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Does Central Bank of Republic of TURKEY React to Asset Prices?

ABSTRACT

The last decade made many Central Bankers dry and single minded inflation targeting bodies or at least they acted as if they were just targeting inflation. However, some speeches of the Central Bankers or some econometric analyses about Central Bank behaviors show different intentions. This paper analyses last ten years or the inflation targeting years of CBRT and tries two answer two critical questions: Does CBRT react to asset prices and if it does, is this reaction asymmetrically biased? A Taylor Rule like inflation targeting rule is used to regress Central Bank's policy tool interest rate with inflation deviation, output gap and a self created Asset Price Index. The econometric analysis below shows that the answer to both of the questions above is positive in this context.

Keywords: Central Bank Policy, Asymmetric Behavior, Asset Booms, Housing Bubble, GMM.

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ÖZET

1980'lerden sonra zaman tutarsız politikaların ve iradi para politikalarının sonuçlarını irdeleyen geniş bir literatürün oluşması devamında Merkez Bankalarını hem daha muhafazakar hem de sadece enflasyonu önemsiyormuş gibi davranan kurumlara çevirdi. Ancak hem bazı önemli Merkez Bankacıların geçtiğimiz dönemlerdeki konuşmaları hem de bazı ekonometrik analizler hala Merkez Bankacıların farklı niyetlerinin de olabildiğini gösteriyorlar. Bu makale de bu niyetleri Türkiye Cumhuriyeti Merkez Bankası'nın enflasyon hedeflediği son on yılını iki kritik soru çerçevesinde analiz ediyor: Türkiye Cumhuriyeti Merkez Bankası varlık fiyatlarına tepki veriyor mu ve eğer veriyorsa bu tepki asimertik olarak yanlı bir tepki mi? Burada Taylor Kuralı benzeri bir tepki fonksiyonu oluşturularak; Merkez Bankası politika aleti olarak seçilen kısa dönem faiz oranı ile enflasyonun hedeften sapması, üretim açığı ve bu makale için üretilen bir varlık fiyati endeksindeki değişmeler ilişkilendirilmiştir. Aşağıda yapılan analiz yukarıdaki her iki sorunun da cevabının pozitif olduğunu göstermektedir.

Anahtar Kelimeler: Merkez Bankası Politikaları, Asimetrik Davranış, Varlık Fiyatları, Ev Fiyatları, GMM.

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1. INTRODUCTION

Although the title of this paper is about Central Bank of Republic of Turkey's (CBRT) reaction to asset prices, in its core it deals with the possible asset bubbles. The burst of asset bubbles which slumped the Japanese growth rate during 1990's, the collapse of financial markets of the East Asian Tigers in 1997 and most importantly the housing bubbles in England, Ireland, Spain and Australia followed by the US during the end of the last decade showed that an asset bubble is a phenomenon that should be focused and analyzed by the economic policymakers.

Although in microeconomic terms they happen through the decisions of rational agents; the asymmetric information among agents, moral hazard of individuals, herd behavior causes systemic risk on the economy. Thus Central Banks may respond to asset price fluctuations when necessary.

In this paper the CRRT's reaction is modeled via a policy rule, namely the Taylor rule. However, instead of the classical Taylor Rule which adjusts the interest rates to reach the inflation targets and natural rate of output, this variant rule also incorporates an asset price index which is compelled from real house prices, real effective exchange rate and real stock prices.

In the short literature there are a few different arguments about the Central Bank's reaction the asset prices. Most of the contributions to the literature came during the last ten years and the controversial issues are heated during the last five years. One of the earliest contributions in this field came from Bernake and Gertler (1999). Their final comment was not to respond directly to deviations of stock prices. However, Cecchetti, Genberg, Lipsky and Wadwani (2000) made a deep analysis about this issue and they were in agreement with Bernake and Gertler result under a special condition when asset prices have no fundamental movements and there is a credit market friction. In this case just inflation targeting was the best policy. However, if stock price movements generate inflationary or deflationary spirals, in other words if stock prices differ from their fundamental values persistently the positive results of Bernake Gertler analysis fail and asset bubbles are formed. In this case the accommodative reaction policy of Bernake Gertler "is a disaster" but also deflating the bubble can be done easily by modestly increasing the interest rate, so aggressive response is not demanding (Cecchetti, Genberg, Lipsky and Wadwani, 2000). Another inference from the analysis above was the inclusion of any asset price index to the rule will raise the variability of inflation but would reduce the variability of output.

