Middle Eastern Finance and Economics
ISSN: 1450-2889 Issue 4 (2009)

http://www.eurojournals.com/MEFE.htm

# Asymmetric Effects of Aggregate Demand Policy in Turkey

**Yakup Kucukkale**
*Assoc. Prof. Dr., Economics Department, Karadeniz Technical University*
*FEAS, Trabzon, Turkey*
E-mail: ykucukkale@hotmail.com
Tel: +90-462-3773485

**Rahmi Yamak**
*Prof. Dr., Econometrics Department, Karadeniz Technical University, FEAS*
*Trabzon, Turkey*
E-mail: yamak@ktu.edu.tr
Tel: +90-462-3773315

**Abstract**

The Rational Expectations Natural Rate (RENR) Hypothesis implies that the aggregate demand policy affects the real economic activity only when such demand policy is purely unanticipated. This idea is usually called Neutrality Hypothesis of the new classical macroeconomics. On the other hand, there exist some theoretical controversies to this hypothesis such as anticipated demand policy affect real economic activity at least in the short run because of the rigidities in wage and price contracts. This idea is also called Non-Neutrality Hypothesis of the non-classical RENR model. In this paper, the Neutrality Hypothesis of the new classical macroeconomics has been examined by focusing the asymmetric effects of the aggregate demand policy. The findings of the study show that the Neutrality Hypothesis is valid for Turkish economy, but only asymmetrically. Asymmetric relations among the innovations of the system strongly reject the non-classical RENR models which assume that wages and prices are rigid.

**Keywords:** Rational Expectations, Natural Rate Models, Neutrality Hypothesis, Asymmetricity Test

## 1. Introduction

The Rational Expectations-Natural Rate (hereafter RENR) model developed by Lucas (1973) and Sargent and Wallace (1975) implies that the aggregate demand policy affects the real economic activity (e.g. real output, employment, etc.) only when such demand policy is purely unanticipated. This idea is usually called neutrality hypothesis of the new classical macroeconomics. The theoretical studies of Fischer (1977) and Phelps and Taylor (1977), on the other hand, conclude that anticipated demand policy influences real economic variables at least in the short-run because of the rigidities in wage and price contracts. This idea is also called non-neutrality hypothesis of the non-classical RENR model.

The neutrality hypothesis of the new classical macroeconomics has not only theoretically but also empirically created a disagreement over the effectiveness of the aggregate demand policy. In a series of his influential studies, Barro (1977, 1978) investigates the neutrality hypothesis of the RENR model that only unanticipated, not anticipated, demand policy does matter by using a two step estimation procedure[1]. His statistical results supported the neutrality hypothesis that only unanticipated demand policy is relevant to the real economic activity. Following Barro's study, numerous studies (e.g. Barro and Rush, 1980; Wogin, 1980; Attfield et al., 1981; Bellante et al., 1982; Canarella and Pollard, 1989) found results similar to those of Barro in support of the neutrality hypothesis.

In contrast to these studies, Mishkin (1982a; 1982b) employed a somewhat different methodology and found no evidence that anticipated demand policy does not influence real economic activity. In 1985, McGee and Stasiak (1985) introduced another methodology for examining the RENR hypothesis. By focusing on the stationarity and restriction issues of the variables, they developed an autoregressive system. Their results supported the findings of Mishkin that anticipated demand policy does influence real output in the short-run. Following McGee and Stasiak's methodology, Khatri-Chettri et al (1990) and Marashdeh (1993) provided additional evidences that did not support the neutrality hypothesis of the RENR models. In addition, the findings of Yamak and Kucukkale (1998) did not support the predictions of the new classical rational expectations model in which wage and prices are assumed to be completely flexible and thus all adjustments are instantaneous for Turkish case. Their evidences lend support to the non-classical rational expectations model where wages and prices are assumed to be rigid.

Recent developments in macroeconomics also showed that unanticipated demand policy may affect the real economic activity in different manners. In his revolutionary study, Cover (1992) argues that unanticipated changes in aggregate demand policy may have asymmetric effects on the real economic activity. That is, unanticipated negative changes in aggregate demand policy slow the real economic activity more than unanticipated positive changes accelerate the real economic activity. This argument has been confirmed by a numerous empirical studies [e.g. Morgan (1993); Rhee and Rich (1995); Karras (1996a, 1996b)].

Several attempts have been made to draw theoretical framework for the asymmetric effects of unanticipated demand policy. Among the others, Caballero and Engel (1992), Tsiddon (1993), and Ball and Mankiw (1994) have all focused on the asymmetric price adjustment and trend inflation. According to them, unanticipated demand policy will have asymmetric effects on the real economic activity if prices are less flexible downward than upward.

The main purpose of this study is to examine the hypothesis that unanticipated demand policy have asymmetric effects on the real economic activity in Turkey for the period of 1987:I-2006:IV. In addition to money supply, some demand policy variables such as government expenditures, prices and exchange rates have also included in the autoregressive system similar to McGee and Stasiak (1985).

Remaining parts of the study have organized as follows: the methodology used in the study has been presented in the second section and the findings have been summarized in the third section. The last section has drawn the remarkable conclusions.

## 2. Methodology and Data

Expanding McGee and Stasiak (1985)'s procedure, the following autoregressive system that consists of five variables was set up and estimated[2].

