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Budget Deficits and Interest Rates: An Empirical Analysis for Turkey

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Abstract

The aim of this study is to analyze causality between budget deficits and its ratio to gross domestic product and interest rate in the Turkish economy during years between 2006 and 2011. By doing so, we investigate the validity of crowding out view against the Ricardian equivalence hypothesis. To this end, we employee the conventional Toda-Yamamoto (1995) linear Granger type causality test and Hacker and Hatemi-J (2005, 2006) bootstrap process-based Toda-Yamamoto linear Granger type causality test. In this regard, we use Kwiatkowski, Phillips, Schmidt and Shin (1992, KPSS) and Elliot, Rothenberg, Stock (1996, DF-GLS) unit root tests.

Analysis results show that there is no causal relation between budget deficits, budget deficit ratio to gross domestic product and nominal interest rate. Results reveal the existence of Ricardian equivalence hypothesis. Rational household predict that there is no difference between payment time of taxes and they know that expansionary fiscal policies financed by loan do not affect aggregate demand and capital allocation in a full-employment economy via nominal interest rate channel. Results of empirical analysis support Ricardian equivalence hypothesis and imply that there is no effect of financing type of budget deficit on nominal interest rate.

Keywords: Ricardian Equivalence, Crowding-out, Budget Deficit, Bootstrapped Causality Analysis, Turkish Economy.

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1. Introduction

Fiscal position of government and argument about how budget deficits affect decisions of households are important issues in the literature of economics. According to Ricardian equivalence hypothesis developed by Barro (1989) an increase in public debt would be perceived by households as an increase in the future tax burden equal to present value of debt. In this context, increase in budget deficit and in the ratio of budget deficit to gross domestic product have been blamed as a cause of high interest rate, unemployment and inflation. In this study, our primary goal is to investigate relationship between budget deficit and nominal interest rate for the Turkish economy in the context of Ricardian equivalence hypothesis. By using conventional Toda Yamamoto (1995) Granger type linear causality test and bootstrapped Toda Yamamoto linear causality test developed by Hacker and Hatemi-J (2005). We aim to examine change in behavior of households after fiscal arrangements by a medium-term fiscal program and rapid growth in the economy and also to compare results of conventional and bootstrapped Toda Yamamoto causality tests. We employ monthly data including years between 20006M1 and 2011M8. Because, the ruling government has begun to prepare medium-term fiscal programs by the beginning of 2006 and these programs are as a guide for both private and public sector.

2. Theoretical Framework and Literature Review

According to Ricardian equivalence hypothesis, real public expenditures are the most convenient tool to investigate effects of government's economic activities on households and it is not important that how government finances public expenditures (Mukhtar and Zakaria, 2008). So, the type of finance (tax or loan) does not make any difference on the consumption decisions of household and capital allocation of the economy. This situation is called Ricardian equivalence hypothesis. According to Barro (1989), if government does not finance expenditures by tax, budget deficit would occur. If budget deficits are financed by loan, household would know that government has to increase taxes in the near future to compensate principal and interest payments. Barro (1989) concluded that household would reflect the same response whether government finance budget deficit by loan or taxes. Consequently, change in the present value of current and future government spending would affect national savings and hence interest rate.
Feldstein (1980) formulates consumption pattern of household as follows,

$$C_t = \beta_0 + \beta_1 Y_t + \beta_2 W_t + \beta_3 SSW_t + \beta_4 G_t + \beta_5 T_t + \beta_6 TR_t + \beta_7 D_t + u_t \qquad (1)$$

In equation 1, C_t denotes total consumption expenditures, Y_t denotes actual income, W, T, TR, SSW and D_t denote value of private wealth, taxes, and transfer expenditures for individuals, social security benefits in the future and total

public debt, respectively. u_t is a white noise disturbance term with variance σ^2; and $t = 1,...,T$ is an index of time.