Roubini (2006) also stands for actively bursting bubbles via Central Bank policies. He is of the opinion that claims against the necessity of asset price targeting are not robust. According to Roubini (2006) as supported by many analytical models[1] Central Banks should react to both endogenous and exogenous asset bubbles, even there is an uncertainty about the existence of the bubbles; because the aftermath and the bubbles are costly.

In US during the Greenspan period FED reacted to bubbles and bursts asymmetrically by letting the bubbles to rise, but not letting them to burst. Such a policy may seem appropriate for a short term but in the long term it may distort the investment incentives of the agents and may trigger new bubbles. In this paper the possible asymmetric CBRT incentives about asset prices will be investigated by using an asymmetric and augmented Taylor rule.

An area of critics to this sub literature of papers may be toughness of the identification of asset bubbles or how and when an increasing asset price turns to a bubble. Also there is no orthodox positive policy guide to respond uncertain bubbles even there is a strong suspicion about the existence of the bubble (Miskhin, 2008).Still, the European Central Bank and Papademos (2009) insist the importance of monitoring and analyzing the asset prices for ECB policy applications.

In Turkey the CBRT's primary goal is defined as "maintaining" the price stability in the 4th article[2]. Still the same 4th article in the law also points to the responsibility of the Central Bank for financial stability and gives flexibility to the Central Bank to intervene to asset price and exchange rate deviations when needed. Thus, there is no real legal detainment to react against asset price

[1] See Cecchetti, Stephen G., Hans Genberg and Sushil Wadhwani (2002) for technical information.
[2] See www.tcmb.gov.tr

changes and the asymmetric Taylor Rule augmented with an asset price index can be used to test the reaction of CBRT.

The rest of the paper is organized as follows: In the second section the symmetric and asymmetric Taylor Rules are modeled, in the third section the data and the econometric methods are discussed. Fourth section summarizes the results and fifth section concludes.

2. THE MODEL

The simple linear Taylor Rule from Taylor (1993) is defined with the equation

$$i_t^* = i^* + \rho_0[E_t(\pi_{t+i}) - \pi_{t+i}^*] + \rho_1 E_t(y_{t4j}) + \rho_2 Z_{t+k} \qquad (1)$$

where the Central Bank's desired interest rate at time t i_t^* is determined according to the constant equilibrium interest rate i^*, the deviation of i period forward inflation expectation $E_t(\pi_{t+i})$ from its target π_{t+i}^*, the expected output gap and a matrix of other possible factors that Central Bank may give importance represented with Z_{t+k}.

According to Clarida, Gali & Gertler (1998) because of the lags and uncertainties in the application of the monetary policy or the rigid interest rates Central Bank's desired interest rate and the actual interest rates are different. The actual interest rate is a weighed combination of desired interest rate and last period's interest rate.

$$i_t = (1-\rho_i)\, i_t^* + \rho_i\, i_{t-1} \qquad (2)$$

When this interest rate smoothing equation in (2) and the equation (1) are brought together

the actual interest rate policy of the Central Bank can be summarized as follows:

$$i_t = \rho_i\, i_{t-1} + (1-\rho_i) i^* + (1-\rho_i)\rho_0[E_t(\pi_{t+i}) - \pi_{t+i}^*] + (1-\rho_i)\rho_1 E_t(y_{t4j}) + (1-\rho_i)\, \rho_2 Z_{t+k} \qquad (3)$$

After renaming the constant terms and adding the error term for the econometric model the equation turns to (4)

$$i_t = l_0 + l_{i1}\, i_{t-1} + l_2[E_t(\pi_{t+i}) - \pi_{t+i}^*] + l_3 E_t(y_{t4j}) + l_4 Z_{t+k} + \varepsilon_t \qquad (4)$$

Since the Turkish CPI basket has changed in 2006 some economists criticize the direct use of the backward looking inflation data in the econometric test unhealthy. Therefore instead of taking the expectation of the interest rate the 12 month forward inflation expectation of the public was taken as the inflation expectation data $E_t(\pi_{t+i})$. This data also relaxes the perfect foresight assumption and also relaxes the necessity of using the GMM.