[1] First, a money growth rate forecasting equation was estimated. Second, the predicted values of the money growth rate were used as a measure of anticipated monetary policy and the residuals as a measure of unanticipated monetary policy.

[2] This procedure has some advantages over its alternatives. First, it does not depend on a priori knowledge of the specific structural model of the economy. Second, it provides information on an exogeneity assumption as a consequence of model estimation. Third, it guarantees that residuals are serially uncorrelated. Finally, the output equation in the system is a reduced form where the coefficients in $\alpha_{12}$, $\alpha_{13}$, $\alpha_{14}$ and $\alpha_{15}$ represent the direct impact of anticipated changes of related nominal variables on output, under the assumption that there is a pure one-period delay in information.

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

where $Q_t$ is real output at time t (measured as real industrial production index), $M_t$ is narrow money supply (M1) at time t,[3] $G_t$ is nominal government expenditures at time t, $P_t$ is consumer price index at time t, $D_t$ is a series of exchange rate for US Dollar at time t, L is a lag operator, $\alpha_{ij}(L)$'s are polynomials in the lag operator and $e_{jt}$ is the innovation of the each equation at time t.

Standard test of the neutrality hypothesis requires a number of restrictions on the coefficients and the relationships among the innovations of the equations. If the innovations of the first (output) equation are found to be significantly correlated with current innovations of the second equation, it will be concluded that unanticipated monetary policy matters. On the other hand, if the coefficient(s) of the monetary variables in the first equation is (are) jointly and statistically insignificant, it is then concluded that anticipated monetary policy does not matter.

Asymmetricity test of the neutrality hypothesis has somewhat differences from standard neutrality hypothesis tests. At first, the innovations of the each equation should be divided into two parts, as negative and positive. If the negative innovations of the first (output) equation are found to be significantly correlated with current negative innovations of the second equation, this provides that unanticipated decreases in the money supply reduce the real output. Similarly, if the negative innovations of the output equation have a significant relationship with the positive innovations of the money supply equation, this implies that increases in unanticipated money reduce the real output. Similar interpretations can be made for the remaining equations.

Testing asymmetric effects of positive and negative innovations requires to use a two step procedure employed by Barro (1977, 1978) and Barro and Rush (1980). To do this, three distinct series must have been created: i) the complete series of residuals, ii) the negative residual series which equal to the residual value if the residual is negative, otherwise equal to zero, and iii) the positive residual series which equal to the residual value if the residual is positive, otherwise equal to zero[4]. This is once done, the asymmetric effects of the innovations on real output can be estimated.

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), Zivot and Andrews (1992) among the others) and each has been widely used in the applied economics literature. However, Ben-David and Papel (1994) have argued that stationarity tests can not be performed effectively if there is a structural break in the time series in question. In order to eliminate the structural break problem, some stationarity tests have been developed by Lee and Strazicich (2004) and Zivot and Andrews (1992) (hereafter ZA). The ZA test has some superiorities compared to its alternatives, because the structural breaks are assumed to be endogenous. Therefore, in this study, the ZA test procedure was employed for implementing stationarity tests.

The ZA test has been implemented under three models to test for a unit root: (1) model A, which permits a one-time change for the intercept; (2) model B, which permits a one-time change for

---

[3] This narrow definition of money is chosen here for two reasons. First, M1 has a very close relation to monetary base, which is under the control of the monetary authorities. Second, M1 appears to be exogenous and policy determined due to the findings of Abaan(1987).

[4] There are also two alternative methods to create the distinct series in the applied economics literature. The first one is described as (a) and the second one is described as (b). Both of the alternate methods produce the same results with the method which has been used in this study.

a) $neg_t = -½\,[\text{abs}(residual_t) - residual_t]$ and $pos_t = ½\,[\text{abs}(residual_t) + residual_t]$

b) $neg_t = ½[(\text{residual}_t - \{(\text{residual}_t)^2\}^{1/2})]$ and $pos_t = ½\,[(\text{residual}_t + \{(\text{residual}_t)^2\}^{1/2})]$

the slope of the trend function, and (3) model C, which allows both changes simultaneously. The ZA test requires to run the following regressions.

$$\text{(Model A)}\ \Delta lx_t = \alpha + \beta t + \Phi lx_{t-1} + \gamma DU_t + \sum_{j=1}^{k} \delta_j \Delta lx_{t-j} + \varepsilon_t \quad (2)$$

$$\text{(Model B)}\ \Delta lx_t = \alpha + \beta t + \Phi lx_{t-1} + \theta DT_t + \sum_{j=1}^{k} \delta_j \Delta lx_{t-j} + \varepsilon_t \quad (3)$$

$$\text{(Model C)}\ \Delta lx_t = \alpha + \beta t + \Phi lx_{t-1} + \gamma DU_t + \theta DT_t + \sum_{j=1}^{k} \delta_j \Delta lx_{t-j} + \varepsilon_t \quad (4)$$

where; $DU_t$, is a dummy variable which represents the significant mean shift for each possible break date during the sample; $DT_t$, is also a dummy variable which represents the trend shift for each possible break date. Formally,

$$DU_t = \begin{cases} 1 ......if\ \ t > TB \\ 0 ......otherwise \end{cases} \quad \text{and}$$

$$DT_t = \begin{cases} t - TB ....if\ \ t > TB \\ 0 ..........otherwise \end{cases}$$

The null hypothesis in all models is $\Phi = 0$, which implies that the series in question ($lx_t$) have a unit root with a drift, while the alternative hypothesis ($\Phi < 0$) implies that the series is a trend stationary process with an endogenous time break at an unknown point in the sample. The ZA stationarity test regards each point in the sample as a potential time break (TB) and the exact time break is chosen by procedure which minimizes the one-sided t-statistics for testing $\hat{\alpha}(=\alpha - 1) = 1$. In estimating the ZA models, the lag length of the dependent variable was determined by using the "Akaike Information Criterion" (AIC).

