ANTICIPATED MONEY GROWTH and STOCK PRICES in TURKEY

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ABSTRACT

This study investigates the validity of the policy ineffectiveness hypothesis of Rational Expectations-Natural Rate Models that only unanticipated policy changes affect stock prices by using Turkish data over the period of 1986:1-1999:3. The procedure used to test the hypothesis is the autoregressive system introduced by McGee and Stasiak (1985). The empirical results reported in this paper imply that both anticipated and unanticipated monetary policy appears to play a significant expansionary impact upon stock prices. Such evidence for Turkey strongly rejects the policy ineffectiveness hypothesis of Rational Expectations-Natural Rate Models.

1. INTRODUCTION

The Rational Expectations-Natural Rate (hereafter RENR) models developed by Lucas (1973) and Sargent and Wallace (1975) imply that the monetary policy affects the stock prices only when such monetary policy is purely unanticipated. This idea, called neutrality hypothesis of the new classical macroeconomics, has not only theoretically but also empirically created a disagreement over the effectiveness of the monetary policy. In a series of influential studies, Barro (1977, 1978) investigated the hypothesis by using a two step estimation procedure. In contrast to Barro's, Mishkin (1982) employed a somewhat different methodology and found no evidence that only unanticipated, and not anticipated, money does matter. Recently, McGee and Stasiak (1985) introduced another methodology that focus on the stationarity and restriction issues of the variables. Their results supported the findings of Mishkin's study.

Relating the money supply-stock market interrelationship, numerous studies have examined the empirical relationship between monetary policy and stock prices. Some studies [forexample, Homa and Jafee (1971); Palmer (1970); Hamburger and Kochin (1972); Cooper (1974); Rozeff (1974); Thornton (1993) claimed that movements in the money supply and stock prices were related. More recent studies by Sorensen (1982) extended and confirmed previous research investigating the money supply-stock market interrelationship. Using a two-stage technique developed by Barro (1977), Sorensen find that the stock market does not react abnormally to a large percentage of monetary activity which can be estimated and/or anticipated. On the other hand, current and future changes in monetary aggregates, which are not predicted, do cause rather large abnormal stock prices.

This study investigates the validity of the policy ineffectiveness hypothesis of the RENR models that only unanticipated monetary policy affect the stock prices by using Turkish data over the period of 1986:1-1999:3. The procedure used to test the hypothesis is the autoregressive system developed by McGee and Stasiak (1985). The empirical results reported in this paper imply that unanticipated monetary policy appears to play an insignificant role in the stock prices, and that anticipated monetary policy exerts a significant expansionary effect upon the prices. Such evidence for Turkey strongly rejects the policy ineffectiveness hypothesis. In particular, unanticipated changes in the money supply do not contain information on future changes in the stock prices.

2. METHODOLOGY AND DATA

Employing McGee and Stasiak procedure, the following autoregressive system that consists of five variables was set up and estimated.

$$\begin{bmatrix} S_t \\ M_t \\ P_t \\ E_t \\ INT3_t \end{bmatrix} = \begin{bmatrix} \alpha_{11}(L) & \alpha_{12}(L) & \alpha_{13}(L) & \alpha_{14}(L) & \alpha_{15}(L) \\ \alpha_{21}(L) & \alpha_{22}(L) & \alpha_{23}(L) & \alpha_{24}(L) & \alpha_{25}(L) \\ \alpha_{31}(L) & \alpha_{32}(L) & \alpha_{33}(L) & \alpha_{34}(L) & \alpha_{35}(L) \\ \alpha_{41}(L) & \alpha_{42}(L) & \alpha_{43}(L) & \alpha_{44}(L) & \alpha_{45}(L) \\ \alpha_{51}(L) & \alpha_{52}(L) & \alpha_{53}(L) & \alpha_{54}(L) & \alpha_{55}(L) \end{bmatrix} \times \left[\begin{bmatrix} S_t \\ M_t \\ P_t \\ E_t \\ INT3_t \end{bmatrix} \right] + \begin{bmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \\ e_{4t} \\ e_{5t} \end{bmatrix} \quad (1)$$

where M_t is money supply (represented by two definitions of money supply: M1 and M2) at time t; P_t is consumer price index at time t; E_t is a series of exchange rate for US Dollar at time t, S_t is Istanbul Stock Market Index (IMKB-100) at time t, $INT3_t$ is a three month interest rate at time t, L is a lag operator, $\alpha_{ij}(L)$'s are polynomials in the lag operator and e_{it} is the innovation of each equation at time t. Each variable in the autoregressive system was used as a stationary series. The autoregressive model is treated as a system and estimated using Zellner's technique for seemingly unrelated regressions (SUR).