Specially for this paper the Z matrix is just simplified to just one variable; namely the Asset Price Index (API) to measure weather Central Bank reacts to asset prices or not. The (4) the equation thus becomes:

$$i_t = l_0 + l_{i1}\, i_{t-1} + l_2[E_t(\pi_{t+i}) - \pi_{t+i}^*] + l_3 E_t(y_{t4j}) + l_4 api_t + \varepsilon_t \qquad (5)$$

In the model instead of a forward looking API current asset price is used and therefore instead of t+k as subscript just t is written above.

As Greenspan quoted Central Banks sometimes do not react symmetrically but asymmetrically to asset price booms and bursts. To check this asymmetry the Asset Price Index which is just a weighed average of housing price, stock market and exchange rate indices is calculated and with the help of a filter its natural growth data is also calculated. The api_t is just the difference of the actual index from its long term natural rate.

Then to test for asymmetry the api_t data is divided into two subgroups:

If $api_t > 0$ then $api_t = api_t^{above}$

else $api_t = 0$

Similarly,

if $api_t < 0$ then $- api_t = api_t^{below}$

And else $api_t = 0$

With these two new series the econometric equation to test becomes;

$$i_t = l_0 + l_{i1}\, i_{t-1} + l_2[E_t(\pi_{t+i}) - \pi_{t+i}^*] + l_3E_t(y_{t4j}) + l_4api_t^{above} + l_5api_t^{below} + \varepsilon_t \qquad (6)$$

if $|l_4|>|l_5|$ then it can be concluded that Central Bank reacts to asset price booms stronger than asset price bursts and if $|l_4|<|l_5|$ then it can be concluded that Central Bank reacts to asset price booms weaker than asset price bursts and if $|l_4|=|l_5|$ then Central Banker reacts to booms and bursts symmetrically.

3. DATA

The data needed for the regression includes overnight interest rate data of CBRT, inflation expectation of the public, inflation target, output growth and a real asset price index, which consists of a weighed average of real house prices indicator, real equity index and a real exchange rate[3].

The monthly data used for the regressions ranges from 2002:01 to 2011:12, because of two reasons. First, in Turkey the inflation targeting was begun in year 2002. Second the inflation expectation data of the public obtained from CBRT data begun to be released in August 2001.

For the regression the data used are generally obtained from the CBRT database EDDS. The inflation target used is the one that was officially announced by the Central Bank before the beginning of that year. The inflation expectation is taken from the Survey of Expectations of CBRT as the expected CPI over the next twelve month data. The interest rate used is the overnight lending rate of the CBRT but since all data are made real the interest rate is also made real by stripping off the inflation component. Normally the output gap is calculated from the difference of output growth and natural rate of output growth. However, the Hodrick-Prescott filter that is used to calculate the natural rate is optimal only when the series are non-stationary. Therefore, first from the non stationary real GDP data the natural real GDP level was calculated and then the difference was taken and real GDP gap was calculated.

The most problematic data is the API. The weight of all three components in the index the exchange rate, the stock prices and the house price index was taken as one third. The nominal exchange rate is taken as the average of dollar and euro basket form CBRT, the nominal stock exchange is taken as XU100 from the IMKB and then these data were made real with CPI index. CBRT releases a House Price Index from 2010 onwards however the number of data were still insufficient during the writing of this paper. Therefore as a representative of this data the Construction Statistics According to Occupancy Permits in nominal value from TUİK database is taken as the representative and then again made real with CPI.

The API index calculated then is again filtered with Hodrick-Prescott to separate the cyclical component of a time series from raw data and to create a natural growth of this data. This is made just to calculate the api_t^{above} and api_t^{below} the growth rates of asset price indices.

The reason why a basket of three different markets is taken instead of just one single index like housing index is that a drop just in one market or a bubble in just one market can not be interpreted as a bubble alone it can also be a substitution of one investment to another field but if the average of all three markets rise unexpectedly without a reason then there is a high probability that this increase is a bubble.