If the series under consideration turn out to be integrated of the same order, it is possible to proceed by testing for cointegrating relationships between the integrated variables. In this paper cointegration tests were carried out by means of the method developed by Johansen (1988), and Johansen and Juselius (1990). The Johansen method applies the maximum likelihood procedure to determine the presence of cointegrating vectors in nonstationary time series. This procedure sets up the nonstationary time series as a vector autoregressive (VAR):

$$\Delta Z_t = C + \sum_{i=1}^{K} \Gamma \Delta Z_{t-1} + \eta_t \quad (5)$$

where $Z_t$ is a vector of nonstationary (in log levels) variables and C is the constant term. The information on the coefficient matrix between the levels of the series $\Pi$ is decomposed as $\Pi = \alpha\beta'$ where the relevant elements of the $\alpha$ matrix are adjustment coefficients and the $\beta$ matrix contains the cointegrating vectors. Johansen and Juselius (1990) specify two likelihood ratio test statistics to test for the number of cointegrating vectors. The first likelihood ratio statistics for the null of exactly r cointegrating vectors against the alternative of r+1 vectors is the maximum eigenvalue statistic. The second statistic for the hypothesis of at most r cointegrating vectors against the alternative is the trace statistic. Critical values for both test statistics are tabulated in Johansen and Juselius (1990). The number of lags applied in the cointegration test are based on the information provided by the multivariate generalization of the AIC [5].

If the time series integrated of order of one are not cointegrated, the autoregressive system set up in Equation (1) is estimated by utilizing the first differences of the series. On the other hand, there are two approaches in using of cointegrated nonstationary data in a system model. One is to estimate the model in terms of the levels of the data, without modeling the cointegrating relationships. An

[5] The multivariate generalization of the AIC is AIC = Tlog|Σ|+2N where |Σ| is determinant of the covariance matrix of the residuals, T is observation number and N is total number of parameters estimated in all equations.

alternative to this approach is to estimate the model in first differences with the addition of cointegrating terms.

The estimation of the autoregressive system in this study was done under two different lag specifications. The first lag specification was based on the results of the final prediction error criterion (FPE) due to Akaike (1969) [6]. The second specification which was also used by McGee and Stasiak (1985) was based on stepwise selection procedure. The maximum number of lags was arbitrarily restricted to eight 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-statstics 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 were quarterly and seasonally adjusted. The data also cover the period of 1987:I-2006:IV. All data come from the Electronic Data Delivery System (EDDS) of The Central Bank of Turkey (http://www.tcmb.gov.tr).

## 3. Empirical Findings

Table 1 presents the ZA test results for the log levels as well as the first (logged) differences of the series.

**Table 1:** Results of the ZA Test

| Variables | [k] | Minimum t-statistics | Time Break |
|---|---|---|---|
| LQ | [8] | -4.80913 | 2001:1 |
| LM | [0] | -3.89607 | 1996:4 |
| LG | [6] | -3.93812 | 1996:2 |
| LP | [1] | -2.67026 | 2001:2 |
| LD | [1] | -3.75509 | 2002:2 |
| ΔLQ | [1] | -9.02910[a] | 2002:1 |
| ΔLM | [1] | -8.44517[a] | 1994:2 |
| ΔLG | [3] | -6.98205[a] | 1996:2 |
| ΔLP | [3] | -5.58520[a] | 1994:2 |
| ΔLD | [0] | -7.50736[a] | 2003:1 |

**Note:** The critical values for ZA test are -5.57, -5.08 and -4.82 at 1%, 5% and 10%, respectively. k denotes the lag length which has been chosen by using the Akaike Information Criterion. “a” denotes significance at 1% level.

The third column in Table 1 records the ZA minimum t-statistics for the levels and first differences of the variables. Critical values for the ZA minimum t-statistics are given at the bottom of the table. As seen from the table, the absolute values of the calculated ZA minimum t-statistics are greater than the corresponding critical values 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. However, a single significant cointegrating vector was identified by applying Johansen’s maximum likelihood approach. The trace statistics of VAR(1) are presented in Table 2. On the basis of such results, the autoregressive system constructed in Equation (1) was estimated in terms of the log levels of the variables [7].

[6] By varying the order of lags from 1 to 8 for each equation in the system, the optimum number of lags was selected by minimizing the FPE statistic defined as: $FPE = [(T+m+1)(T-m-1)]/[SSR(m)/T]$. Where; T is the total number of observations, m is the number of lags, and SSR(m) is the related sum of squared residuals.

[7] The system has been also estimated by using the first differences of all variables with the addition of cointegrating terms. The results, which were essentially the same, are available from the authors upon requests.

