

## Inflation and Inflation Uncertainty in Turkey

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### 1. 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 Watchel (1993), and Ball and Cecchetti (1990) find statistical support for a positive association between the rate of inflation and inflation uncertainty in the U.S.<sup>1</sup> 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. More recent empirical work focuses specifically on the direction of causality between inflation and inflation uncertainty. Holland (1995) finds that inflation raises inflation uncertainty in the U.S. and also that higher inflation uncertainty leads to lower average inflation due to stabilization motives of policymakers. Grier and Perry (1998) show 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 U.S., U.K. and Germany where increased inflation uncertainty lowers average inflation.

In the present study, following the methodology used in Grier and Perry, we construct a time series of monthly inflation uncertainty in Turkey from 1960-1998 using GARCH models and investigate the link between inflation and inflation uncertainty using Granger tests. The results of these tests allow us to determine whether the opportunistic behavior predicted by Cukierman and Meltzer, or the stabilizing behavior described by Holland and Grier and Perry, prevails in Turkey over the full sample and various subsample periods.

We find strong statistical support that inflation significantly raises inflation uncertainty in Turkey over the full sample period and three subsamples. Overall, stabilizing 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. We find evidence of opportunistic behavior in the short run during the late 1980s and 1990s, where inflation uncertainty raises average inflation. Furthermore, an examination of the political conditions and the record of macroeconomic policymaking in Turkey between 1960-1998 reveal institutional and political factors that can help explain our empirical results.

In section 2 we construct a time series of inflation uncertainty for Turkey. Section 3 presents the empirical results, and in section 4 we discuss how the policy environment in Turkey over this period can help explain our empirical findings. Conclusions are presented in section 5.

### 2.A GARCH Model for Inflation Uncertainty in Turkey

Our empirical results are based on the monthly Turkish CPI from January 1960-March 1998.<sup>2</sup> Panel A of Table 1 shows the results of a time series model for the inflation rate that includes 8 lags of inflation and a 12th order moving average term. Using standard Box-Jenkins techniques, we find that this is the best fitting time series model for Turkish inflation over the full sample period. Ljung-Box Q-tests on the residuals show no sign of autocorrelation up to 12 lags. However, the squared residuals are extremely correlated, indicating that the inflation error variance is significantly time-varying. Q<sup>2</sup> test statistics for the presence of conditional heteroskedasticity in the residuals are significant at 4, 8 and 12 lags. Therefore, the null hypothesis of a constant error variance is rejected at the 0.05 level of significance. 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.

Panel B of Table 1 adds a GARCH(1,1) model of the conditional variance of inflation to the time series model of the conditional mean of inflation.<sup>3</sup> Ljung-Box Q-statistics for the residuals of the GARCH model are shown in panel B and reveal no pattern in either the residuals or squared residuals. The AR(8), MA(12) - GARCH(1,1) model seems to fit both the mean and variance of Turkish inflation well. The estimated conditional variance of inflation ( $\sigma_{\varepsilon}^2$ ) 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.

### **3. Empirical Results**

The results of Granger-causality tests for Turkish inflation and inflation uncertainty are reported in Table 2. Panel A shows that over the full sample period, 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.<sup>4</sup> 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 in Turkey. Increased inflation first raises inflation uncertainty, which creates real economic costs, and then leads to monetary tightening and stabilization to lower subsequent inflation.

We next investigate various sub-sample periods and report these results in panels B, C and D in Table 2. In each sample period, the procedure outlined above is used to estimate equations (1) and (2). The best time series model for inflation is determined for each period using standard Box-Jenkins techniques, and a GARCH(1,1) model is used to generate a time series estimate of inflation uncertainty with information from that time period only.<sup>5</sup> A summary of these results follows.

For all three sub-sample periods, as was the case for the full sample period, the effect of inflation on inflation uncertainty is consistently positive and significant (see panels B-D). At all lag lengths and in all sample periods, we find that higher inflation is associated with higher 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 2, Panel B), we find only limited evidence of stabilizing behavior. Inflation uncertainty lowers inflation at 4 and 12 lags at the 0.10 and 0.05 level of significance, respectively. At 8, 16 and 24 lags we find no statistically significant relationship between inflation uncertainty and inflation.

Over the 1986-1998 period (Table 2, Panel C) we find evidence in the short run of the opportunistic policy behavior predicted by Cukierman and Meltzer. Inflation uncertainty is associated with significantly (0.01 level) higher levels of inflation at 4 and 8 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 2, Panel D), 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 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.

Our main empirical results show 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 sub-samples, we find at least some evidence of stabilization, since increased inflation uncertainty always leads to lower inflation, especially at longer lags. There is also some evidence of the opportunistic behavior predicted by Cukierman and Meltzer at lags of a year and less in the late 1980s and in the 1990s. This variation in policy responses can perhaps be explained by variation in the political and policy climate in Turkey during this period.

