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RESEARCH ARTICLE

The Government Revenue–Expenditure Nexus: Asymmetric Causality Test**

Kamu Gelir-Harcama Bağlantısı: Asimetrik Nedensellik Testi

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Abstract

The purpose of this study is to examine the asymmetric relationship between government revenues and expenditures for Turkish economy. In this study, the data cover the period of 2006Q1-2019Q3. In this study, unliker the literature, the relationship between variables is investigated asymmetrically. The asymmetric causality relationships were tested by using Asymmetric Causality Test developed by Hatemi-J (2012). The asymmetric causality approach divides the series into two as positive shocks and negative shocks and captures nonlinear effects in the series. The data of this study contain quarterly observations of the total expenditures, total revenues and tax revenues based on sub-items over the 2006: Q1-2019: Q3 time period for the Turkish economy. In this study, because of data constraint, the data started in 2006: Q1.The empirical findings of this study indicate that the Fiscal Synchronization Hypothesis is valid for the relationships between total expenditures and total revenues. However, when the relationship between total expenditures and tax revenues is evaluated, it is seen that the Spend-and-Tax Hypothesis is valid. According to the findings, there is bidirectional causality between total revenues and government expenditures in Turkish economy, symmetrically. There is a symmetric bidirectional causality between tax revenues and government expenditures. Also, negative cumulative total revenues cause the negative cumulative expenditures, asymmetrically.

Keywords: Government Expenditures, Government Revenues, Asymmetric Causality, Hatemi J.

Öz

Bu çalışmanın amacı Türkiye ekonomisi için kamu gelirleri ile harcamaları arasındaki asimetrik ilişkiyi test etmektir. Çalışma 2006:01-2019:03 dönemini kapsamaktadır. Bu çalışmada değişkenler arasındaki ilişki literatürün aksine asimetrik olarak ele alınmıştır. Değişkenler arasındaki asimetrik nedensellik ilişkisi, Hatemi-J (2012) tarafından geliştirilen Asimetrik Nedensellik Testi ile test edilmiştir. Asimetrik nedensellik yaklaşımı bir seriyi pozitif ve negatif şoklara ayırarak, serideki doğrusal olmayan etkileri yakalamaktadır. Çalışmanın veri seti üçer aylık olmak üzere toplam harcamalar, toplam gelir ve vergi gelirlerini kapsamaktadır. Veri seti Türkiye ekonomisinin 2006:01-2019:03 dönemini içermektedir. Veri kısıtından dolayı veri seti 2006:01 döneminden başlamıştır. Çalışmanın ampirik bulguları, toplam harcamalar ve toplam gelir arasında Mali Senkronizasyon Hipotezinin geçerli olduğunu göstermektedir. Buna karşın, toplam harcamalar ve vergi gelirleri arasında Harcama-Vergi Hipotezi geçerlidir. Çalışmanın bulgularına göre, toplam gelir ve kamu harcamaları arasında Türkiye ekonomisinde simetrik ilişki mevcuttur. Ayrıca, vergi gelirleri ve kamu harcamaları arasında da karşılıklı olmak üzere çift yönlü simetrik bir ilişki vardır. Ek olarak, gelirin negatif şokları ve harcamaların negatif şokları arasında asimetrik ilişkiye rastlanılmıştır.

Anahtar Kelimeler: Kamu Harcamaları, Kamu Gelirleri, Asimetrik Nedensellik, Hatemi-J.

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Introduction

Four alternative hypotheses have been argued in the theoretical literature to test the causal relationship between government revenues and expenditures: the tax-and-spend hypothesis, the spend-and-tax hypothesis, the fiscal synchronization hypothesis, and the institutional separation hypothesis. Friedman (1978) proposed the tax-and-spend hypothesis. The hypothesis focuses on that an increase in budget revenues (taxes) would cause an increase in expenditures (spending). However, Buchanan and Wagner (1977) have indicated that a negative relationship causality from revenues to expenditures. This is the fiscal illusion hypothesis. In this hypothesis, the public finances government spending using indirect taxation as being cheaper (Darrat, 1998; Athanasenas et al., 2014). In contrast to Friedman, secondly, Barro (1979) and Peacock and Wiseman (1979) have suggested the spend-and-tax hypothesis. The hypothesis supposes a causality relationship from expenditures to taxes. Contrary to these opinions, thirdly, Musgrave (1966) and Meltzer and Richard (1981) proposed the fiscal synchronization hypothesis that assumed two ways causality between the variables. The last one is the institutional separation hypothesis. The institutional separation hypothesis states that there is no relationship between expenditures and taxes. In the institutional separation hypothesis, decisions on taxes are independent of decisions on expenditures.