**Table 2:** The Johansen Test for Cointegrating Vectors

| $H_0$ | $H_1$ | Trace Test Statistics | Critical Values (95%) |
|---|---|---|---|
| r=0 | r≥1 | 155.3261 | 68.52 |
| r≤1 | r≥2 | 79.32879 | 47.21 |
| r≤2 | r≥3 | 27.13240 | 29.68 |
| r≤3 | r≥4 | 10.86332 | 15.41 |
| r≤4 | r≥5 | 2.111872 | 3.76 |

**Note:** r indicates the number of cointegrating relationships

The results of FPE criterion of the autoregressive model for real output (LQ), money supply (LM), nominal government expenditure (LG), exchange rate (LD) and price level (LP) are reported in Table 3. The $\chi^2$ statistics for the joint significance of the coefficients of the lags on each variable are also given in Table 3. Ljung Q-Box statistics for the first 24 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, in the real output equation, the estimated coefficients on the lags of money are statistically different from zero as a whole, indicating that anticipated money affects anticipated component of real output. Based on the $\chi^2$ statistics, anticipated changes in all other variables affect real output, except exchange rates.

The correlation matrix of the unanticipated changes of the variables in where lag specification is based on the FPE criterion is presented in Table 4. Table indicates that unanticipated money does not affect real output. The correlation coefficient between unanticipated money and real output is not statistically different from zero. However, unanticipated component in price level has a significant effect on real output. The correlation coefficient between unanticipated price level and real output is found to be significant and negative, indicating that unanticipated component of price level affects real output negatively. The results given in Tables 3-4 imply that the only anticipated monetary policy influences real output, thus directly rejecting the neutrality hypothesis. At the same time, both anticipated and unanticipated price changes affect real output significantly, lending support to the non-classical RENR models and also rejecting the neutrality hypothesis.

**Table 3:** Estimation Results (Final Prediction Error)

| Variables | LQ | LM | LG | LP | LD |
|---|---|---|---|---|---|
| **Constant** | 1.264[a] | -0.712 | 1.159 | -0.127 | -0.453 |
| **$LQ_{t-1}$** | 0.635[a] | -0.538[b] | 0.750[b] | -0.048 | -0.172 |
| **$LQ_{t-2}$** | 0.132 | 0.374 | -0.320 | -0.188 | 0.117 |
| **$LQ_{t-3}$** | -0.064 | 0.252 | -0.205 | -0.042 | -0.119 |
| **$LQ_{t-4}$** | -0.051 | 0.083 | -0.899[b] | 0.332[b] | -0.860[a] |
| **$LQ_{t-5}$** | 0.067 | -0.259 | 1.452[a] | -0.063 | 0.234 |
| **$LQ_{t-6}$** | -0.095 | -0.119 | -1.032[b] | -0.029 | 0.217 |
| **$LQ_{t-7}$** | 0.185 | 0.716[b] | 0.219 | -0.183 | 0.008 |
| **$LQ_{t-8}$** | | | 0.078 | 0.088 | 0.163 |
| **$LM_{t-1}$** | 0.143[a] | 0.679[a] | 0.495[a] | -0.126[a] | -0.044 |
| **$LM_{t-2}$** | -0.106[c] | 0.076 | -0.702[a] | 0.153[b] | 0.056 |
| **$LM_{t-3}$** | -0.013 | 0.005 | 0.228 | -0.025 | -0.043 |
| **$LM_{t-4}$** | 0.033 | -0.081 | 0.273 | 0.013 | 0.053 |
| **$LM_{t-5}$** | -0.032 | -0.165 | 0.193 | -0.091 | 0.055 |
| **$LM_{t-6}$** | -0.090 | 0.347[b] | -0.635[a] | | -0.004 |
| **$LM_{t-7}$** | 0.090 | | | | -0.051 |
| **$LM_{t-8}$** | 0.011 | | | | |
| **$LG_{t-1}$** | 0.024 | 0.040 | 0.518[a] | -0.009 | -0.117[b] |
| **$LG_{t-2}$** | -0.002 | -0.035 | 0.212[c] | 0.017 | 0.075 |
| **$LG_{t-3}$** | -0.055 | -0.003 | -0.0001 | 0.013 | 0.070 |
| **$LG_{t-4}$** | -0.067[b] | -0.031 | 0.279[a] | 0.060[c] | 0.008 |
| **$LG_{t-5}$** | 0.018 | -0.115 | 0.169[c] | 0.002 | 0.0007 |
| **$LG_{t-6}$** | -0.021 | -0.022 | -0.109 | -0.091[a] | 0.057 |
| **$LG_{t-7}$** | | -0.014 | -0.273[a] | 0.008 | -0.147[a] |
| **$LG_{t-8}$** | | | | -0.042 | -0.012 |
| **$LP_{t-1}$** | -0.192 | -0.144 | 0.313 | 1.038[a] | -0.021 |
| **$LP_{t-2}$** | 0.318[c] | 0.426 | 0.099 | -0.057 | 0.111 |
| **$LP_{t-3}$** | 0.111 | | -0.164 | 0.129 | 0.434[c] |
| **$LP_{t-4}$** | -0.229 | | -0.286 | 0.020 | 0.761[a] |
| **$LP_{t-5}$** | -0.243 | | 0.544 | 0.064 | -1.422[a] |
| **$LP_{t-6}$** | 0.034 | | 0.214 | -0.084 | 0.472 |
| **$LP_{t-7}$** | 0.470[b] | | -0.910 | -0.026 | -0.120 |
| **$LP_{t-8}$** | -0.221 | | 0.505 | 0.126 | 0.023 |
| **$LD_{t-1}$** | 0.025 | -0.014 | 0.046 | -0.031 | 0.850[a] |
| **$LD_{t-2}$** | -0.002 | -0.144 | -0.654[b] | 0.017 | -0.155 |
| **$LD_{t-3}$** | 0.048 | 0.098 | 0.205 | -0.042 | 0.002 |
| **$LD_{t-4}$** | -0.042 | 0.267 | 0.412[c] | -0.046 | 0.010 |
| **$LD_{t-5}$** | | -0.233 | | | 0.262[b] |
| **$LD_{t-6}$** | | -0.030 | | | -0.142[c] |
| **$LD_{t-7}$** | | 0.044 | | | |
| **$LD_{t-8}$** | | | | | |
| **$R^2$** | 0.98 | 0.99 | 0.99 | 0.99 | 0.99 |
| **Q(8)** | 6.685 | 5.752 | 9.131 | 3.825 | 8.083 |
| **Q(16)** | 16.925 | 12.109 | 19.268 | 8.426 | 15.289 |
| **Q(24)** | 27.375 | 20.250 | 40.474 | 34.442[b] | 28.321 |
| **$\chi^2_{LQ}$** | 74.400[a] | 7.281 | 20.294[a] | 12.136 | 36.277[a] |
| **$\chi^2_{LM}$** | 17.351[b] | 152.930[a] | 61.361[a] | 11.734 | 4.304 |
| **$\chi^2_{LG}$** | 22.177[a] | 7.076 | 34.689[a] | 13.488[b] | 8.945 |
| **$\chi^2_{LP}$** | 18.712[b] | 7.292[b] | 12.752 | 1145.360[a] | 98.579[a] |
| **$\chi^2_{LD}$** | 0.844 | 3.761 | 10.830[b] | 5.044 | 187.580[a] |