According to Feldstein (1980), it is required to accept Ricardian equivalence that

$\beta_4 < 0, \beta_5 = 0, \beta_6 = 0, \beta_3 = 0$ and $\beta_2 = \beta_7$

Evans (1985) derives a linear relationship between the long term nominal interest rate (i), the budget deficit (D), the public spending (G), the real money supply (M/P) and the expected inflation rate (π^e);

$$i_t = \beta_0 + \beta_1 D_t + \beta_2 G_t + \beta_3 (\frac{M_t}{P_t}) + \beta_4 \pi_t^e + u_t \quad (2)$$

Hoelscher (1986) focuses on the long-term relationship between public deficit and interest rates, with equality between the supply and demand of the loanable funds determining the equilibrium interest rate;

$$i_t = \beta_0 + \beta_1 D_t + \beta_2 \pi_t^e + \beta_3 r_t^e + \beta_4 y_t + u_t \quad (3)$$

where r_t^e is the expected real short term interest rate, y_t is the economy's growth rate.

Carreia-Nunes and Stemitsiotis (1995) add to above equation a public debt to GDP ratio variable. According to them, long term interest rates may be influenced not only by the budget deficit, but also by the stock of the accumulated public debt, which can be considered as a proxy for specific country risk;

$$i_t = \beta_0 + \beta_1 D_t + \beta_2 \pi_t^e + \beta_3 r_t^e + \beta_4 y_t + \beta_5 B_t + u_t \quad (4)$$

where β is the debt / GDP ratio.

Raymond and Mauleon (1997) estimate the following reduced form for the long term interest rate based on a model of supply and demand of total saving;

$$i_t = \beta_0 + \beta_1 D_t + \beta_2 Pf_t + \beta_3 y_t + \beta_4 \pi_t^e + \beta_5 i_t^* + u_t \quad (5)$$

where Pf_t is the public revenues / GDP ratio proxy of the fiscal pressure, i_t^* is the foreign long term nominal interest rate and D is the public saving instead of the budget deficit.

In all models β_1 parameter is statistically significant in the hypothesis of a link between long term interest rate and budget deficits, which implies that Ricardian equivalence is not supported by analysis. According to Aisen and Hauner (2008), when deficits are high, mostly domestically financed and interact with high domestic debt, financial openness is low and financial depth is low. In these conditions causal relationship between budget deficit and interest rate occurs. According to them, the effect of deficits on interest rates is smaller under these conditions, implying less crowding out and greater multiplier.

Bilgili and Bilgili (1998) concluded that Ricardian equivalence hypothesis is valid in the Turkish economy between periods 1975 and 1993. Arıcan (2005) tested Ricardian equivalence hypothesis by investigating relationship between real

interest rate and value that obtained by using Lagrange multiplier model. Arıca (2005) implied that consumption has decreased when real interest rate is high except years economic crisis occurred, 1994, 2000 and 2001. Başer and Temurlenk (2007) investigated crowding out effect of government expenditures in the Turkish economy between years 1980 and 2005 by using SVAR methodology. They concluded that there is no necessary crowding out effect in the Turkish economy.

Uğurlu and Düzgün (2009) analyzed the Turkish economy between years 1990Q1 and 2007Q3 by employing linear unit root test and regression methods and implied that Ricardian equivalence hypothesis is not valid for Turkey. Düzgün (2010) examined efficiency of money and fiscal policies in the Turkish economy in the 1987Q1-2007Q3 period by using ARDL bounds test approach. He implied that as a result of application of expansionary fiscal policies, private investment would reduce nominal interest rate and economy would contract.

3. Methodology and Empirical Analysis

In our analysis, BD denotes budget deficit, BDGDP denotes budget deficit/GDP ratio and R denotes nominal interest rate. We obtained monthly data including periods between 2006M1 and 2011M8 from the Central Bank of Republic of Turkey. All data belonging three variables were deseasonalized by using Tramo-Seats program.

3.1. Unit Root Tests

In order to check stationarity of variables, we use DF-GLS unit root test developed by Elliot, Rothenberg and Stock (1996) and KPSS unit root test developed by Kwiatkowski, Phillips, Schmidt and Shin (1992) will be used. In KPSS test that depends on Lagrange multiplier principle, different from the other unit root tests in literature, zero hypotheses means trend stationary (average stationary) as it distinguishes series from deterministic trend (Özgen and Güloğlu, 2004: 14). DF-GLS tests, on the other hand, distinguish the series from the trend and eliminate the autocorrelation. Having an asymptotic distribution, when deterministic terms take place, this test gives better results compared to Dickey Fuller unit root test. (Özgen and Güloğlu, 2004: 16).

