.

Delays in stabilization in the early 1990s also added to inflation and inflation uncertainty. Mounting macroeconomic problems since the late 1980s heightened the need for stabilization, but despite rising inflation and deteriorating macroeconomic imbalances, such efforts were delayed. A "war of attrition" between opposing political interests, similar to that described in Alesina and Drazen (1991), and reliance on increased discretionary public expenditures as a way of gaining political support were the main reasons for delays in stabilization (see Sayari, 1992, for details).

The coalition governments of this period tried to disinflate while maintaining a high rate of economic growth. Rather than implementing a credible stabilization package, the coalition governments chose populist measures, such as maintaining an overvalued Turkish lira, lowering interest rates, and strategically adjusting the prices of a wide range of goods and services produced by the state economic enterprises. In view of rising public-sector borrowing requirements, these measures proved unsustainable, and the CB failed on numerous occasions to meet its monetary targets. Consequently, the financial crisis of 1994 ensued, which led to the implementation of a stabilization program later in the same year.

After a short period of monetary and fiscal tightening, economic growth resumed in 1995. Inflation, after dropping from its all-time high level in 1994 to 72% in 1995, gradually began to rise as upward price adjustments in the public sector followed. Public-sector borrowing requirements continued to increase as well. And as efforts to lower the Treasury's reliance on CB resources began to show a sign of weakening, the Treasury and CB once again agreed to coordinate their efforts, this time to target inflation. Early data show that the strategy seemed to work, despite remaining concerns about the budget deficit and the unsettled issue of CB autonomy.

From this examination of Turkey's disinflation experiment it is clear that the CB is not independent of macroeconomic policy making. Stabilizing behavior, or the lack of it, is the responsibility of both the fiscal and monetary authorities. And for the most part, consistent with Sargent and Wallace's (1981) coordination scheme between the fiscal and monetary authorities, the fiscal authority in Turkey appears to have the upper hand. The fiscal authority has even more influence on monetary policy during periods of high turnover of coalition governments. For example, during the 1983–86 politically stable period, inflation and inflation variability remained relatively low, but frequent elections and governments that followed after 1987 led to an expanding budget that increasingly relied on CB resources.

It is also clear that central bank independence can accomplish little without fiscal discipline. If Turkey is to become a single-digit inflation country, it seems almost imperative that the fiscal authority seriously consider ways to move away from inflationary bias. Then, it may be possible for the CB, as an autonomous entity, to stabilize the economy through sound monetary polices.

8. Cukierman (1992) conducts a comprehensive study measuring central bank independence in 58 countries, including Turkey. Much of the empirical evidence on Turkey's Central Bank independence reported by Cukierman confirms our discussion here. For example, Turkey's turnover rate of Central Bank governors between 1950 and 1989 is 5th highest out of 58 countries. In another ranking of overall central bank independence in the 1980s, Turkey ranks 42nd out of 46 countries, when the countries are ranked from most independent to least independent.

True, the CB-Treasury alliance has attempted and to some extent succeeded in putting downward pressure on inflation, especially during the 1980–1987 period. But throughout the full sample period and particularly during the 1990s, inflation stabilization not only increasingly suffered from the problem of time inconsistency but also failed to produce a fiscal environment that would allow the CB to practice its autonomy.[9]

VI. CONCLUSION

The results of this study confirm the predictions made by Friedman (1977) and Ball (1992) about the relationship between inflation and inflation uncertainty. We find overwhelming statistical evidence that increased inflation significantly raises inflation uncertainty in Turkey between 1960 and 1998 and in three subsamples. The evidence on the effect of inflation uncertainty on average inflation is mixed and depends on the time period examined. Over the full sample period, increased inflation uncertainty is associated with lower average inflation at all lags. In the two subsample periods that cover the last half of the 1980s and the 1990s, inflation uncertainty raises average inflation over lags of a year and less. During those periods, increased inflation uncertainty leads to lower inflation at longer lags of between 12 and 24 months. Thus, stabilizing policy behavior seems to prevail overall, especially in the long run, but opportunistic behavior is evident in the short run in the later subsample periods.