**Note:** a, b, and c denote the significance level for 1%, 5%, and 10%, respectively.

**Table 4:** Correlation Matrix of Residuals (FPE)

| Variables | LQ | LG | LD | LP |
|---|---|---|---|---|
| **LG** | -0.163 | | | |
| **LD** | 0.064 | -0.019 | | |
| **LP** | -0.372[a] | -0.009 | -0.263[c] | |
| **LM** | -0.109 | -0.215 | 0.063 | 0.016 |

**Note:** a, b, and c denote the significance level 1%, 5%, and 10%, respectively.

The results of the autoregressive system estimation where lag specification was based on stepwise selection procedure are reported in Table 5. Taking into consideration Ljung Q-Box statistics, it is found that there is no autocorrelation in the regressions. There is a positive and significant relationship between anticipated money and real output. The estimated coefficients on the lags of money are statistically and jointly significant at the 1% level. This result shows that the RENR hypothesis is once more rejected for Turkish case. In addition, as seen from Table 6, there does not exist a significant correlation between residuals of output equation and the residuals of money equation. It is resulted that unanticipated money in Turkey does not matter in the context of the RENR hypothesis. On the other hand, unanticipated price changes has a significant effect on real output. This result may exist because of the asymmetric effects of the monetary policy. If the positive and negative effects of unanticipated monetary policy neutralize each other, there would not be a net significant effect on real output. However, if the effect of negative unanticipated monetary growth is greater than the effect of positive unanticipated monetary growth, price level would decrease. And this change in price level would have some effects on real output. This indirect interaction between unanticipated money growth and real output has been investigated in Table 7 and 8.

