Research article

Testing the fiscal fatigue phenomenon in Turkey using a long-run non-linear fiscal reaction function approach

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Abstract: The primary purpose of this study is to use a non-linear fiscal reaction function approach to investigate the fiscal fatigue phenomenon in Turkey. Quarterly data for the years of 2001 through 2018 were analyzed using fully modified ordinary least squares (FM-OLS) and threshold models. The results from both the FM-OLS and threshold models provide evidence about the presence of the fiscal fatigue phenomenon in Turkey. The primary balance has minimum and maximum values at debt levels of about 30% and 80%, respectively. The primary balance begins to decrease after the maximum value is achieved; negative values are reached at a debt level of about 110%. Therefore, it is recommended that Turkey focus on fiscal sustainability and the risk of external shocks by implementing a fiscal discipline policy. In addition, a primary surplus targeting principle should be implemented, to carry out the sustainability of the liabilities and the fiscal targets.

Keywords: fiscal fatigue; non-linear fiscal reaction function; debt limits

JEL Codes: E62, H63, H68

1. Introduction

The 2008 global crisis has adversely affected fiscal sustainability in many developed and developing countries (Armingeon, 2012). To reduce the negative effects of the global crisis, the fiscal measures implemented by countries have led to an increase in public debt. This is important, as public debt and expenditures are important parameters of fiscal sustainability. Therefore, the

sensitivity of fiscal policy to public debt and changing economic conditions have been one of the most important research subjects in recent years.

A significant number of studies on fiscal consolidation, space, fatigue and reaction functions (FRF) have been conducted. These studies focus on the increasing public debt in countries (Di Iorioa and Fachin, 2019; Everaert and Jansen, 2018; Tran, 2018; Checherita-Westphal and Žďárek, 2017; Ghosh et al., 2013; Legrenzi and Milas, 2013; Baharumshah et al., 2017; Burger et al., 2011; De Mello, 2015; Fournier and Fall, 2017; Tran, 2018). A common aspect of these studies is the recommendation of policies on how to restore fiscal sustainability after a crisis.

One of the most important problems caused by a fiscal sustainability failure is the risk of governments not paying their debts (i.e., sovereign risk). In practice, the debt levels, where the probability of this risk is increased, are calculated (Fournier and Fall, 2017). If exceeded, this level of debt, which makes the government risk (i.e., sovereign risk) unsustainable, is called the debt limit or threshold value (Tran, 2018). Ostry et al. (2010) define the debt limit as the critical point where countries' debt sustainability is insufficient.

Debt dynamics are sustainable when debt growth leads to sufficient increases in the primary fiscal balance to stabilize the debt/GDP ratio and the debt is in a moderate range. In other words, the sustainability of the debt is related to the FRF. In addition, the debt limit concepts express the reaction of the primary balance to the delayed debt (Ostry et al., 2010; Akbayır and Yereli, 2019; Di Iorioa and Fachin, 2019). The failure of the primary balance to meet interest payments at high debt levels is defined as "fiscal fatigue". At a high debt level, because governments try to reduce taxation or non-interest expenditures, output growth decreases and fiscal fatigue symptoms appear (Robertson and Tambakis, 2016).

The primary aim of this study is to analyze the fiscal fatigue phenomenon in Turkey with a long-run non-linear FRF. This is an important investigation because Turkey is a fragile economy that is significantly affected by global shocks. In particular, in recent years, the Turkish lira has experienced a steady loss in value against other currencies. This situation has negatively affected important macro indicators (e.g., inflation, domestic demand, economic confidence, investment climate). It has also led to an increase in the country's debt burden and economic stress. It is necessary to better understand the relationship between debt and the primary budget balance to develop macroeconomic policies for achieving Turkey's future growth targets.

Baldi and Staehr (2016) state that the use of a time series analysis in the determination of FEF and debt limits in countries produces more useful and realistic results in estimating country-specific FRFs than a panel analysis. According to Bohn (2007) in the studies related to the economic questions about the sustainability of the debt, the reaction functions are estimated for primary surpluses that are scaled by GDP. The fiscal reaction functions are sufficient instrument to analyze fiscal sustainability. The FRFs focus on the government's reaction to the recovery of debt by regulating primary balances in the future. If the primary surplus responds positively to the rise in gross debt, it is stated that the government's fiscal policy is sustainable. For this reason, in accordance with the research rationale, quarterly data within the period of 2001–2018 is analyzed to investigate fiscal fatigue and the debt limits in Turkey by using fully modified ordinary least squares (FM-OLS) and threshold models. The findings provide evidence about the presence of the fiscal fatigue phenomenon in Turkey. The minimum value of the primary balance is a debt level of 30%; the maximum value is at the debt level of 80%. The primary balance started to decrease after reaching the maximum value and took on negative values at a debt level of approximately 110%.