Finally all data here except interest rate and inflation are converted to differences i.e. growth rates and thus the data were made I(0) stationary before the regression. Also all data except inflation

[3] Some other API index calculations around the world may include credit spreads or/and future spreads but then these spreads are nominal percentages and they are hard to melt in the same pot with nominal price valued indexes according to the author and therefore such financial variables are neglected.

are real variables including the interest rate. The GDP data and Construction Statistics According to Occupancy Permits Nominal Values are seasonally adjusted with X11 (Historical) which is present as a subprogram under EViews 5 program which is used for the regressions in the next section.

The regression method was chosen as GMM because of the current data of output growth and api, but since the inflation deviation data was use as 12 month forward expectances it was also possible to use just the Ordinary Least Squares with one period lags of output growth and api. Still OLS is also checked for robustness analysis.

4. RESULTS

Two regressions were done with the E-Views using the GMM. The first regression was done using the symmetric Taylor Rule similar to Clarida, Gali, Gertler(1998) fashion in equation 5. The estimation result as found in e-views is given in Table 1.

As seen from the Table 1 all coefficients except the constant term are significant at 5% significance level. Thus it can be concluded that according to this regression CBRT reacts not just to inflation deviations but also to GDP gap and Asset Prices. In addition these three explanatory variables explain quite a good a 95 per cent of the variations of the interest rate.

Although last periods interest rate explains most of the actual interest rate, when people expect that inflation will increase 1 % above the target that CB had announced it can be expected that Central Bank will react to this change by increasing the interest rate 10 points.

CBRT'S SYMMETRIC REACTION

Dependent Variable: INT
Method: Generalized Method of Moments
Date: 04/17/12 Time: 16:46
Sample (adjusted): 2003M02 2011M12
Included observations: 107 after adjustments
Kernel: Bartlett, Bandwidth: Fixed (12), No prewhitening
Simultaneous weighting matrix & coefficient iteration
Convergence achieved after: 113 weight matrices, 114 total coef İterations
Instrument list: C INFDEV(-1) INFDEV(-2) INFDEV(-3) INFDEV(-4) INFDEV(-5) INFDEV(-6) D(GDPGAP(-1)) D(GDPGAP(-2)) D(GDPGAP(-3)) D(GDPGAP(-4)) D(GDPGAP(-5)) D(GDPGAP(-6)) D(API(-1)) D(API(-2)) D(API(-3)) D(API(-4)) D(API(-5)) D(API(-6)) INT(-1) INT(-3) INT(-6) INT(-9) INT(-12) INFDEV(-9) INFDEV(-12) D(GDPGAP(-9)) D(GDPGAP(-12)) D(API(-9)) D(API(-12))

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INT(-1)	0.974460	0.005205	187.2202	0.0000
INFDEV	0.104067	0.025288	4.115320	0.0001
D(GDPGAP)	-5.17E-06	1.03E-06	-5.041878	0.0000
D(API(-1))	0.011988	0.003924	3.055353	0.0029
C	-0.088459	0.069617	-1.270651	0.2067

R-squared	0.960201	Mean dependent var	10.18196
Adjusted R-squared	0.958640	S.D. dependent var	6.595690
S.E. of regression	1.341376	Sum squared resid	183.5276
Durbin-Watson stat	1.991451	J-statistic	0.075942

Table 1

This reaction is in line with the theory since Central Bank's primary goal is to control inflation. Not quite in line with the theory if GDP falls below the natural rate 1 per cent Central Bank Central Bank will increase the interest rate still infinitesimally ($5.17*10^{-06}$). That is CBRT does not apply time inconsistent policies to increase the output in classical fashion. However, according to this regression CBRT gives importance to the Asset Price Index and reacts to the changes in API readily. When the asset prices increase above their natural rate one per cent Central Bank readily increases the interest rates 0,012 per cent to control this increase. Thus this first regression shows that CBRT does a quite good inflation targeting without any time inconsistency about the output level but with considering the API prices. Thus the question at the title of the paper is a clear yes. In this regression it should be also added that the J-statistic in the regression table shows that the instruments used for the regression are valid and the data meet the restrictions well.[4] The correleogram of the residuals are also clean and there is no autocorrelation among the residuals[5].