**Table 5:** Estimation Results (Stepwise Procedure)

| Variables | LQ | LM | LG | LP | LD |
|---|---|---|---|---|---|
| **Constant** | 1.337$^{a}$ | -2.147$^{b}$ | 1.327 | -0.517 | -0.193 |
| **$LQ_{t-1}$** | 0.670$^{a}$ | | 0.404$^{c}$ | | |
| **$LQ_{t-2}$** | -0.004 | | | -0.179$^{a}$ | |
| **$LQ_{t-3}$** | -0.076 | | | | |
| **$LQ_{t-4}$** | 0.006 | | -1.030$^{a}$ | 0.214$^{a}$ | -0.643$^{a}$ |
| **$LQ_{t-5}$** | -0.080 | | 1.262$^{a}$ | | |
| **$LQ_{t-6}$** | | | -0.792$^{a}$ | | 0.252$^{b}$ |
| **$LQ_{t-7}$** | 0.196$^{a}$ | 0.570$^{a}$ | | | |
| **$LQ_{t-8}$** | | | | | |
| **$LM_{t-1}$** | 0.118$^{a}$ | 0.608$^{a}$ | 0.557$^{a}$ | -0.068 | |
| **$LM_{t-2}$** | -0.107$^{b}$ | | -0.572$^{a}$ | 0.107$^{b}$ | |
| **$LM_{t-3}$** | | | | | |
| **$LM_{t-4}$** | | | 0.364$^{a}$ | | |
| **$LM_{t-5}$** | | | | | |
| **$LM_{t-6}$** | -0.042 | | -0.459$^{a}$ | | |
| **$LM_{t-7}$** | | 0.260$^{a}$ | | -0.103$^{b}$ | |
| **$LM_{t-8}$** | 0.094$^{a}$ | | | -0.069 | |
| **$LG_{t-1}$** | | | 0.533$^{a}$ | | |
| **$LG_{t-2}$** | | | 0.209$^{a}$ | | |
| **$LG_{t-3}$** | -0.033 | | | | |
| **$LG_{t-4}$** | -0.054$^{b}$ | | 0.334$^{a}$ | | |
| **$LG_{t-5}$** | | | | | |
| **$LG_{t-6}$** | | -0.121$^{b}$ | | | |
| **$LG_{t-7}$** | | | -0.254$^{a}$ | | |
| **$LG_{t-8}$** | -0.069$^{a}$ | -0.090$^{c}$ | | | |
| **$LP_{t-1}$** | | | 0.300$^{a}$ | 1.026$^{a}$ | 0.187$^{b}$ |
| **$LP_{t-2}$** | | | | | |
| **$LP_{t-3}$** | | | | | 0.488$^{a}$ |
| **$LP_{t-4}$** | | | | | 0.727$^{a}$ |
| **$LP_{t-5}$** | | | | | -1.244$^{a}$ |
| **$LP_{t-6}$** | | 0.404$^{a}$ | | | |
| **$LP_{t-7}$** | 0.376$^{a}$ | | | | |
| **$LP_{t-8}$** | -0.268$^{a}$ | | | 0.182$^{a}$ | |
| **$LD_{t-1}$** | | | | | 0.727$^{a}$ |
| **$LD_{t-2}$** | | | -0.519$^{a}$ | | |
| **$LD_{t-3}$** | | | | | |
| **$LD_{t-4}$** | | | 0.501$^{a}$ | | |
| **$LD_{t-5}$** | | | | -0.093$^{a}$ | 0.201$^{a}$ |
| **$LD_{t-6}$** | | | | | -0.177$^{b}$ |
| **$LD_{t-7}$** | | | | | |
| **$LD_{t-8}$** | | -0.130$^{b}$ | | | 0.121$^{a}$ |
| **$R^2$** | 0.98 | 0.99 | 0.99 | 0.99 | 0.99 |
| **Q(8)** | 6.116 | 4.997 | 7.117 | 5.318 | 7.031 |
| **Q(16)** | 17.207 | 10.471 | 17.012 | 16.069 | 13.707 |
| **Q(24)** | 28.430 | 21.016 | 33.415$^{b}$ | 24.645 | 26.239 |
| **$\chi^2_{LQ}$** | 99.968$^{a}$ | 12.512$^{a}$ | 20.385$^{a}$ | 12.078$^{a}$ | 42.374$^{a}$ |
| **$\chi^2_{LM}$** | 15.914$^{a}$ | 121.580$^{a}$ | 39.735$^{a}$ | 28.121$^{a}$ | |
| **$\chi^2_{LG}$** | 37.770$^{a}$ | 12.786$^{a}$ | 177.293$^{a}$ | | |
| **$\chi^2_{LP}$** | 21.760$^{a}$ | 26.002$^{a}$ | 11.977$^{a}$ | 4066.598$^{a}$ | 173.390$^{a}$ |
| **$\chi^2_{LD}$** | | 5.507$^{b}$ | 24.348$^{a}$ | 9.936$^{a}$ | 229.441$^{a}$ |

**Note:** a, b, and c denote the significance level for 1%, 5%, and 10%, respectively.

**Table 6:** Correlation Matrix of Residuals (Stepwise)

| Variables | LQ | LG | LD | LP |
|---|---|---|---|---|
| **LG** | -0.146 | | | |
| **LD** | -0.004 | -0.051 | | |
| **LP** | -0.336[b] | -0.048 | -0.138 | |
| **LM** | -0.088 | -0.281[b] | 0.093 | 0.046 |

**Note:** a, b, and c denote the significance level 1%, 5%, and 10%, respectively.

Table 7 summarizes the correlations among the unanticipated changes of the system variables in question. Table 7 consists of four parts. In the first part of the table, the correlation coefficients among the negative residuals are given. In the second part of the table, the correlations among positive residuals are reported. While in the third part the correlations between positive output residuals and negative for others are reported, the correlations between negative output residuals and positive for others are summarized in the fourth part.

As seen from the table, there is only one significant relationship between negative residuals of output and negative residuals of government expenditure. All other possible relations for these series are not statistically significant. In this case, it can be pointed out that there is a significant and asymmetric relationship between government expenditure and real output. Similarly, there is only one significant relationship between money supply residuals and real output residuals. This interaction can be seen in the fourth section of the Table. This one way relationship proves that the relationship between these two variables is asymmetric.

**Table 7:** FPE

| **Correlation Matrix of Negative Residuals** | | | | |
|---|---|---|---|---|
| **Variables** | **LQ** | **LG** | **LD** | **LP** |
| **LG** | -0.238[c] | | | |
| **LD** | 0.016 | 0.041 | | |
| **LP** | -0.126 | -0.057 | -0.231[c] | |
| **LM** | -0.006 | -0.189 | -0.073 | -0.091 |
| **Correlation Matrix of Positive Residuals** | | | | |
| **Variables** | **LQ** | **LG** | **LD** | **LP** |
| **LG** | 0.018 | | | |
| **LD** | 0.065 | -0.086 | | |
| **LP** | -0.155 | -0.074 | -0.191 | |
| **LM** | -0.118 | -0.224[c] | 0.047 | 0.112 |
| **Correlation Matrix of Positive Residuals for Output and Negative Residuals for Others** | | | | |
| **Variables** | **LQ** | **LG** | **LD** | **LP** |
| **LG** | -0.195 | | | |
| **LD** | 0.019 | 0.041 | | |
| **LP** | -0.129 | -0.057 | -0.231[c] | |
| **LM** | 0.069 | -0.189 | -0.073 | -0.091 |
| **Correlation Matrix of Negative Residuals for Output and Positive Residuals for Others** | | | | |
| **Variables** | **LQ** | **LG** | **LD** | **LP** |
| **LG** | -0.445 | | | |
| **LD** | 0.819 | -0.086 | | |
| **LP** | -3.515[a] | -0.074 | -0.191 | |
| **LM** | -1.815[c] | -0.224[c] | 0.047 | 0.112 |