The relationships between expenditures and revenues have been frequently discussed in the empirical literature. The studies have been mostly tested by the classical time series approaches such as causality and vector auto regressions based on the linear relationships. For example, Darrat (1998), Koren and Stiassny (1998), Chang and Ho (2002). They consider the relationship as symmetric. However, at this point, in analyzing the relationships between expenditures and revenues, the fact that asymmetric techniques will give more accurate results than symmetric techniques must be known (Athanasenas et al., 2014; Paleologou, 2013; Zapf and Payne, 2009). Unlike standard causality tests, an asymmetric causality test obtains the causal impact of positive shocks from negative shocks. The asymmetric causality test performs well when the sample size is small and when the underlying data set is not normally distributed. This study examines the relationships between expenditures and revenues are tested for the period 2006Q01–2019Q03 of Turkish economy, by using asymmetric causality tests. The process of the asymmetric causal relationship between the expenditures and the revenues (tax and total) for the Turkish economy are examined in the following estimation procedure. Firstly, the expenditures and revenues were been separated to positive and negative shocks. Secondly, the effects of positive and negative shocks of the expenditures and revenues are captured, using the cumulative form. The asymmetric causality is examined using the cumulative sums of positive and negative components of the expenditures and revenues. Finally, the asymmetric causal relationships between the variables were examined by using a bootstrap test for causality. In this step, the ten null hypotheses are tested to estimate the asymmetric causality relationships between all variables. Wald test is applied to compare to the bootstrap critical value. Therefore, the probable causal relationships between expenditures and revenues are tested. In this study, empirical literature, data and methodology, estimation strategy and empirical results are given in Sections 2, 3, 4, and 5, respectively.

Empirical Literature

Four hypothesizes have been investigated by numerous studies, empirically. In Table 1, the findings of some studies are summarized. As seen from Table 1, there are two groups. The studies test the hypotheses in terms of linear or nonlinear econometric techniques. The first group is based on the linear relationship between two variables. For example, Furstenberg et. al. (1986), Li (2001), Narayan (2005), and Hong (2009) applied linear econometrics techniques to examine the hypotheses. In spite of that, the second group applies the nonlinear econometrics techniques relationship between taxes and expenditures. They evaluate the asymmetric relationships of revenues over expenditures and vice versa. For instance, Athanasenas et al. (2014), Paleologou (2013), and Zapf and Payne (2009) used the nonlinear econometrics techniques to test the revenues-

expenditures nexus. These papers argue that in the light of an asymmetric adjustment process, the empirical justification of the nexus could help more effectively towards fiscal discipline.

Table 1.
The empirical literature

Surname, Date	***Countries***	***Methods***	***Results***
Furstenberg, et al., 1986	U.S.	VAR	S→T
Darrat, 1998	Turkey	The Engle-Granger and Johansen Co-integration Tests	The Buchanan- Wagner Hypothesis
Koren and Stiassny, 1998	Nine Industrialized Countries	Trivariate Structural VAR	S→T for Italy, Austria, and France. T→S for the United Kingdom, Netherlands, Germany, and the United States.
Dhanasekaran, 2001	India	Co-integration and Geweke 's Decomposition Models	IS
Li, 2001	China	VAR, VECM	FS
Chang and Ho, 2002	China	Granger Causality, MVECM	FS
Narayan, 2005	Indonesia, Singapore, Sri Lanka	ARDL	T→S for Indonesia, Singapore, Sri Lanka. S→T for Indonesia and Sri Lanka.
Payne, et al., 2008	Turkey	Johansen–Juselius test of cointegration, Gregory–Hansen's test of Cointegration, DOLS,VECM	T→S
Afonso and Rault, 2009	European Economies	Bootstrap Panel Analysis	S→T for Italy, France, Spain, Greece, and Portugal. T→S for Germany, Belgium, Austria, Finland and the UK.
Chang and Chiang, 2009	15 OECD countries	Panel Analyses	FS
Hong, 2009	Malaysia	Johansen Co-Integration Test	FS
Zapf and Payne, 2009	U.S.	TAR, MTAR, Error Correction.	S→T
Saunoris and Payne, 2010	United Kingdom	MTAR	T→S
Yamak and Abdioğlu, 2012	Turkey	Granger Causality	S→T
Paleologou, 2013	Sweden, Greece, and German	TAR and MTAR, and ECM	S→T for Greece. FS for Sweden and German
Athanasenas, et al., 2014	Greece	NARDL	FS
Obeng, 2015	Ghana	OLS, VAR	T→S
Mutascu, 2016	European Economies	Bootstrap Panel Granger Causality	S→T for Bulgaria. T→S for the Czech Republic, Hungary, and Slovenia. FS for the Slovak Republic. IS for Estonia, Latvia, Lithuania, Poland, and Romania.
Tiwari and Mutascu ,2016	Romania	TAR, MTAR	S→T
Yinusa, et al., 2017	Nigeria	Engle–Granger, Gregory and Hansen, Hatemi-J, TAR, MTAR	T→S

