PUBLIC SECTOR PRICING BEHAVIOR AND INFLATION RISK PREMIUM IN TURKEY

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ABSTRACT : **This paper argues that the difference between the pricing behavior of public and private sectors contributes to higher inflation uncertainty, and hence higher interest rates in Turkey. The empirical evidence suggests that if the volatility of public sector prices was the same as private sector ones, interest rates would be lowered by 11 percent per year for the period from January 1989 to November 2000 for Turkey.**

Keywords: Public Pricing, Inflation Uncertainty & Interest Rates

JEL Codes: E43, E42 & E31.

I. INTRODUCTION

Turkey has had a high level of inflation since the mid 1970s. Governments used various fiscal and monetary policy tools to control inflation. In addition to these tools, governments also attempted to control inflation by regulating the prices of publicly produced goods and services. Governments either use the publicly produced goods' prices as a nominal anchor to decrease inflation (e.g., July 1997 and early 2000 anti-inflation programs) as a part of their general anti-inflation programs, or they try to postpone price increases of publicly produced goods and services until after elections (as was the case prior to the 1991, 1995 and 1999 elections). However, governments ultimately had to correct the lower prices in the public sector, mainly to avoid losses in the state owned enterprises. On a parallel with this, Turkish data suggests that, on the average price increases in the private and public sectors are approximately the same; however, the frequency of these price increases in the public sector is lower than those in the private sector. The purpose of this article is to show that this infrequency of price changes in the public sector increases the volatility of the general price level, causing uncertainty in forecasting general price level, and this in turn increases interest rates.

There is extensive literature regarding the effects of inflation uncertainty on macroeconomic performance. Cukierman and Wachtel (1979) and Holland (1993, 1995) examined how inflation uncertainty affects the inflation rate while Hafer (1986) and Holland (1986) searched for the results of inflation uncertainty on employment. Prior to this, Froyen and Waud (1987) and Holland (1988) looked at the inflation uncertainty-output relationship. In Berument (1999), the impact of inflation uncertainty on interest rates was investigated for the UK by using the Fisher Hypothesis framework. A similar approach for determining the results of inflation uncertainty on interest rates in Turkey was pursued in Berument and Güner (1997) and Berument and Malatyalý (2001).

The Fisher hypothesis suggests a positive relationship between the expected inflation and interest rates. Berument (1999), Berument and Malatyalý (2001) and Chang (1994) argue that inflation uncertainty also accelerates interest rates. This study aims to explore the effect on treasury auction interest rates of the uncertainty stemming from differences in the public and private sector pricing behavior. In order to model inflation uncertainty, it is assumed that each component of inflation (public and private sector pricing) follows an unbalanced vector autoregressive process and that their weighted conditional means are equal to the expected inflation. The conditional variances of the prices of goods produced by the public and private sectors are estimated via Generalized Autoregressive Conditional Heteroskedastic (GARCH) processes. The square root of the weighted average of these conditional variances is used as a measure of inflation uncertainty, and its effect is investigated within the Fisher hypothesis. Parallel to Berument (1999), Berument and Malatyalý (2001) and Chang (1994), it is shown that inflation uncertainty increases the interest rate. Moreover, if the conditional variance of the public prices was the same as the conditional variance of private prices, then interest rates would be lowered by 12 percent.

In the following section, the basic statistics of monthly inflation rates of the Wholesale Price Index (WPI) and its private and public components are analyzed. In Section III, the method for assessing price level uncertainty is presented. In section IV, findings obtained by the application of this method are documented, and the effects on interest rates of uncertainty stemming from the difference in public and private sector pricing behavior are presented. In Section V, conclusions are drawn from the analyses on public sector price setting behavior.

II. DATA

In this section, we explore the features of the distribution of the monthly changes of the logarithmic first difference of the General Wholesale Price Index and its public and private sector components for the period 1989:1 to 2000:11. Data is available from The Central Bank of The Republic of Turkey internet homepage. The basic statistics of these series are reported in Table 1 below.

Table 1: Basic Statistics of Monthly WPI Inflation Distributions

	General WPI	***Public Sector***	***Private Sector***
Observations	*143*	*143*	*143*
Mean	*4.29*	*4.45*	*4.22*
Variance	*7.58*	*18.69*	*6.77*
Skewness	*4.88*	*5.72*	*2.34*
Kurtosis	*40.89*	*48.76*	*14.21*

In the sample, which is composed of 143 monthly inflation figures, we see that the monthly price increase of the General WPI is 4.29 percent. The monthly inflation rate of the private sector is 4.22 percent while this figure is 4.45 percent for the public sector, on the average. However, the most important and interesting feature revealed in the data is the high volatility of the public sector monthly inflation figures: the variance of public prices is three times that of private prices. This characteristic of the public sector pricing behavior is noteworthy since a higher variance in public sector inflation rates might be contributing to the uncertainty in general price setting. Hence, this point is the crux of this analysis.