**Note:** a, b, and c denote the significance level 1%, 5%, and 10%, respectively.

Table 8 summarized the correlations among the unanticipated changes of the system variables in question with stepwise selection procedure. As seen from the table, there is only one significant relationship between positive residuals of money supply and negative residuals of real output. Any other possible relationships between these two variables could not be founded out as statistically significant. This one way relationship proves that the relationship between these two variables is asymmetric once again.

**Table 8:** Stepwise

| Correlation Matrix of Negative Residuals | | | | |
|---|---|---|---|---|
| **Variables** | **LQ** | **LG** | **LD** | **LP** |
| **LG** | -0.214 | | | |
| **LD** | -0.019 | -0.005 | | |
| **LP** | -0.137 | -0.123 | -0.247[c] | |
| **LM** | 0.065 | -0.309[b] | -0.141 | -0.010 |
| **Correlation Matrix of Positive Residuals** | | | | |
| **Variables** | **LQ** | **LG** | **LD** | **LP** |
| **LG** | 0.086 | | | |
| **LD** | 0.010 | -0.122 | | |
| **LP** | -0.164 | -0.055 | 0.000 | |
| **LM** | -0.192 | -0.159 | 0.141 | 0.055 |
| **Correlation Matrix of Positive Residuals for Output and Negative Residuals for Others** | | | | |
| **Variables** | **LQ** | **LG** | **LD** | **LP** |
| **LG** | -0.184 | | | |
| **LD** | 0.023 | -0.005 | | |
| **LP** | -0.223[c] | -0.123 | -0.247[c] | |
| **LM** | 0.112 | -0.309[b] | -0.141 | -0.010 |
| **Correlation Matrix of Negative Residuals for Output and Positive Residuals for Others** | | | | |
| **Variables** | **LQ** | **LG** | **LD** | **LP** |
| **LG** | -0.100 | | | |
| **LD** | -0.022 | -0.122 | | |
| **LP** | -0.384[a] | -0.055 | 0.000 | |
| **LM** | -0.234[c] | -0.159 | 0.141 | 0.055 |

**Note:** a, b, and c denote the significance level 1%, 5%, and 10%, respectively.

## 4. Conclusion

The main purpose of this paper is to examine the neutrality hypothesis of the new classical macroeconomics by focusing the asymmetricity. To do this, a five-variate autoregressive system has been setup and estimated. Real output, monetary policy, fiscal policy, exchange rate and price level are the variables of the system. The estimation of the autoregressive system was done under two alternative lag specifications: final prediction error criterion and stepwise selection procedure.

The results obtained from standard neutrality test show that the only variable which significantly affects the real output is unanticipated price level changes. There is not any relationship among the unanticipated changes of the variables in the context of the RENR hypothesis. This result rejects the neutrality hypothesis and lending support to the non-classical RENR models. The results obtained from the asymmetricity test, however, indicate that there is a direct and significant relationship between unanticipated monetary policy and real output. Both final prediction error lag specification and stepwise selection procedure test results imply that unanticipated component of money has a significant and asymmetric impact upon real output. A negative and statistically significant correlation between positive monetary shock and negative output shock shows that a decrease in positive monetary shock would decrease the real output. That is, if the monetary expansion would not be greater than expectations, then the output would surprisingly decrease.

A similar result can be observed for fiscal policy. A negative and statistically significant relationship between negative shock of government expenditures and negative shock of real output implies that an increase in negative fiscal shock would decrease the real output. That is, if the fiscal expansion is greater than expectations, the real output would surprisingly decrease.

Combining the standard neutrality and asymmetricity tests results, we can conclude that the neutrality hypothesis is valid for Turkish economy, but only asymmetrically. Asymmetric relations among the innovations of the system strongly reject the non-neutrality hypothesis of the non-classical RENR models which assume that wages and prices are rigid.

## References


[1] Abaan, E. D., "Parasal Sok ve Reel Ekonomik Etkinlik", *ODTU Gelisme Dergisi* 14, no. 3, (1987), 271-282.

[2] Akaike, H., "Fitting Autoregression for Prediction", *Annals of the Institute Statistical Mathematics* 21, (1969), 243-247.

[3] Attfield, C.; Demery, D.; and N. Duck, "Unanticipated Monetary Growth, Output and Price Level: UK, 1946-1977", *European Economic Review* 16, (1981), 367-385.

[4] Ball, L. and N. G. Mankiw, "Asymmetric Price Adjustment and Economic Fluctuations", *Economic Journal* 104, (1994), 247-261.

[5] Barro, R. J., "Unanticipated Money Growth and Unemployment in the United States", *American Economic Review* 67, (1977), 101-115.

[6] Barro, R. J., "Unanticipated Money, Output and the Price Level in the United States", *Journal of Political Economy* 86, (1978), 549-580.