Note: T→S: The Tax-and-Spend Hypothesis, S→T: The Spend-and-Tax Hypothesis, FS: The Fiscal Synchronization, IS: The institutional separation, NARDL: Asymmetric ARDL Co-integration, MTAR: Momentum Threshold Autoregressive, MVECM: Multivariate Error-correction Models, TAR: The Threshold Autoregressive, OLS: Ordinary Least Squares, VAR: Vector Autoregressive Models, VECM: Vector Error Correction.

Data and Methodology

3.1. Data

The data of this study contain quarterly observations of the total expenditures, total revenues and tax revenues based on sub-items over the 2006: Q1-2019: Q3 time period for the Turkish economy. In this study, because of data constraint, the data started in 2006: Q1. The series were converted real. All data were seasonally adjusted by using the Census X12 method. All series obtained from the Central Bank of the Republic of Turkey. The variables were used in logarithmic form. The abbreviations and descriptions of both variables are as follows:

Table 2.
The variables

Variables	***Abbreviation***	***Description***
Total Expenditure	EXP	General Budget Expenditure
Total Revenue	TOT	General Budget Revenue
Tax Revenues	TAX	Tax Revenues

3.2. Methodology: Asymmetric Causality Test

The asymmetric causality test contains the Toda and Yamamoto (1995) test. The asymmetric causality approach divides the series into two as positive shocks and negative shocks and captures nonlinear effects in the series. This approach assumed that asymmetric behavior is associated with the cumulative sums of positive and negative shocks. This asymmetric causality test method combined with bootstrap simulations (Hatemi-J, 2012). Hatemi-J (2012) assumes that integrated variables are set as a random walk process as follows:

$$Z_t = Z_{t-1} + u_{1t} = Z_0 + \sum_{i=1}^{t} u_{1i} \quad \textbf{(1)}$$

$$M_t = M_{t-1} + u_{2t} = M_0 + \sum_{i=1}^{t} u_{2i} \quad \textbf{(2)}$$

where t=1, 2,….T, Z_0 and M_0 are initial values, and u_{1t} and u_{2t} are signify white noise disturbance terms. u_{1i}^{+} =max (u_{1i}, 0) and u_{2i}^{+} =max (u_{2i}, 0) are positive shocks, u_{1i}^{-} =min(u_{1i}, 0) and u_{2i}^{-} =min(u_{2i}, 0) are negative shocks. Therefore, u_{1t} and u_{2t} are defined as $u_{1i}^{+}+u_{1i}^{-}$ and $u_{2i}^{+} + u_{2i}^{-}$, respectively. Z and M also can be re-written by Equation (3-4).

$$Z_t = Z_{t-1} + u_{1t} = Z_0 + \sum_{i=1}^{t} u_{1i}^{+} + \sum_{i=1}^{t} u_{1i}^{-} \quad \textbf{(3)}$$

$$M_t = M_{t-1} + u_{2t} = M_0 + \sum_{i=1}^{t} u_{2i}^{+} + \sum_{i=1}^{t} u_{2i}^{-} \quad \textbf{(4)}$$