An analysis of the political environment in Turkey between 1960 and 1998 generally supports our empirical results. Over the full sample period, Turkey's fiscal and monetary authorities appear to be generally spending a concerted effort to disinflate, which is consistent with our empirical findings of stabilizing behavior overall. While the attempts to stabilize inflation seemed to work during the politically stable periods of the early 1980s, the political instability that we document in the late 1980s and the 1990s resulted in opportunistic policy behavior. We speculate that the problems of time inconsistency, the lack of fiscal discipline, a high turnover of Central Bank governors, and politically motivated monetary expansions were all contributing factors that led to opportunistic behavior and subsequently to periods of high inflation and inflation uncertainty. A move toward greater central bank independence in Turkey could help mitigate some of these outcomes in the future by creating an institutional framework that would reduce opportunistic behavior and increase the possibility that monetary stability would prevail. Also, further research on Turkish inflation could help determine whether inflation uncertainty has affected real output growth during this period of chronically high inflation.

9. In Cukierman's (1992) central bank independence ratings, Turkey scores fairly high in terms of overall legal independence, ranking 16th highest out of 68 countries and far ahead of low-inflation countries such as Japan and France. As Cukierman emphasizes and as we document, the legal status of a central bank is only one of several factors that determine its actual independence. As mentioned in note 8, Turkey ranks 42nd out of 46 countries in a separate measure by Cukierman of "overall central bank independence," which more closely measures actual independence.

REFERENCES

Alesina, Alberto, and Allan Drazen, "Why Are Stabilizations Delayed?" *American Economic Review*, *81*:5, 1991, 1170–1188.

Ball, Laurence, "Why Does High Inflation Raise Inflation Uncertainty?" *Journal of Monetary Economics*, *29*, 1992, 371–388.

Ball, Laurence, and Stephen G. Cecchetti, "Inflation and Uncertainty at Short and Long Horizons," *Brookings Papers on Economic Activity*, *1*, 1990, 215–245.

Balvers, Ronald J., and Thomas F. Cosimano, "Inflation Variability and Gradualist Monetary Policy," *Review of Economic Studies*, *61*, 1994, 721–738.

Bollerslev, Tim, "Generalized Autoregressive Conditional Heteroskedasticity," *Journal of Econometrics*, *31*, 1986, 307–327.

Brunner, Allan, and Gregory Hess, "Are Higher Levels of Inflation Less Predictable? A State-Dependent Conditional Heteroskedasticity Approach," *Journal of Business and Economic Statistics*, *11*, 1993, 187–197.

Cukierman, Alex, *Central Bank Strategy*, *Credibility*, *and Independence*, MIT Press, Cambridge, Mass., 1992.

Cukierman, Alex, and Alan Meltzer, "A Theory of Ambiguity, Credibility, and Inflation Under Discretion and Asymmetric Information," *Econometrica*, *54*, 1986, 1099–1128.

Engle, Robert, "Estimates of the Variance of U.S. Inflation Based on the ARCH Model," *Journal of Money*, *Credit and Banking*, *15*, 1983, 286–301.

Evans, Martin, "Discovering the Link Between Inflation Rates and Inflation Uncertainty," *Journal of Money*, *Credit*, *and Banking*, *23*, 1991, 169–184.

Evans, Martin, and Paul Wachtel, "Inflation Regimes and the Sources of Inflation Uncertainty," *Journal of Money*, *Credit*, *and Banking*, *25*, 1993, 475–511.

Friedman, Milton, "Nobel Lecture: Inflation and Unemployment," *Journal of Political Economy*, *85*, 1977, 451–472.

Grier, Kevin B., and Mark J. Perry, "On Inflation and Inflation Uncertainty in the G-7 Countries," *Journal of International Money and Finance*, *17*, 1998, 671–689.

Holland, A. Steven, "Inflation and Uncertainty: Tests for Temporal Ordering," *Journal of Money Credit and Banking*, *27*, 1995, 827–837.

Okun, Arthur, "The Mirage of Steady Inflation," *Brookings Papers on Economic Activity*, *2*, 1971, 485–498.

Sargent, Thomas, and Neil Wallace, "Some Unpleasant Monetarist Arithmetic," *Federal Reserve Bank of Minneapolis Quarterly Review*, 1981, 1–17.

Sayari, Sabri, "Politics and Economic Policy-Making in Turkey, 1980–1988." In *Economics and Politics of Turkish Liberalization*, T. Nas and M. Odekon, eds., Lehigh University Press, Bethlehem, 1992, 26–43.