As shown in the first model CBRT reacts to asset price changes but are these reactions symmetric or asymmetric? The second regression is in similar fashion to Naraidoo and Kasai (2010) and it tries to answer this question. This regression uses the equation (6) and the result of E-Views is given in Table 2.

CBRT'S ASYMMETRIC REACTION

Dependent Variable: INT
Method: Generalized Method of Moments
Date: 04/17/12 Time: 18:08
Sample (adjusted): 2003M02 2011M12
Included observations: 107 after adjustments
Kernel: Bartlett, Bandwidth: Fixed (12), No prewhitening
Simultaneous weighting matrix & coefficient iteration
Convergence achieved after: 197 weight matrices, 198 total coef İterations
Instrument list: C INFDEV(-1) INFDEV(-2) INFDEV(-3) INFDEV(-4) INFDEV(-5) INFDEV(-6) D(GDPGAP(-1)) D(GDPGAP(-2)) D(GDPGAP(-3)) D(GDPGAP(-4)) D(GDPGAP(-5)) D(GDPGAP(-6)) D(APIABOVE(-1)) D(APIABOVE(-2)) D(APIABOVE(-3)) D(APIABOVE(-4)) D(APIABOVE(-5)) D(APIABOVE(-6)) INT(-1) INT(-3) INT(-6) INT(-9) INT(-12) INFDEV(-9) INFDEV(-12) D(GDPGAP(-9)) D(GDPGAP(-12)) D(API(-9)) D(API(-12))D(APIBELOW(-1)) D(APIBELOW(-2)) D(APIBELOW(-3)) D(APIBELOW(-4)) D(APIBELOW(-5)) D(APIBELOW(-6)) D(APIBELOW(-9)) D(APIBELOW(-12))

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INT(-1)	0.992783	0.005489	180.8681	0.0000
INFDEV	0.112755	0.014373	7.844936	0.0000
D(GDPGAP(-1))	-1.88E-07	2.07E-07	-0.907481	0.3663
D(APIABOVE(-1))	-0.002418	0.002984	-0.810527	0.4195
D(APIBELOW(-1))	-0.014975	0.003648	-4.105039	0.0001
C	-0.339100	0.061078	-5.551947	0.0000

R-squared	0.970286	Mean dependent var	10.18196
Adjusted R-squared	0.968815	S.D. dependent var	6.595690
S.E. of regression	1.164754	Sum squared resid	137.0218
Durbin-Watson stat	1.961139	J-statistic	0.080161

Table 2

As it is seen in this Table similar to the first regression the lagged interest rate is the main explanatory variable and the inflation deviation is still important (and statistically significant) for the reaction function of the Central Bank. In this regression the weak correlation between interest rate and GDP gap is lost totally and it can not be said that Central Bank reacts to GDP deviations at all. The more important issue of this regression was however weather Central Bank reacts asymmetric or not. First of all the regression shows when the Asset Price Index is above the natural rate the

[4] The J-Stat result x The number of included observations (=8,12 in this case) should be smaller than $\chi 2$ value at a given significance level say 5 per cent (=43,77 in this case with 30 degrees of freedom).
[5] See Appendix

reaction of the Central Bank is insignificant. In other words when asset prices balloons the Central Bank do not see this as a danger and does not react. However, when the Asset Price Index falls below the natural rate the reaction of the Central Bank becomes significant and lowers the interest rates to increase the Asset Prices back again. Thus the CBRT is asymmetrically biased toward asset price changes. In addition the Wald coefficient test[6] also shows that $|l_4|<|l_5|$ significantly.

Again as it was in the first regression, J-statistic in the regression table shows that the instruments used for the regression are valid and the data meet the restrictions well and the autocorrolelogram of the regression shows that the residuals are not correlated[7].

5. CONCLUSION

In this paper, the classical Taylor Rule is diversified with a self calculated Asset Price Index and both the symmetric and asymmetric reactions of the CBRT were tested with a GMM regression for a sample period of last ten years. The regression results show that CBRT obviously targets the inflation via interest rate and GDP deviations are not important for the Central Bank as expected.