$Z_i^{+} = \sum_{i=1}^{t} u_{1i}^{+}$, $Z_i^{-} = \sum_{i=1}^{t} u_{1i}^{-}$ are the positive and negative shocks of Z in a cumulative form, respectively. The positive and negative shocks of M are showed in a cumulative form as $M_i^{+} = \sum_{i=1}^{t} u_{1i}^{+}$, $M_i^{-} = \sum_{i=1}^{t} u_{1i}^{-}$, also. In the next step, the causal relationship between these components will be tested. The test for causality can be applied by employing the vector autoregressive regression. Hatemi-J (2003, 2008) suggested an information criterion to select the optimal lag length:

$$HJC = In\left(\left|\hat{\vartheta}_j\right|\right) + m\left(\frac{n^2 InT + 2n^2 In(InT)}{2T}\right),\ q = 0, \ldots, p \quad \textbf{(5)}$$

HJC is Hatemi-J Criterion, $\left|\hat{\vartheta}_j\right|$ is the determinant of the estimated variance-covariance matrix of the error terms in the vector autoregressive model (VAR) based on lag order m, n is the number of equations in the VAR model. T is the total number of observations in the VAR model. The optimal lag order first is selected,

and then, the null hypothesis is tested that the ^{kth} element of Y_t^+ does not Granger-cause the ^{wth} element of Y_t^+.

In this study, in order to investigate the asymmetric causal relationship between the variables, the following steps are used in the econometric process.

In step 1, the asymmetric causal relationships between the expenditures and tax and total revenues were tested by using asymmetric causal test. In this step, the expenditures and tax and total revenues were been separated to positive and negative shocks.

In step 2, the impacts of positive and negative shocks of the expenditures and tax and total revenues are computed.

The vector EXP_i^+, TOT_i^+, and TAX_i^+ indicate the cumulative sum of positive changes of the expenditures, total revenues, and tax revenues, respectively. The vector EXP_i^-, TOT_i^-, and TAX_i^- represents the cumulative sum of negative changes of the expenditures, total revenues, and tax revenues, respectively. The asymmetric causality is examined using the cumulative sums of positive and negative components of the expenditures and revenues.

In Step 3, the asymmetric causal relationships between the variables were examined by using a bootstrap test for causality. In this step, the twenty null hypotheses are tested to estimate the asymmetric causality relationships between expenditures and total revenues, and expenditures and tax revenues.

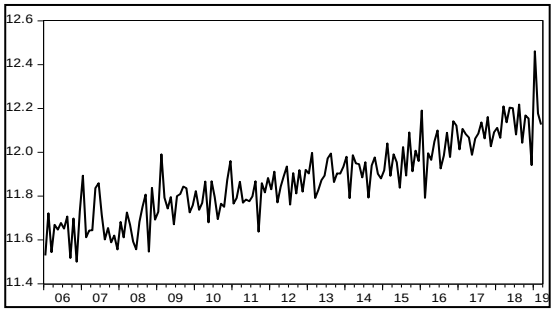
Empirical Findings

In the study, descriptive statistics such as average, maximum, minimum, standard deviation, skewness and kurtosis related to total expenditure, total revenue and tax revenues series are shown in Table 3. All variables are used in logarithmic form.

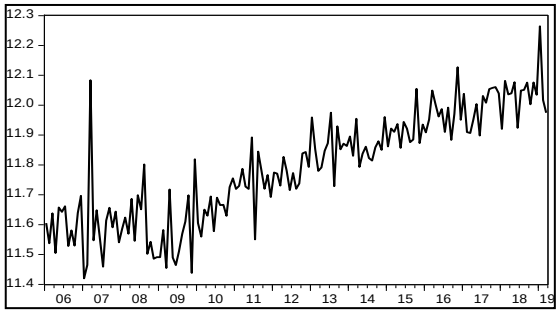
Table 3.
Descriptive statistics

	EXP	TOT	TAX
Mean	11.87353	11.78936	11.62340
Maximum	12.46155	12.26412	11.97582
Minimum	11.50039	11.42017	11.23748
Standard Deviation	0.176053	0.184278	0.188785
Skewness	0.193905	-0.055396	-0.140501
Kurtosis	2.825670	2.091417	1.847383
Jarque-Bera	1.197721	5.550417	9,207316
Prob.	0.549437	0.062336	0.010015

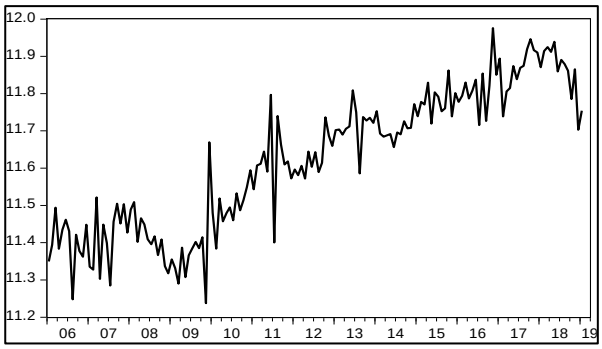
As seen as Graphics 1, 2 and 3, during the period 2006:Q1-2019:Q3, total expenditures, total revenues and tax revenues have an increasing trend.