As an initial step in the autoregressive system, stationarity tests must be performed for each of the variables. There have been a variety of proposed methods for implementing stationarity tests (for example, Dickey and Fuller, 1979; Sargan and Bhargava, 1983, Phillips and Perron, 1988 among the others) and each has been widely used in the applied economics literature. However, there is now a growing consensus that the stationarity test procedure (hereafter ADF) due to Dickey and Fuller (1979) has superior small sample properties compared to its alternatives. Therefore, in this study, ADF test procedure was employed for implementing stationarity tests. The ADF test procedure requires to run the following regression for both level and first difference of each variable, separately. If necessary, the ADF regression can be run for the higher levels of the variables.

$$DLX_t = \alpha + \Phi LX_{t-1} + \sum_{i=1}^{m} \delta_i DLX_{t-i} + w_t \quad (2)$$

where LX is the logarithmic form of the variable in question, α and γ are a constant term and time trend, respectively, "D" is the first difference operator , w is the white noise residual and m is the lagged values of DLX_t that are included to allow for serial correlation in the residuals. In the context of the ADF test, a test for nonstationarity of the series, LX, amounts to a t-test of Φ=0. The alternative hypothesis of stationarity requires that Φ be significant negative. If the absolute value of the computed t-statistic for Φ exceeds the absolute critical value given in Dickey (1976), then the null hypothesis that the log level of X series is not stationary must be rejected against its alternative. If, on the other hand, it is less than the critical value the logarithmic level of X, it is concluded that series LX is nonstationary. In this case, the same regression must be repeated for the fist difference of the logarithmic value of the series. In estimating ADF regressions, the number of own lags (m) was chosen using by the HEGY [Hylleberg, Engle, Granger and Yoo (1990)] approach. First, each regression was regressed on 24 lags. Then significant lags at the %10 level were included in the final regressions.

The estimation of the autoregressive system in this study is based on stepwise selection procedure. The maximum number of lags was arbitrarily restricted to twelve for each variable. The only variables which contributed significantly to the overall regression were entered and retained in the final regression. All variables were added to the regression sequentially until none of the remaining variables would have t-statistics with a P-value smaller than 20 percent. Starting from the full set of regressors, variables were then deleted sequentially as long as their t-statistics produce a P-value larger than 20 percent. At the beginning of the procedure, a constant term was forced to include in the system equations.

The data used in this study are monthly and seasonally unadjusted. The data cover the period of 1986:12-1999:3. All data come from Central Bank of Turkey's web sites at http://www.tcmb.gov.tr.

3. EMPIRICAL RESULTS

Table 1 presents the ADF test results for the log levels (except interest rate) as well as the first (logged) differences of the series. The last column in Table 1 records the ADF-t statistics for the levels and first differences of the variables. Critical value for the ADF-t statistics is given at the bottom of the table. As seen from the table, the absolute value of the calculated ADF-t statistics is greater than its critical value only for the first differences of the variables. Thus, the evidence suggests that each of the variables has one unit root, that is, first differencing of each variable appears to be sufficient to achieve stationarity. Each variable in the autoregressive system was therefore used as its growth rate.

Estimation Results of Autoregressive System for M1

The estimation results of the autoregressive model for stock price growth (DLS), growth rate of narrow money (DLM), interest rate (DINT3), exchange rate growth (DLDOL) and inflation (DLP) are reported in Table 2. The χ^2 statistics for the joint significance of the coefficients of the lags on each variable are also reported in Table 2. Ljung Q-Box statistics with various autocorrelations of the residuals indicate that autocorrelation does not appear to be a serious problem for any equation in the system. As seen from the second column of the table, the stock price equation reveals a significant positive effect of lagged money supply growth. In the stock price equation the estimated coefficients of the lags of money growth are statistically different from zero as a group, indicating that anticipated changes in money supply affect anticipated movements of stock prices, positively. Based on the χ^2 statistics, anticipated changes in all other variables also influence stock prices.