Table 1: Results of by Kwiatkowski, Phillips, Schmidt and Shin (1992, KPSS) Unit Root Test

Variables	Levels		First Differences	
	Intercept*	Trend+Intercept**	Intercept*	Trend+Intercept**
BD	0.465	0.145	0.299	0.262
BDGDP	0.354	0.162	0.204	0.111
R	0.918	0.215	0.294	0.154

Notes: * The asymptotic critical values of LM statistic for intercept 0.739, 0.463 at the %1 and %5 levels, ** the asymptotic critical values of LM statistic for trend and intercept 0.216, 0.146 at the %1 and %5 levels.

According to DF-GLS and KPSS unit root test results, it is clear that the series of budget deficit (BD) and its ratio to GDP (BDGDP) are stationary in their level. But nominal interest rate (R) is stationary in its first difference.

Table 2: Results of DF-GLS Unit Root Test

Variables	Levels		First Differences	
	Without Trend*	With Trend**	Without Trend*	With Trend**
BD	-2.088(2)	-7.789(0)	-1.162(5)	-8.171(1)
BDGDP	-1.752(2)	-6.736(0)	-0.901(5)	-12.935(0)
R	-1.408(1)	-1.809(1)	-2.193(0)	-2.374(0)

Notes: * The asymptotic critical values for without trend -2.591, -1.944 at the %1 and %5 levels.
** The asymptotic critical values for with trend -3.602, -3.1772 at the %1 and %5 levels. The figures in parenthesis denote the number of lags in the tests that ensure white noise residuals. They were estimated through the Schwarz criterion.

3.2. Toda-Yamamoto Linear Granger type Causality Test

Toda-Yamamoto (1995) applies VAR model due to number of the delay and also take into account the degree of integration of the series with $\chi 2$ distribution of the Wald test. Toda-Yamamoto causality analysis of the values β of the variables so that the level of the series by creating a standard VAR model eliminates the problems of determining the rank of cointegration (Zapata and Rambaldi, 1997, Duasa, 2007). Accordingly, the generated for relationship between budget deficit and nominal interest rate VAR(p) can be written as follows;

$$BD_t = \sum_{i=1}^{p+d_{\max}} \alpha_{1i} BD_{ti} + \sum_{i=1}^{p+d_{\max}} \beta_{1i} R_{ti} + \varepsilon_{1t} \quad (6)$$

$$R_t = \sum_{i=1}^{p+d_{\max}} \alpha_{2i} R_{ti} + \sum_{i=1}^{p+d_{\max}} \beta_{2i} BD_{ti} + \varepsilon_{2t} \quad (7)$$

and relationship between budget deficit-GDP ratio and nominal interest rate VAR(p) process can be expressed as ;

$$BDGDP_t = \sum_{i=1}^{p+d_{\max}} \alpha_{1i} BDGDP_{ti} + \sum_{i=1}^{p+d_{\max}} \beta_{1i} R_{ti} + \varepsilon_{1t} \quad (8)$$

$$R_t = \sum_{i=1}^{p+d_{\max}} \alpha_{2i} R_{ti} + \sum_{i=1}^{p+d_{\max}} \beta_{2i} BDGDP_{ti} + \varepsilon_{2t} \quad (9)$$

where $d_{\max}$ is the maximum degree of integration of the variables in the model, p is the optimal lag length obtained from the VAR model and ε_t is the term refers to the error correction based on the assumption of white noise. The null hypothesis is tested as $\beta_{1i} = 0$ for i≤k in equation 6. If the alternative hypothesis is accepted, it means that causal relationship between BD and R running from BD to R. The null hypothesis is tested as $\beta_{2i} = 0$ and i≤k in equation 7 again and if the alternative hypothesis accepted, it means that there is a causality between variables running from R to BD.

Table 3: Results of Toda-Yamamoto (1995) Granger Causality

Hypothesis	Lag Length $k + d_{\max}$	MWALD	p-value	Causality
BD ≠> R	3*	4.713	0.0947	No
R ≠>BD		5.624	0.0601	No
BDGDP ≠>R	3*	3.936	0.139	No
R ≠>BDGDP		3.657	0.16	No

Notes: *denotes lag length chosen by according to Schwarz criterion. The notation BD ≠> R implies that BD does not Granger cause R.