Graphic 1. EXP



Graphic 2. TOT



Graphic 3. TAX

Prior to asymmetric causality testing, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP)[1] unit root tests were applied for the level and first difference of all variables. Table 4 presents the results of the ADF and PP test statistics. The ADF and PP unit root test results indicate that the variables All variables were found to be stationary in their first differences at 1% significance level.

Table 4.
The results of unit root tests

	ADF		***PP***	
Variables	***Constant***	***Constant+ Trend***	***Constant***	***Constant+ Trend***
EXP	*-0.1977*	*-14.64****	*-5.0463****	*-14.5846****
TOT	*-0.2722*	*-12. 9195****	*-4.4406****	*-13.3047****
TAX	*-1.1154*	*-2.7773*	*-3.2875****	*-11.0290****

Note:*** is significance level of 1%, ** is significance level of 5% and * is significance level of 10%.

The empirical findings of the asymmetric causality tests are given in Table 5. As seen in table, the estimated test value is 24.890 for Model 1. The value of this statistics is greater than the all-critical values. Therefore, the null hypothesis can be rejected at 1% significance level for Model 1. According to this result, the government expenditures cause the total revenues. The estimated test values are 21.832 for the Model (2). The value of this statistics is greater than the 1% significance level. These empirical findings indicate that there is bidirectional causality between total revenues and government expenditures in Turkish economy, symmetrically. The findings support that the fiscal synchronization hypothesis is valid for Turkish economy.

In Model 3, positive cumulative expenditures do not cause positive total cumulative revenues. As seen in Model 3 and 4, there are no relationships between the positive cumulative expenditures and the positive cumulative total revenues. The result of Model 5 shows that the negative cumulative expenditures do not cause the negative cumulative total revenues. However, the estimated test values are 10.692 for the Model 6 and, the statistics is greater than the 10% significance level. This result reveals that negative cumulative total revenues cause the negative cumulative expenditures, asymmetrically. Model 7 indicates that there is no causal relationship from the positive cumulative expenditures to the negative cumulative total revenues. In Model 8, there is an asymmetric causal relationship from the negative cumulative revenues to the positive cumulative expenditures. Also, there is no relationship from the negative cumulative expenditures to the positive cumulative total revenues. In addition, in the result of Model 10, there is an asymmetric causal relationship from positive cumulative total revenues to negative cumulative expenditures.

Table 5.
The results of the asymmetric causality tests between EXP and TOT

Models	H_0	Estimated Test Value	1%	5%	10%	HJC
(1)	$EXP_i \nRightarrow TOT_i$	**24.890**	**11.992**	**8.036**	**6.375**	3
(2)	$TOT_i \nRightarrow EXP_i$	**21.832**	**11.878**	**7.967**	**6.410**	*3*
(3)	$EXP_i^t \nRightarrow TOT_i^+$	0.507	12.220	7.793	5.903	2
(4)	$TOT_i^+ \nRightarrow EXP_i^t$	7.617	16.535	10.430	8.216	2
(5)	$EXP_i^- \nRightarrow TOT_i^-$	4.650	11.082	7.269	5.507	2
(6)	$TOT_i^- \nRightarrow EXP_i^-$	**10.692**	13.656	**8.985**	**6.925**	**2**
(7)	$EXP_i^+ \nRightarrow TOT_i^-$	2.683	10.921	7.084	5.333	2
(8)	$TOT_i^- \nRightarrow EXP_i^+$	**9.774**	16.617	10.781	**8.537**	**2**
(9)	$EXP_i^- \nRightarrow TOT_i^+$	1.917	11.350	7.190	5.570	2
(10)	$TOT_i^+ \nRightarrow EXP_i^-$	**11.105**	15.388	**10.236**	**8.139**	**2**

In Table 6, the symmetric and asymmetric causality relationships between government expenditures and tax revenues are shown. In Model 1 and 2, the estimated values are 12.845, and 12.583, respectively. The statistics are statistically significant at the 1 percent levels in both models. According to Model 1 and 2, there is a symmetric bidirectional causality between tax revenues and government expenditures for Turkish economy. It can be said that the fiscal synchronization hypothesis is valid for Turkish economy.