The correlation matrix of the unanticipated changes of the variables in the autoregressive model is presented in Table 3. Table indicates that unanticipated money growth also affects stock prices. The correlation coefficient between unanticipated money growth and stock prices is positive and statistically significant different from zero at the 10% level. Movements in the stock prices are not only influenced by unanticipated changes in money growth, but also influenced by unanticipated changes in interest rate and exchange rate. But, the effect of these variables on the stock prices appears to be negative. It means that the stock prices decrease (increase) when unanticipated changes in interest rate or exchange rate increase (decrease). The results given in Tables 2-3 imply that both anticipated and unanticipated narrow money affects stock prices significantly, rejecting the neutrality hypothesis.

Table 1
The Augmented Dickey-Fuller Test for Unit Roots

Variables	**Lags**	**ADF t-statistics**
LS	14, 19 [14,19]	0.643 -2.880
LM1	4,5,13,15 [5,12,15]	2.328 -1.741
LM2	1,4,8,12,13 [1,4,8,9,12,13]	3.437 -0.840
LP	1,12 [1,12]	-0.062 -2.527
LDOL	1 [1]	1.213 -2.034
INT3	3,6,11,14,17 [1,3]	-1.327 -3.355
DLS	1 to 15, 17, 18 [1 to 18]	**-5.109** **-4.863**
DLM1	24 [1 to 7, 9,12,13,14,24]	**-13.699** **-5.534**
DLM2	0 [2,12]	**-8.357** **-8.981**
DLP	22 [0]	**-8.469** **-8.612**
DLDOL	0 [0]	**-8.215** **-8.381**
DINT3	1 to 13 [1 to 16]	**-4.317** **-4.559**

Not: The %1 critical value of the ADF statistics for 150 Observations is –4.02.

Estimation Results of Autoregressive System for M2

The results of the autoregressive system estimation where money is defined as M2 are reported in Table 4. Taking into consideration Ljung Q-Box statistics, it is found that there is no autocorrelation in these regressions. As seen from Table 4, there is a positive and significant relationship between anticipated money growth and stock prices. The estimated coefficients on the lags of money growth are statistically and jointly significant at the % 1 level. The estimated χ^2 statistics for the joint significance of the coefficients of the lagged effects of anticipated price level movements on stock prices was found to be negative and statistically significant at 1% level, indicating that anticipated price and interest rate affect the stock prices significantly and negatively. The same statistics for interest rate is also found to be negative and statistically significant at 5% level. According to same equation, anticipated changes in exchange rate do not tend to lead the stock prices when money in the autoregressive system is defined as M2.

Table 5 presents the correlation matrix of the unanticipated changes of the variables in the autoregressive model. *From this table, it seems that there does not exist a significant correlation between the residuals of stock price equation and the residuals of money growth equation. In this case, it is concluded that unanticipated money growth in Turkey is not a matter in affecting the stock prices.* That is, the RENR hypothesis is again rejected in the context of the unanticipated monetary policy. In the cases of unanticipated exchange rate and interest rate, the RENR hypothesis is supported by the evidence. The correlations between stock prices and unanticipated changes in exchange and interest rates were found to be negative and statistically significant at 10% level. Exchange rate policy does affect stock prices whenever such policy is anticipated or unanticipated.

Table 2
Estimation Results (M1)

Dependent Variable	DLS	DLM	DLP	DLE	DR
$\chi2_{DLM}$ Sum of Coef.	28.260 [a] 2.772 [a]	68.354[a] 0.106		8.246 [b] - 0.223 [a]	11.520[a] -0.374 [a]
$\chi2_{DLP}$ Sum of Coef.	16.687 [a] -3.601 [a]	12.410[a] -0.279	66.768[a] 0.053	16.995 [a] -0.318 [c]	53.298[a] -0.721 [a]
$\chi2_{DLDOL}$ Sum of Coe.	2.916 [c] 0.587 [c]	20.341[a] 0.686 [a]	42.438[a] 0.459 [a]	38.487 [a] -0.330 [a]	80.618[a] 0.548 [a]
$\chi2_{DLS}$ Sum of Coef.	6.192[b] -0.263 [b]	6.596[b] -0.020	15.975[a] 0.020	26.841[a] -0.067 [b]	8.423[b] -0.007
$\chi2_{DINT3}$ Sum of Coef.	15.772[a] 0.378	19.405[a] -0.219 [b]	16.214[a] -0.229 [b]	63.099 [a] -0.369 [a]	68.876 [a] -1.113 [a]
R^2	0.253	0.396	0.462	0.497	0.600
Q(1)	0.188	0.008	0.125	0.966	0.346
Q(4)	0.833	4.565	5.153	2.138	5.359
Q(8)	2.604	10.133	7.389	5.890	16.660
Q(12)	4.762	12.431	8.439	7.678	17.991