#### **4. Policy Discussion**

Throughout the entire sample period, Central Bank (CB) policies were invariably 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, but this type of money management began to change after 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 panels C and D of Table 2, we find evidence of the opportunistic central bank behavior predicted by Cukierman and Meltzer during this period of CB transformation. For both the 1986-1998 and 1990-1998 sub-sample 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 macroeconomic policymakers in Turkey rather than specifically those of the CB. Throughout the sub-sample periods, the CB has in fact tried to stabilize inflation in spite of inflexible fiscal policies. For example, in an effort to reinstate its credibility as an autonomous monetary authority, the CB announced a monetary program for 1990. The CB initially met the stated monetary targets, but during the years that followed, a high turnover of CB governors and a rapid expansion of public-sector credits lowered the effectiveness of the monetary program.

Macroeconomic mismanagement in the early 1990s also added to inflation uncertainty. 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 (TL), lowering interest rates, and strategically adjusting the prices of a wide range of goods and services produced by the state economic enterprises. An overvalued TL lowered the price pressure on domestic goods and also helped to improve the revaluation account included under the asset side of the CB's balance sheet, but that led to a worsening of the current account and to an increased inflow of high cost short-term capital. Domestic borrowing was kept at a minimum to avoid any upward pressure on interest rates that would increase the interest payments category of budgetary liabilities. But the Treasury's strategy of restricting the supply of government securities and cancelling (or delaying) auctions backfired, causing interest rates to surge instead.<sup>6</sup> Thus, 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, and that led to the implementation of a stabilization program later in the same year.<sup>7</sup>

After a short period of monetary and fiscal tightening, economic growth resumed in 1995. Inflation, after dropping from its all-time high levels in 1994 to 72 percent in 1995, gradually began to rise as upward price adjustment in the public sector followed.<sup>8</sup> The CB responded with open market operations to stabilize the financial markets and in an accommodative fashion tried to control the liquidity level.<sup>9</sup> Inflation continued to rise, 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 brief examination of Turkey's disinflation experiment it is clear that the CB does not appear to be independent of macroeconomic policymaking. Stabilizing behavior, or the lack of it, seemingly is the responsibility of both the fiscal and monetary authorities, and for the most part, the fiscal authority appears to have the upper hand. It should be noted that 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. Recent studies show a significant relationship between inflation and budget deficits in Turkey.<sup>10</sup> 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 policies. 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.<sup>11</sup>

## **5. Conclusions**

We find overwhelming evidence that increased inflation significantly raises inflation uncertainty in Turkey between 1960-1998 and in various sub-samples. The evidence on the effect of inflation uncertainty on average inflation is mixed and depends on the time period examined. Over the full sample, increased inflation uncertainty is associated with lower average inflation at all lags. In the two sub-sample periods that cover the last half of the 1980s and the 1990s, inflation uncertainty raises inflation over lags of a year and less. During those periods, increased inflation uncertainty leads to lower inflation at longer lags of between 12-24 months. Thus, stabilizing policy behavior prevails overall in the long run, but opportunistic behavior is evident in the short run in the later sub-sample periods.

An analysis of the political environment in Turkey between 1960-1998 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 CB 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.

## **Endnotes**

<sup>1</sup> Holland (1984) reviews the earlier empirical literature.

<sup>2</sup> Data was obtained from Global Financial Data.

<sup>3</sup> Other representations of the (G)ARCH process are possible for the conditional inflation variance. We consider other estimations,

but find that the GARCH(1,1) model is the best.

<sup>4</sup> Standard Granger-causality models are a test of temporal ordering between two variables and do not reveal the sign of the relationship. 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.

<sup>5</sup> The results of the inflation times series model for the sub-sample periods are not reported to save space. Several additional subsample periods were considered, but because of unstable GARCH equations they were not suitable.

<sup>6</sup> As a result of this strategy, domestic borrowing in total budget financing requirements declined but the share of both foreign borrowing and short term credits from the CB rose.

<sup>7</sup> Combining monetary, fiscal, and income policies, the 1994 stabilization program attempted to contract the economy to improve the imbalances in the real goods and financial markets. Some of the measures included a devaluation of the TL by 38.8 percent, gradual reduction of the short term credits from the CB, tax increases, and spending cuts.

<sup>8</sup> Frequent changes of governments and other events such as the Turkey-EU customs union also created uncertainty in financial markets.

<sup>9</sup> See Yapi and Kredi, Quarterly Economic Bulletin (p. 12, 1997/III).

<sup>10</sup> See Everaert (1992), Abaan (1993), Ertel and Insel (1993), Sonmez (1994), and Ulengin (1995).

<sup>11</sup> 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 like 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 we noted previously, Turkey ranks 42nd out of 46 countries in a separate measure by Cukierman of "overall central bank independence", which more closely measures actual independence.