According to conventional Granger type Toda-Yamamoto (1995) causality test results, budget deficit and its ratio to GDP does not Granger cause of nominal interest rate. The Ricardian equivalence hypothesis would argue that increasing government debt (we can say budget deficits on this way) should not affect interest rate. If there is no causality between budget deficits and interest rate, the existence of Ricardian neutrality hypothesis is confirmed in Turkey by these results. So, change in budget deficit was not perceived as an extra tax burden in the future and they did not change consumption patterns. As we found similar results with Barro and Sala-i Martin (1990) who examine that world budget deficits and the stock of world government debt have no effect on the determination of world real interest rates.

3.3. Hacker and Hatemi-J (2005, 2006) Bootstrap Process-Based Toda-Yamamoto (1995) Linear Granger Causality

Toda-Yamamoto (1995) causality test, applying a number of sampling is less, and if you have ARCH effect in error terms, based on the results of causality is wrong to make comments. Therefore, Hacker and Hatemi-J (2006) and also Hatemi-J (2005) developed a new methodology by using Efron (1979) bootstrap process based on the causality test. The vector autoregressive model of order p VAR(p) can be expressed as where y_t is the number of variables in the VAR model, v is an vector of intercepts and A_r is matrix of parameters for lag r (r=1,…,p) ;

$$y_t = v + A_1 y_{t-1} + A_2 y_{t-2} + \ldots + A_p y_{t-p} + \varepsilon_t \quad (10)$$

If the variables are cointegration equation 10 and 11 in the VAR ($p + d_{\max}$) model with a simple expression;

$$y_t = v + A_1 y_{t-1} + \ldots + A_p y_{t-p} + \ldots + A_{p+d_{\max}} y_{t-p-d_{\max}} + \varepsilon_t \quad (11)$$

(Hatemi-J and Roca, 2007:830, Hacker and Hatemi-J, 2006:1490). For choice of optimal lag order Hatemi-J (2003) are developed new information criteria. The Hatemi-J Criterion as where $\det \hat{\Omega}_j$ the determinant of the estimated variance-covariance matrix of ε_t when the VAR model is estimated for lag order j, n is the number of variables, T is the sample size;

$$HJC = In(\det \hat{\Omega}_j) + j\left(\frac{n^2 InT + 2n^2 In(InT)}{2T}\right) \quad (12)$$

(Hatemi-J, 2008:240, Hatemi-J and Morgan, 2009:439). The estimated VAR(p+d) model in equation 13 can be written compactly as: $Y = (y_1, ..., y_T)$, $\hat{D} = (\hat{v}, \hat{A}_1, ..., \hat{A}_p, ..., \hat{A}_{p+d_{\max}})$, $\hat{\delta} = (\hat{\varepsilon}_1, ..., \hat{\varepsilon}_T)$ and $Z_t = \begin{bmatrix} 1 \\ y_t \\ y_{t-1} \\ . \\ . \\ . \\ y_{t-p-d+1} \end{bmatrix}$;

can be written as,

$$Y = \hat{D}Z + \hat{\delta} \quad (13)$$

Null hypothesis that the there is no Granger causality (causality non Granger) Todo-Yamamoto (1995) developed by the modified Wald test (Modified WALD);

$$MWALD = (C\hat{\beta})'[C((Z'Z)^{-1} \otimes S_U)C']^{-1}(C\hat{\beta}) \sim \chi_p^2 \quad (14)$$

where $\otimes$ is the Kronecker product, and C is a $pxn(1+n(p+d_{\max}))$ selector matrix, S_U is variance-covariance matrix of residuals and $\hat{\beta} = vec(D)$ is vec signifies the column-stacking operator. The error terms are normally and the MWALD test statistic is asymptotically χ^2 distributed (Hatemi-J and Roca, 2007:831, Hacker and Hatemi-J, 2006:1491, Hatemi-J and Morgan, 2009:441).