III. METHOD

Obtaining basic information about the pricing behavior of the public and private sectors, in this part of the paper, we first aim to assess the dynamics of the price level and then price level uncertainty in those two groups. To this end, we utilize the multivariate GARCH method. Then, we integrate the measure of inflation uncertainty obtained into the Fisher equation in order to quantify the effect on interest rates of uncertainty stemming from public sector pricing behavior.

In the first step, we will determine the dynamic relationship between public sector and private sector prices by applying the following model.

$$\begin{aligned} Pub_t &= \delta_0 + \delta_{01} Pub_{t-1} + \delta_{02} Pub_{t-2} + \ldots + \delta_{0m} Pub_{t-m} \\ &\quad + \delta_{11} Pri_{t-1} + \delta_{12} Pri_{t-2} + \ldots + \delta_{1m} Pri_{t-m} + \varepsilon_{pub\ t} \\ Pri_t &= \delta_2 + \delta_{21} Pub_{t-1} + \delta_{22} Pub_{t-2} + \ldots + \delta_{2m} Pub_{t-m} \\ &\quad + \delta_{31} Pri_{t-1} + \delta_{32} Pri_{t-2} + \ldots + \delta_{3m} Pri_{t-m} + \varepsilon_{pri\ t} \end{aligned} \quad (1)$$

Where Pub_t is the logarithmic first difference of public prices and Pri_t is the logarithmic first difference of private sector prices at time *t,* and *m* is the maximum lag order, in which some of the parameters could be zero. We also assume that error terms are distributed normally with mean zero and with time varying variances ($h^2_{pub\ t}, h^2_{pri\ t}$).

(2) $\varepsilon_{pubt} \sim N(0, h^2_{pub\ t})$

$\varepsilon_{prit} \sim N(0, h^2_{pri\ t})$

Here, the GARCH(p,q) model can be written for each public and private sector price change as:

(3) $h^2_{i\ t} = \alpha_{i0} + \Sigma_{j=1}^{pi} \alpha_{1j} h^2_{pub\ t-j} + \Sigma_{j=1}^{qi} \alpha_{2j} \varepsilon^2_{pub\ t-j}$ i = Pub and Pri

where

(4) $E(\varepsilon_{pub\ t}, \varepsilon_{pri\ t}) = h$, where h is a constant

After specifying the variance equation by the GARCH method, we move onto the step in which we incorporate the risk factor into the Fisher equation. The original Fisher equation suggests that nominal interest rates move with the expected inflation rate, as reflected in equation (5);

(5) $1+R = (1+r)(1+\pi^e)$

Where R is the nominal interest rates, r is the real interest rates and π^e is the expected inflation.[1] The lack of information on future general prices increases the riskiness of the real return on the assets and conveys itself in the form of an additional risk premium request. Thus, the original Fisher equation given in (5) should contain a variable reflecting the inflation risk measured with the conditional standard deviation. The Fisher equation might be specified as in equation (6);

(6) $1+R = (1+R_f)(1+\gamma\pi^e + \text{Risk}) + \eta$

Where R_f is the risk free real interest rate, Risk is the inflation risk and η is the additive residual term with zero mean and constant variances. In order to account for

[1] In the literature, the Fisher equation is also written as $R=r+\pi^e$. This is a close approximation of equation 5 if we can assume that $r\pi^e$ is close to zero. However, Turkey has had high inflation since the mid 1970s. Hence, ignoring that component could be fatal.

the Tobin effect, we included γ where if γ is less than one, then real interest rates may decrease with higher inflation.[2]

The effect of inflation uncertainty on nominal interest rates was analyzed in Berument and Malatyalý (2001). The main task of this paper is to search for the effect on the interest rate of the differences in public and private sector pricing within the Fisherian framework**.** We can rewrite the conditional variance as

$$\textbf{(7)} \qquad H_t = [\omega^2_{pub} * h^2_{pub\,t} + \omega^2_{pri} * h^2_{pri\,t} + 2 * \omega_{pub} * \omega_{pri} * \mathrm{cov}\,(h_{pub\,t}\, h_{pri\,t})]^{0.5}$$

And the expected inflation

$$\textbf{(8)} \qquad \pi^e_t = \omega_{pub}\, \pi^e_{pub\,t} + \omega_{pri}\, \pi^e_{pri\,t}$$

Where ωs measure the appropriate weights in the price indices calculations. Presenting the model and related assumptions thus, we can move on to the basic findings of the model in the next section.

IV. BASIC FINDINGS

First, we specify the dynamic relationship between public and private sector inflation with an unbalanced VAR framework. We could also use a structural model to assess the public and private sectors' behavior. In this study, we are interested in the predictability of these components rather than in explaining their behavior. Hence, VAR seems a plausible method to follow. Using unbalanced VAR rather than balanced VAR had the advantage of avoiding over-paramatization. Final Prediction Error (FPE) criteria is used to determine the optimum lag order of the VAR structure for the full sample. The FPE criteria determines the lag length such that errors are no longer autocorrelated. This is important because the presence of autocorrelation may indicate the presence of the ARCH effect even if there is no ARCH effect (see, Cosimano and

[2] Tobin(1965) assumes that the real wealth is kept constant in the form of financial assets: money and capital stock. As the inflation rate increases, the opportunity cost of holding money will increase and money demand will decrease. At a given level of the real financial wealth, this increases the capital stock. If the production function exhibits decreasing returns to scale, then the marginal productivity of the capital stock decreases with higher capital stock and lowers the firm's profit maximizing interest rates.