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**Table 1. Time Series Models of the Turkish Inflation Rate**

**A: Least Squares Results**

$$\begin{aligned} \Pi_t = & 7.425 + .375 \Pi_{t-1} + .063 \Pi_{t-2} + .192 \Pi_{t-3} - .068 \Pi_{t-4} - .032 \Pi_{t-5} - \\ & (3.21) (8.00) (1.27) (3.84) (1.35) (0.62) \\ & .003 \Pi_{t-6} + .037 \Pi_{t-7} + .200 \Pi_{t-8} + .146 \varepsilon_{t-12} + \varepsilon_t \\ & (0.07) (0.75) (4.29) (3.02) \end{aligned}$$

Log-Likelihood = -2122  
 R<sup>2</sup> = .390  
 Q(4) = 1.25    Q(8) = 4.7    Q(12)=11.4  
 Q<sup>2</sup>(4)=24.0    Q<sup>2</sup>(8)=24.1    Q<sup>2</sup>(12)=24.3

**B: GARCH(1,1) Results**

$$\begin{aligned} \Pi_t = & 6.549 + .556 \Pi_{t-1} - .059 \Pi_{t-2} + .166 \Pi_{t-3} - .024 \Pi_{t-4} - .019 \Pi_{t-5} - \\ & (3.13) (8.12) (0.93) (2.38) (0.39) (0.34) \\ & .018 \Pi_{t-6} - .013 \Pi_{t-7} + .165 \Pi_{t-8} + .114 \varepsilon_{t-12} + \varepsilon_t \\ & (0.30) (0.27) (3.30) (3.90) \\ \sigma_{\varepsilon_t}^2 = & 211.5 + .355 \varepsilon_{t-1}^2 + .378 \sigma_{\varepsilon_{t-1}}^2 \\ & (6.21) (7.09) (5.52) \end{aligned}$$

Log-Likelihood = -2070  
 R<sup>2</sup> = .365  
 Q(4) = 6.2    Q(8) = 8.2    Q(12) = 16.0  
 Q<sup>2</sup>(4) = 4.38    Q<sup>2</sup>(8) = 5.17    Q<sup>2</sup>(12) = 6.17

Numbers below the coefficients are t-statistics. Sample is monthly from 1960.01 through 1998.03 using Turkish CPI. Q(x) is the Ljung-Box statistic for xth order serial correlation in the residuals, and Q<sup>2</sup>(x) is the statistic xth order serial correlation in the squared residuals. Critical values at the 5% level of significance are 9.4, 15.51 and 21.0 for 4, 8 and 12 lags respectively.

**Table 2. Granger Causality Tests for Inflation and Inflation Uncertainty in Turkey**

**A. Sample Period: 1960.1-1998.03**

|                  | Ho: Inflation does not<br>Granger-cause Inflation<br>Uncertainty | Ho: Inflation Uncertainty<br>does not Granger-cause<br>Inflation |
|------------------|--|--|
| Four Lags        | 30.63*** (+)   | 5.66*** (-)  |
| Eight Lags       | 16.57*** (+)   | 2.93*** (-)  |
| Twelve Lags      | 11.83*** (+)   | 2.95*** (-)  |
| Sixteen Lags     | 9.79*** (+)  | 2.16*** (-)  |
| Twenty four Lags | 8.78*** (+)  | 1.96*** (-)  |

**B. Sample Period: 1980.1-1998.03**

|                  |              |            |
|------------------|--------------|------------|
| Four Lags        | 46.07*** (+) | 2.14* (-)  |
| Eight Lags       | 23.80*** (+) | 1.08       |
| Twelve Lags      | 18.22*** (+) | 1.87** (-) |
| Sixteen Lags     | 14.49*** (+) | 1.34       |
| Twenty four Lags | 9.72*** (+)  | 1.07       |

**C. Sample Period: 1986.1-1998.03**

|                  |              |             |
|------------------|--------------|-------------|
| Four Lags        | 46.31*** (+) | 4.38*** (+) |
| Eight Lags       | 22.89*** (+) | 3.83*** (+) |
| Twelve Lags      | 15.63*** (+) | 2.83*** (-) |
| Sixteen Lags     | 12.08*** (+) | 2.66*** (-) |
| Twenty four Lags | 8.73*** (+)  | 2.17*** (-) |

**D. Sample Period: 1990.1-1998.03**

|                  |              |             |
|------------------|--------------|-------------|
| Four Lags        | 43.72*** (+) | 4.55*** (+) |
| Eight Lags       | 22.93*** (+) | 3.53*** (+) |
| Twelve Lags      | 14.65*** (+) | 2.13** (+)  |
| Sixteen Lags     | 11.54*** (+) | 1.97** (-)  |
| Twenty four Lags | 8.26*** (+)  | 1.12        |

\*\*\*, \*\*, and \* indicate significance at the 0.01, 0.05 and 0.10 levels respectively. A (+) indicates the sum of the coefficients is positive and significant and a (-) indicates the sum of the coefficients is negative and significant.