This study will contribute to the literature in several ways. According to our knowledge, this is the first study to examine the fiscal fatigue phenomena in the Turkish economy. While most studies emphasize the state of the current public debt and fiscal space in Turkey, this study focuses on the fiscal fatigue phenomenon. In addition, this paper recommends structural policy implications to overcome the fiscal fatigue phenomenon which has been observed after the global crisis in Turkey.

The remainder of the study is organized as follows. In the second section, the literature review is discussed; in the third section the data and empirical methodology are presented. In the fourth section, the empirical results are reported. In the fifth section, the robustness check is submitted. The last section concludes the paper.

2. Literature review

Some fiscal fatigue and FRF studies use a time series analysis (Bohn, 1998; Burger et al., 2011; Pergallini and Postigliola, 2012; De Mello, 2005; Simonassi et al., 2014; Baharumshah et al., 2017). Others use a panel data analysis (Afonso and Jalles, 2011; Everaert and Jansen, 2018; Fournier and Fall, 2017; Mendoza and Ostry, 2008; Ghosh et al., 2013; Mauro et al., 2013; Plödt and Reicher, 2015; Robertson and Tambakis, 2016; Tran, 2018; Di Iorioa and Fachin, 2019; Medeiros, 2012; Legrenzi and Milas, 2013; Bénétrix and Lane, 2013; Weichenrieder and Zimmer, 2013; Berti et al., 2016; Baldi and Staehr, 2016; Checherita-Westphal and Žďárek, 2017).

Afonso and Jalles (2011) examined the relationship between primary balance and the debt level of countries which are a member of the Organization for Economic Co-operation and Development (OECD) by panel data analysis. The results reveal that fiscal authorities have increased their primary budget balances to deal with higher debt levels and reduce debt levels. The results support the existence of Ricardian fiscal regimes. In the period between 1970 and 2010, the country-specific vector autoregression (VAR) model had a negative response to the debt/GDP ratio after the changes in the primary equilibrium rate (except for Australia).

The primary balance ratio's response to the debt ratio is mostly positive for panel countries, as such, long-run fiscal sustainability is achieved. Everaert and Jansen (2018) analyzed whether or not the FRF exhibited fiscal fatigue features in OECD countries using data for the years of 1970 through 2014. The results show that the primary balance significantly responds to delayed debt and that fiscal fatigue is not a general feature of the FRF. Fournier and Fall (2017) also examined debt limits and the fiscal fatigue phenomenon in OECD countries for the years of 1985 and 2013. During this period, the current debt limits were very high (almost twice that of GDP) for most OECD countries. This was primarily due to low-risk interest rates. This indicates that the primary balance surplus at the medium and high debt level was very large. The findings suggest that governments have a strong response to the debt ratio that rises to 120% of GDP. When the debt ratio rises to 170% of GDP, fiscal fatigue occurs.

Studies analyzing non-OECD countries have also been conducted. Mendoza and Ostry (2008) analyzed fiscal fatigue and FRFs for developed and emerging countries, which are not members of the OECD. They found that the primary balance powerfully reacts more to the changes in the public debt in emerging countries than in developed countries. The main conclusion of this study is that countries should not be allowed to have public debt levels above 50–60% of GDP.

Ghosh et al. (2013) analyzed the FRF and the concept of fiscal fatigue with data from 23 developed economies over the period of 1970–2007. They found that the marginal response of the primary balance to the delayed debt is not linear. This response was found to be positive at a

moderate debt level, but started to decrease when the debt/GDP ratio reached 90–100%. Mauro et al. (2013) pointed out that there are significant differences in sustainability among countries in fiscal policies over time. They investigated the causes of changes in fiscal prudence or proclivity by estimating the response of the primary fiscal balance to changes in government debt with a panel regression analysis. When a country has a public debt stock above the threshold value, unexpected decreases occur in the long-term growth. In addition, a weak increase in the non-interest fiscal balance results in an increase in the debt. The results reveal that debt for countries other than Latin America is sustainable in the short term. This is because their debts are below the limits of 40–55% of GDP. However, fiscal sustainability is much more difficult to realize in most Latin American countries. Di Iorioa and Fachin (2019) have reviewed and analyzed the FRF in developed countries. A limited amount of evidence on fiscal fatigue has been obtained.

According to Plödt and Reicher (2015), no consensus exists on the actual responses of the fiscal policy to the output and the past public debt level in developed countries. The cyclical adjustment literature suggests that the primary surplus has a strong response to the output gap[*], while the time series literature suggests that this response is much smaller. Robertson and Tambakis (2016) analyzed the concept of fiscal fatigue and found that excessive fiscal fatigue (i.e., level of debt exceeding 150% of GDP) increased the stable debt ratio and reduced the expected fiscal space.