[7] Barro, R. J. and M. Rush, "Unanticipated Money and Economic Activity", *In Rational Expectations and Economic Policy*, (1980), S. Fischer (Ed.), University of Chicago Press, Chicago, IL.

[8] Bellante, D.; Morrell, S. O. and A. Zardkoohi, "Unanticipated Money Growth, Unemployment, Output and the Price Level in the United Kingdom: 1946-1977", *Southern Economic Journal*, 49, (1982), 62-76.

[9] Ben-David, D. and D. Papell, "Slowdowns and Meltdowns: Post War Growth Evidence from 74 Countries", *Review of Economics and Stat*istics 28, no. 2, (1997), 561-571.

[10] Caballero, R. J. and E. M. R. A. Engel, "Price Rigidities, Asymmetries, and Output Fluctuations", *National Bureau of Economic Research Working Paper* No: 4091, (1992).

[11] Canarella, C. and S. K. Pollard, "Unanticipated Monetary Growth, Output, and the Price Level in Latin America", *Journal of Development Economics* 30, (1989), 345-358.

[12] Cover, J., "Asymmetric Effects of Positive and Negative Money-supply Shocks", *Quarterly Journal of Economics* 107, (1992), 1261–1282.

[13] Dickey, D. A. and W. A. Fuller, "Distribution of the Estimators for Autoregressive Time Series with a Unit Root", *Journal of the American Statistical Association* 74, (1979), 427-431.

[14] Fischer, S., "Long Term Contracts, Rational Expectations, and the Optimal Money Supply Rule", *Journal of Political Economy* 85, (1977), 191-206.

[15] Johansen, S., "Statistics Analysis of Cointegrating Vector", *Journal of Economic Dynamic and Control* 12, (1988), 231-254.

[16] Johansen, S. and K. Juselius, "Maximum Likelihood Estimation and Inference on Cointegration: with application to the demand for money", *Oxford Bulletin of Economics and Statistics* 52, (1990), 169-210.

[17] Karras, G., "Are the Output Effects of Monetary Policy Asymmetric?: Evidence from a Sample of European Countries", *Oxford Bulletin of Economics and Statistics* 58, (1996a), 267-278.

[18] Karras, G., "Why are the Effects of Money-supply Shocks Asymmetric? Convex Aggregate Supply of 'Pushing on a String?' ", *Journal of Macroeconomics* 18, (1996b), 605-619

[19] Khatri-Chettri, J.; Ampon, K.; and W. Myles, "Anticipated and Unanticipated Money in Thailand", *The American Economist* 34, (1990), 83-87.

[20] Lee, J. and M. C. Strazicich, "Minimum Lagrange Multiplier Unit Root Test with Two Structural Breaks", *The Review of Economics and Statistics* 85, no. 4, (2003), 1082-1089.

[21] Lucas, R. E., "Some International Evidence on Output-Inflation Trade-offs", *American Economic Review* 63, (1973), 326-334.

[22] Marashdeh, O., “Anticipated and Unanticipated Money: A Case Study of Malaysia”, *Applied Economics* 25, (1993), 919-925.

[23] McGee, R. and R. Stasiak, “Does Anticipated Monetary Policy Matter? Another Look”, *Journal of Money, Credit and Banking* 17, (1985), 16-27.

[24] Mishkin, F. S., “Does Anticipated Monetary Policy Matter? An Econometric Investigation”, *Journal of Political Economy* 90, (1982a), 22-51.

[25] Mishkin, F. S., “Does Anticipated Aggregate Demand Policy Matter? Further Econometric Results”, *American Economic Review* 72, (1982b), 788-802.

[26] Morgan, D. P., “Asymmetric Effects of Monetary Policy”, *Federal Reserve Bank of Kansas City Economic Review* 78, (1993), 20-33.

[27] Phelps, E. S. and J. B. Taylor, “Stabilizing Power of Monetary Policy under Rational Expectations”, *Journal of Political Economy* 85, (1977), 163-190.

[28] Philips, P. C. B. and P. Perron, “Testing for a Unit Root in Time Series Regression”, *Biometrika*, (1988), 335-346.

[29] Rhee, W. and R. W. Rich, “Inflation and the Asymmetric Effects of Money on Output Fluctuations”, *Journal of Macroeconomics* 17, (1995), 683-702.

[30] Sargan, J. D. and A. Bhargava, “Testing Residuals from Least Squares Regression for Being Generated by the Gaussian Random Walk”, *Econometrica* 51, (1983), 153-174.

[31] Sargent, T. J. and N. Wallace, “Rational Expectations and the Theory of Economic Policy”, *Journal of Monetary Economics* 2, (1975), 169-184.

[32] Tsiddon, D., “The (Mis)Behavior of the Aggregate Price Level”, *Review of Economic Studies* 60, (1993), 889-902.

[33] Wogin, G., “Unemployment and Monetary Policy under Rational Expectations”, *Journal of Monetary Economics* 6, (1980), 59-68.

[34] Yamak, R. and Y. Kucukkale, “Anticipated versus Unanticipated Money in Turkey”, *Yapi Kredi Economic Review* 9, (1998), 15-25.

[35] Zivot, E. and D. W. K. Andrews, “Further Evidence on the Great Crash, the Oil-Price Shock, and the Unit-Root Hypothesis”, *Journal of Business and Economic Statistics* 10, (1992), 251-270.