Jansen, 1988). We calculated the conditional variance of inflation following equation 3 for both public and private sector prices and equation 7 for general prices, then incorporate this risk factor into the interest rate specification within equation 5 along with the expected inflation from equation 8.

If we use the full sample to estimate the parameters, we use data points which are not available to the economic agent for a mid-point sample. Hence, we estimate the inflation equation and conditional variance specification with rolling regressions. Here the lag orders of public prices and private prices as well as the lag order specifications of the conditional variances is the same for the full sample.[3]

By using the price index and conditional variance, expected prices can be calculated as

(9) $\pi^e_t = 0.24 \ \pi^e_{pub\ t} + 0.76\ \pi^e_{pri\ t}$

Where 0.24 is the weight of the prices of publicly produced goods in the general WPI basket and 0.76 is the weight of the prices of the privately produced goods in the WPI basket and $\pi^e_{pub\ t}$ and $\pi^e_{pri\ t}$ are the expected prices for the public and private sector prices respectively. Next, the conditional standard errors are calculated as

(10) $H_t = [0.24^2 * h^2_{pub\ t} + 0.76^2 * h^2_{pri\ t} + 2 * 0.24 * 0.76 \text{ cov } (h_{pub\ t}\ h_{pri\ t})]^{0.5}$

In order to estimate the Fisher Hypothesis with conditional variance, we calculated the specification in the following form

(11) $(1+ R) / (1+ R_f) = 1 + \gamma\pi^e + \beta H_t$

Hence we can rewrite the Fisher equation as

(12) $R_t = R_f + (1+ R_f)\ \gamma\ \pi_t^e + (1+ R_f)\ \beta\ H_t$

[3] The Final Error predicting criterion suggests that public prices are affected by their own two lags and one lag of the private sector price changes, and private prices are affected by their own three lags and five lags of the public price changes for the full sample. Lagrangian Multiplier tests also suggest that GARCH(1,1) and GARCH(1,2) were appropriate specifications for the conditional variance equations for public and private price inflation respectively.

By assuming R_f is constant, we estimate equation 12 with non-linear least square methods by using the instrumental variables[4] and robust standard errors. The model estimate is the following:

	Estimate	t-stat
R_f	0.034	6.507
β	0.975	2.49
γ	0.205	2.16

The estimated coefficient for the risk free interest rate is 0.034 % (that is approximately equal to 4% risk-free annual real return: $(1+0.00034)^{12}-1$) and it is statistically significant.[5] Moreover, the estimated coefficient of the risk is positive and statistically significant. This suggests that agents want to be compensated with higher returns in order to bear the inflation risk. The estimated coefficient of the expected inflation is positive, less than one and statistically significant. This suggests that real interest rates decrease with higher inflation, this is parallel to Tobin (1965). One could argue that the expected inflation could be that the auction interest rate does not measure the true cost of borrowing. The Turkish Treasury opens auctions with changing maturities, rather than with a constant maturity. Missale and Blanchard (1994) argue that the Treasury uses both the auction interest rate and its maturity as an instrument to decrease its debt burden. Berument and Malatyalý (2001) provide empirical evidence for Turkey in this matter. In order to account for the maturity changes, we tried to extract the effect of change in maturity from the auction interest rates. Following Enders (1995), we regressed the interest rate on the constant term, the lagged value of auction interest rate, and the weighted average of the maturity of the auction for the corresponding month[6]. Next, we calculated the new interest rate by extracting the coefficient of maturity times the maturity itself from the auction interest rates. The new estimates for equation 12 are the following.

[4] The instruments are 12 monthly dummies and three lags of each interest and inflation rates.
[5] The level of significance is 5%, unless otherwise noted.
[6] The lag order of one is suggested by the final prediction error criterion.

	Estimate	t-stat
R_f	0.037	7.201
β	0.978	2.57
γ	0.171	1.83

Here, the estimated coefficient for γ is still positive and statistically significant at the 10% level. The estimate of the risk free interest rate is higher and the estimate of the coefficient of the expected inflation is lower than the previous estimates; however, both these coefficients are statistically significant. Hence, controlling the maturity of the interest rate auctions improved the basic estimate of the model.

This paper argues that inflation risk is one of the components that accelerates the interest rate. Since the volatility is three times higher in public sector prices than in those of the private sector, decreasing public sector price volatility itself can decrease interest rates. Simulations suggest that if the price volatility of the public sector was equal to the one of the private sector, then the annual interest rate would be lower by 11.4 %. When the maturity effect is excluded, the annual interest rate would be lower by 11.5 %. These two magnitudes are important when one considers that the average real interest rate for the period we consider was 17.14%.

V. CONCLUSION

This study argues that public and private sector pricing behavior affects the inflation risk premium differently and this increases the interest rate. The empirical evidence for Turkey shows that the difference in pricing behavior cost 11 % on average for the period from January 1989 to November 2000.

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