The new thing is; it has been found that the CBRT reacts to asset prices significantly. This could be interpreted as a good thing since it could mean that Central Bank monitors asset prices closely as EMU does. However, the second regression showed that this reaction is asymmetrically biased. CBRT reacts to asset bursts but not to asset booms. Therefore, it could be commented that such a policy about Asset Prices may be improper and it may be inflation biased. As mentioned earlier the asymmetric response to bubbles made sense for Greenspan during the last decade and it lead to the housing bubble in US. Such an asymmetry may also lead to an asset price bubble in Turkey in some unseen future. It should be remembered that even showing no response to asset prices may be a better solution than showing asymmetric response[8].

[6] See Appendix
[7] See Appendix
[8] According to Roubini(2006) "theory suggests that either the response should be symmetric (Filardo, 2005) or there should be no response at all (Bernanke and Gertler (1999)".

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APPENDIX:

The Residual AC Table of Regression 1

Date: 04/17/12   Time: 17:56

Sample: 2003M02 2011M12

Included observations: 107

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |. |	. |. |	1	0.010	0.010	0.0115	0.915
. |. |	. |. |	2	-0.056	-0.056	0.3549	0.837
. |* |	. |* |	3	0.129	0.131	2.2269	0.527
.*|. |	.*|. |	4	-0.074	-0.082	2.8451	0.584
. |. |	. |. |	5	-0.055	-0.038	3.1892	0.671
.*|. |	.*|. |	6	-0.064	-0.090	3.6585	0.723
. |. |	. |. |	7	0.023	0.043	3.7187	0.812
. |. |	. |. |	8	-0.029	-0.035	3.8168	0.873
**|. |	.*|. |	9	-0.195	-0.183	8.3326	0.501
. |. |	. |. |	10	0.031	0.014	8.4505	0.585
. |. |	. |. |	11	0.042	0.027	8.6629	0.653
. |. |	. |. |	12	-0.017	0.027	8.6999	0.728
. |. |	. |. |	13	0.010	-0.027	8.7126	0.794
. |. |	. |. |	14	0.036	0.010	8.8741	0.839
. |. |	.*|. |	15	-0.040	-0.062	9.0807	0.873
.*|. |	.*|. |	16	-0.088	-0.071	10.074	0.863
. |. |	. |. |	17	0.028	0.012	10.175	0.896
. |. |	.*|. |	18	-0.027	-0.061	10.270	0.923
. |. |	. |* |	19	0.052	0.086	10.623	0.936
.*|. |	.*|. |	20	-0.072	-0.099	11.313	0.938
. |. |	. |. |	21	-0.054	-0.045	11.711	0.947
. |* |	. |. |	22	0.077	0.040	12.517	0.946
. |. |	. |. |	23	-0.007	0.026	12.524	0.962
.*|. |	.*|. |	24	-0.078	-0.107	13.379	0.959

<table>
<tr><td>. |. |</td><td>.*|. |</td><td>25</td><td>-0.006</td><td>-0.060</td><td>13.383</td><td>0.971</td></tr>
<tr><td>. |. |</td><td>. |. |</td><td>26</td><td>0.029</td><td>0.031</td><td>13.504</td><td>0.979</td></tr>
<tr><td>.*|. |</td><td>.*|. |</td><td>27</td><td>-0.077</td><td>-0.075</td><td>14.380</td><td>0.977</td></tr>
<tr><td>. |. |</td><td>. |. |</td><td>28</td><td>-0.030</td><td>-0.001</td><td>14.515</td><td>0.983</td></tr>
<tr><td>. |. |</td><td>. |. |</td><td>29</td><td>0.032</td><td>-0.039</td><td>14.670</td><td>0.987</td></tr>
<tr><td>. |. |</td><td>. |. |</td><td>30</td><td>0.036</td><td>0.035</td><td>14.864</td><td>0.990</td></tr>
<tr><td>. |. |</td><td>. |. |</td><td>31</td><td>0.013</td><td>0.026</td><td>14.891</td><td>0.994</td></tr>
<tr><td>. |. |</td><td>. |. |</td><td>32</td><td>-0.017</td><td>-0.036</td><td>14.938</td><td>0.996</td></tr>
<tr><td>. |. |</td><td>.*|. |</td><td>33</td><td>-0.032</td><td>-0.101</td><td>15.102</td><td>0.997</td></tr>
<tr><td>. |. |</td><td>. |. |</td><td>34</td><td>0.030</td><td>0.031</td><td>15.245</td><td>0.998</td></tr>
<tr><td>. |. |</td><td>. |. |</td><td>35</td><td>-0.016</td><td>0.015</td><td>15.286</td><td>0.998</td></tr>
<tr><td>. |. |</td><td>.*|. |</td><td>36</td><td>-0.004</td><td>-0.058</td><td>15.289</td><td>0.999</td></tr>
</table>