Hatemi-J (2005) Monte Carlo experiments testing the error terms in the normal zero smudge MWALD (nonnormality) and ARCH effect is rejected because of the null hypothesis leads to excessive. This is why Hatemi-J (2005), Efron (1979) developed by the leveraged bootstrap developed simulations. For this first, the null hypothesis of non Granger causality that the restricted model is estimated in equality 5. For each bootstrap simulation, as following we create the simulated data,

$$Y^* = \hat{D}Z + \delta^* \quad (15)$$

where $\hat{D}$ is $YZ'(ZZ')^{-1}$. Also, the residuals (δ^*) are regression's modified residuals and each with equal probability of $1/T$. This modification is done to guarantee that the mean value of the bootstrapped residuals is zero. The modified residuals are the regression's raw residuals modified to have constant variance, through the use of leverages. The modified residual through leverage adjustment for x_{it} is defined as:

$$\varepsilon_{it}^{m} = \frac{\varepsilon_{it}}{\sqrt{1-h_{it}}}, \text{ (for, i=1,2,3,4),} \quad (16)$$

where h_{it} is the t^{th} element of h_i, and it is the raw residual from the regression for x_{it} (i=1, 2, 3, 4.). It should be mentioned that the $Tx1$ leverages vectors for x_{1t} and x_{jt} are respectively defined as $h_1 = diag\left(X_1\left(X_1'X_1\right)^{-1}X_1'\right)$, and $h_j = diag\left(X\left(X'X\right)^{-1}X'\right)$ for $j = i-1$ and $i = 1, 2, 3, 4$.

where $X = \left(Y_{-1}', \ldots, Y_{-p}'\right)$ and $X_i = \left(Y_{i,-1}', \ldots, Y_{i,-p}'\right)$, (Hatemi-J, Irandoust, 2006:212, Hacker and Hatemi-J, 2006:1492-1493). We generate the distribution for the MWALD test statistics by running the bootstrap simulation 10.000 times and calculating the MWALD test statistics for each run. We then find bootstrap critical values pertaining to 1%, 5% and 10% significance levels. Afterwards, we calculate the MWALD statistics using original data. We reject the null hypothesis of no causality in the Granger sense at the α level of significance, if the actual MWALD is greater than. The Monte Carlo simulations are conducted using programme procedure written by Hacker and Hatemi-J (2005, 2006).

Table 4: Hacker and Hatemi-J (2006) Bootstrap Process-Based Toda-Yamamoto (1995) Linear Granger Causality MWALD Test Results

The Null Hypothesis	Length of Lag $k + d_{\max}$	Test Statistics MWALD	1% Critical Value	5% Critical Value	10% Critical Value
BD ≠> R	3*	3.827	4.709	6.161	10.074
R ≠>BD		5.824	5.195	6.952	10.799
BDGDP ≠>R	3*	3.004	4.801	6.321	10.016
R ≠>BDGDP		3.652	5.148	6.843	10.875

Notes: **denotes lag length chosen by according to Schwarz criterion. The notation BD ≠> R implies that BD does not Granger cause R. Bootstrap iteration was made for 10.000 times.

To check causal relationship between variables we also applied Hacker and Hatemi-J (2006) bootstrap process-based Toda-Yamamoto (1995) linear Granger causality test. Table 4 represents the results of bootstrap process-based causality analysis. The results reveal that the budget deficits and its GDP ratio do not have any significant effect on interest rate. an increase of interest rate while financing government expenditures causes crowding out effect and private sector investment reduce. The size of crowding out effect depends on slopes of IS and LM curves. Results imply that there is no causality between budget deficit and interest rate. This result means that government expenditures does not have any crowding out effect on private sector investments via interest rate.

4. Conclusion

There is a vast literature investigating the effects of financing type of budget deficits, loan or taxing, on the economy. Previous studies analyzed causality between budget deficit and nominal interest rate in the Turkish economy in different periods. In this study, we tried to explain relationship between variables after the application of new fiscal program by the beginning of 2006. Both the amount of budget deficit and interest rate has reduced in past six years and this brings question whether there is a relationship between them. In this regard, we employed conventional Toda-Yamamoto (1995) Granger type causality and Hacker and Hatemi-J (2005, 2006) bootstrap process-based Toda-Yamamoto causality test.

Empirical test results imply that there is no causality between variables. According to results, Ricardian equivalence hypothesis is valid in the Turkish economy for the period 2006M1 – 2011M8. Rational household predict that there is no difference between payment time of taxes and they know that expansionary fiscal policies financed by loan do not affect aggregate demand and capital allocation in a full-employment economy via nominal interest rate channel. Results of empirical analysis support Ricardian equivalence hypothesis and imply that there is no effect of financing type of budget deficit on nominal interest rate.

In an open economy model, interest rates are also affected by another macroeconomics variable. So it can be concluded that reducing budget deficits after 2006 did not have any pressure on monetary policy interest rate.

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