As seen in Model 3 and 4, the estimated values are 8.102 and 6.794, and the statistics are statistically significant at the 5 percent levels. There is an asymmetric bidirectional relationship between positive cumulative expenditures cause positive cumulative tax revenues. The result of Model 5 shows that the negative cumulative expenditures do not cause the negative cumulative revenues. However, the estimated test values are 7.123 for the Model 6 and, the statistics is greater than the 5% significance level. This result indicates that negative cumulative tax revenues cause the negative cumulative expenditures, asymmetrically. According to the result of Model 7 indicates that there is no causal relationship from the positive cumulative expenditures to the negative cumulative tax revenues. In Model 8, there is not an asymmetric causal relationship from the negative cumulative tax revenues to the positive cumulative expenditures. Also, as seen in Model 9 and 10, there is no relationship between the negative cumulative expenditures and the positive cumulative tax revenues.

Table 6.
The results of the asymmetric causality tests between EXP and TAX

Models	H_0	Estimated Test Value	1%	5%	10%	HJC
(1)	$EXP_i \nRightarrow TAX_i$	**12.845**	16.486	**11.931**	**9.815**	**5**
(2)	$TAX_i \nRightarrow EXP_i$	**12.583**	**12.356**	**8.214**	**6.414**	**3**
(3)	$EXP_i^t \nRightarrow TAX_i^+$	**8.102**	10.567	**6.399**	**4.842**	**4**
(4)	$TAX_i^+ \nRightarrow EXP_i^t$	**6.794**	10.602	**6.411**	**4.808**	**2**
(5)	$EXP_i^- \nRightarrow TAX_i^-$	1.389	11.636	8.123	6.451	3
(6)	$TAX_i^- \nRightarrow EXP_i^-$	**7.123**	12.409	**2.804**	**1.595**	**1**
(7)	$EXP_i^+ \nRightarrow TAX_i^-$	2.616	19.602	12.767	10.101	4
(8)	$TAX_i^- \nRightarrow EXP_i^+$	0.156	9.429	6.165	4.753	2
(9)	$EXP_i^- \nRightarrow TAX_i^+$	0.980	10.660	6.983	5.398	2
(10)	$TAX_i^+ \nRightarrow EXP_i^-$	0.800	12.763	7.069	5.092	2

Concluding Remarks

This study analyses the relationships between government expenditures and revenues in the Turkish economy for the period 2006M01–2019M03. In this study, the relationships between government expenditures and revenues in two groups. In the first group, the data cover government expenditure and total revenues. However, in the second group, the data cover government expenditure and tax revenues. Therefore, in this study, the Tax-and-Spend Hypothesis, the Spend-and-Tax Hypothesis, the Fiscal Synchronization Hypothesis, and the Institutional Separation hypothesis are investigated in terms of two different data. The probable causal relationships between expenditures and revenues (tax and total) are investigated by using Asymmetric causality tests. In this study, the asymmetric causal relationships between the expenditures and tax and total revenues were examined by using a bootstrap test for causality.

According to the findings of the first group, in Turkish economy, there is bidirectional causality between total revenues and government expenditures in Turkish economy, symmetrically. Also, the results of the second group indicate there is a symmetric bidirectional causality between tax revenues and government expenditures for Turkish economy. The findings support that the fiscal synchronization hypothesis is valid in Turkish economy. In addition, negative cumulative total revenues cause the negative cumulative expenditures, asymmetrically. It has been revealed that the decrease in total revenues causes a decrease in total expenditures. There is an asymmetric causal relationship from the negative cumulative revenues to the positive cumulative expenditures. So, the decrease in total revenues causes an increase in expenditures. Also, there is an asymmetric causal relationship from positive cumulative total revenues to negative cumulative expenditures. However, there is an asymmetric bidirectional relationship between positive cumulative expenditures cause positive cumulative tax revenues. Negative cumulative tax revenues cause the negative cumulative expenditures, asymmetrically. The rest of another models, there are no relationship between expenditures and revenues (tax and total).

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Notes:

[1] Dickey and Fuller (1979), Phillips and Perron (1988).