Thus, there is no residual autocorrelation

Wald Test for the Equity of $|l_4|$and $|l_5|$

Wald Test:

Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	9.402626	(1, 101)	0.0028
Chi-square	9.402626	1	0.0022

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(4) – C(5)	0.012557	0.004095

Restrictions are linear in coefficients.

Thus, Ho: $l_1 = -l_2$ is rejected.

The Residual AC Table of Regression 2

Date: 04/17/12 Time: 19:23

Sample: 2003M02 2011M12

Included observations: 107

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |. |	. |. |	1	0.027	0.027	0.0799	0.777
. |. |	. |. |	2	0.021	0.020	0.1270	0.938
. |* |	. |* |	3	0.085	0.084	0.9387	0.816
.*|. |	.*|. |	4	-0.092	-0.097	1.8937	0.755
.*|. |	.*|. |	5	-0.095	-0.094	2.9254	0.711
. |. |	. |. |	6	-0.006	-0.005	2.9303	0.818
.*|. |	.*|. |	7	-0.081	-0.061	3.6923	0.814
. |. |	. |. |	8	-0.027	-0.016	3.7799	0.876
.*|. |	.*|. |	9	-0.110	-0.126	5.2290	0.814
. |. |	. |. |	10	-0.023	-0.016	5.2954	0.871
. |* |	. |* |	11	0.079	0.077	6.0557	0.870
. |. |	. |. |	12	-0.025	-0.027	6.1316	0.909
. |. |	. |. |	13	0.013	-0.013	6.1512	0.940
. |. |	. |. |	14	0.040	-0.003	6.3511	0.957
.*|. |	.*|. |	15	-0.089	-0.082	7.3623	0.947
.*|. |	.*|. |	16	-0.058	-0.065	7.7975	0.955
. |* |	. |. |	17	0.071	0.064	8.4573	0.956
. |. |	. |. |	18	-0.056	-0.047	8.8694	0.963
. |. |	. |. |	19	0.049	0.043	9.1841	0.970
. |. |	. |. |	20	0.034	0.013	9.3428	0.979
.*|. |	.*|. |	21	-0.081	-0.083	10.232	0.976
. |. |	. |. |	22	0.018	0.003	10.279	0.984
. |. |	. |. |	23	0.023	0.018	10.352	0.989
. |. |	. |. |	24	-0.043	-0.037	10.607	0.992
. |. |	. |. |	25	0.025	-0.008	10.698	0.994

. |. |	. |. |	26	0.003	0.018	10.699	0.996
. |. |	. |. |	27	-0.046	-0.039	11.005	0.997
.*|. |	.*|. |	28	-0.067	-0.088	11.670	0.997
. |. |	. |. |	29	0.040	0.061	11.905	0.998
. |* |	. |* |	30	0.096	0.084	13.302	0.996
. |. |	. |. |	31	0.015	-0.005	13.337	0.998
.*|. |	.*|. |	32	-0.073	-0.091	14.160	0.997
. |. |	.*|. |	33	-0.034	-0.072	14.348	0.998
. |. |	. |. |	34	0.030	0.058	14.495	0.999
. |. |	. |. |	35	-0.041	0.010	14.766	0.999
. |. |	. |. |	36	-0.008	-0.049	14.777	0.999

Asst. Prof. Ertuğrul Üstün Geyik

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