Note: [a]Significant at the %1 level, [b] significant at the %5 level, [c] significant at the %10 level.

Table 3
Correlation Matrix of Residuals (M1)

	DLDOL	DLM	DLP	DINT3
DLS	-0.178[c]	0.179[c]	0.020	-0.197[b]
DLDOL		-0.142[c]	0.516[a]	0.674[a]
DLM			0.011	-0.250[a]
DLP				0.394[a]

Note: [a]Significant at the %1 level, [b] significant at the %5 level, [c] significant at the %10 level.

Table 4
Estimation Results (M2)

Dependent Variable	DLS	DLM	DLP	DLE	DR
$\chi2_{DLM}$ Sum of Coef.	25.812[a] 2.832 [a]	123.919[a] 0.734 [a]	9.227 [b] 0.021	6.505 [b] -0.316 [b]	29.013 [a] -0.636 [a]
$\chi2_{DLP}$ Sum of Coef.	14.942 [a] -3.605 [a]	16.439 [a] 0.262 [a]	63.317 [a] -0.076	17.449 [a] -0.278	37.196 [a] -0.476 [b]
$\chi2_{DLDOL}$ Sum of Coef.		15.393 [a] 0.210 [a]	33.851 [a] 0.482 [a]	116.323 [a] 0.799 [a]	99.137 [a] 0.688 [a]
$\chi2_{DLS}$ Sum of Coef.	2.834 [c] -0.135 [c]	21.705 [a] -0.008	18.055 [a] 0.040 [b]	5.396 [c] -0.004	
$\chi2_{DINT3}$ Sum of Coef.	4.587 [b] -0.626 [b]	216.170 [a] 0.623 [a]	9.585 [a] 0.094 [b]	71.004 [a] -0.166 [c]	16.830 [a] -0.430 [a]
R^2	0.191	0.716	0.490	0.479	0.612
Q(1)	0.026	0.098	0.261	0.042	0.856
Q(4)	0.342	2.209	1.226	0.858	4.385
Q(8)	2.736	3.026	1.616	1.403	6.031
Q(12)	3.915	4.779	3.957	5.538	7.677

Note: [a]Significant at the %1 level, [b] significant at the %5 level, [c] significant at the %10 level.

Table 5
Correlation Matrix of Residuals (M2)

	DLDOL	DLM	DLP	DINT3
DLS	-0.161[c]	0.084	0.002	-0.199[b]
DLDOL		-0.225[a]	0.495[a]	0.718[a]
DLM			-0.102	-0.291[a]
DLP				0.395[a]

Note: [a]Significant at the %1 level, [b] significant at the %5 level, [c] significant at the %10 level.

4. CONCLUSION

The purpose of this paper was to test the neutrality hypothesis of the new classical macroeconomics in the context of five-variate autoregressive system that consists of stock prices, monetary policy, interest rate, exchange rate and inflation. The estimation of the autoregressive system was done under two alternative definitions of money: M1 and M2. The empirical evidence provides decisive results regarding the neutrality hypothesis: anticipated component of monetary growth exerts a significant impact upon stock prices, rejecting the neutrality hypothesis of RENR models and lending support to the non-classical RENR models. These results were robust with respect to choice of the lag specification and money definition.

The empirical evidence from Turkey does not support the predictions of the new classical rational expectations model in which wages and prices are assumed to be completely flexible and thus all adjustments are instantaneous. The evidence lends support to the non-classical rational expectations model where wages and prices are assumed to be rigid.

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