Reinhart and Rogoff (2010) examined the relationship among the economic growth, external debt and inflation in forty-four developed and developing countries. The results of the study show that the relationship between debt and real GDP growth is weak for debt/GDP rates below the threshold of 90 percent of GDP for developed countries. This ratio is 60 percent for developing countries. Rinhart et al. (2012) investigated the public debt burdens in 22 developed economies from 1800 to 2011. The study focused on developed countries in which the public debt/GDP ratio exceeds 90% for five years or more. If this ratio is exceeded for five years, the debt accumulation could be increased and the output could be decreased.

The debt crisis in the European Union (EU) and the Eurozone in the period following the 2008 global crisis revealed the importance of the reactions of the markets regarding debt sustainability. As a result, many studies have investigated FRFs and fiscal fatigue, especially in European Union countries. One of these studies belongs to Medeiros (2012). Medeiros (2012) used the VAR model and panel FRFs to simulate the debt ratios of the EU members. The results indicate fiscal fatigue at high debt levels. Although the primary balance is positive, it begins to decline when the debt ratio exceeds a certain threshold (60%). Legrenzi and Milas (2013) discuss the sustainability of fiscal policy by addressing thresholds and non-linear FRFs. Their study covers Greece, Ireland, Portugal and Spain from the Eurozone countries. Countries were only found to regulate budget imbalances at high debt ratios. The debt thresholds for this adjustment were estimated to be 69% for Greece, 49% for Ireland, 47% for Portugal and 43% for Spain.

Bénétrix and Lane (2013) carried out a study empirically examining the cyclical fluctuations in the fiscal policy of Eurozone member countries between 1980 and 2007. They found that countries should ensure that the primary balance positively responds to public debt. At this point, fiscal policy arrangements should focus on a structural equilibrium, rather than general balance; in this way, debt sustainability should be realized. Weichenrieder and Zimmer (2013) used the FRFs of the Eurozone countries to compare whether or not the transition to the Euro reduced the sensitivity of debts to

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[*] The Hodrick-Prescott (HP) filter design is used for calculating the output gap.

economic shocks. The results indicate that, because the countries were accepted to the monetary union with very high debt levels, they lost macroeconomic instruments dealing with public debt and competitiveness problems. Therefore, they should have lower debt levels.

Berti et al. (2016) estimated country-specific FRFs for selected EU countries and examined whether or not there has been a change in the fiscal behavior of countries since the beginning of the financial crisis. Since 2009, in a sub-sample of the EU countries, the fiscal response to public debt increased. Countries having a risk of fiscal fatigue exhibited different fiscal behaviors than others. Baldi and Staehr (2016) estimated the fiscal performance of the EU countries with their fiscal response functions. The quarterly data used in the study were analyzed within the pre-crisis and post-crisis periods. The estimation results show that there was feedback from the debt stock to the primary balance during the pre-crisis period. On the other hand, there was much more feedback from the debt stock to the primary equilibrium during the post-crisis period.

Checcherita-Westphal and Žďárek (2017) estimated the FRF of the Eurozone countries with a novel approach. Their findings suggest that after controlling for other relevant factors, each 1-point increase in the debt/GDP ratio improves the primary balance by about 0.03–0.05. In line with the previous studies, it has been determined that the Euro area governments obeyed the weak sustainability constraints. In addition, fiscal fatigue is weaker in non-linear FRF in the Euro area.

A large number of studies have conducted a time series analysis to examine data from the United States, South Africa, Italy, Brazil and Malaysia. Bohn (1998) analyzed the responses of the government to debt accumulation in the United States of America (USA) during the period of 1916–1995. If the primary surplus/GDP and the debt/GDP ratio do not have unit roots, inconsistent estimates can be obtained due to the neglect of other determinants of these variables. Due to neglected variable problems, the empirical analysis used Barro's (1979) tax smoothing model. In the tax smoothing model, the primary surplus equation is obtained by subtracting non-interest government expenditures from the tax revenues. Furthermore, the temporary government expenditures (GVAR) and conjuncture indicator (YVAR) are shown as non-debt determinants of the primary surplus. Thus, unexpected expenditures not related to the economic cycle can be included in the model. In the study, as predicted by Barro (1979), GVAR and YVAR variables were found to be negative in all regressions. If the debt/GDP ratio is controlled in wartime expenditures and cyclical fluctuations, it tends to return to average. The positive response of the primary balance to changes in debt also indicates that the fiscal policy in the USA provides inter-time budgetary constraints. Burger et al. (2011) analyzed how the South African government reacted to changes in the debt position with the FRF. The results show that, since 1946, the South African government has reacted to increasing debt levels by reducing or increasing the primary deficit and implementing a sustainable fiscal policy.

Piergallini and Postigliola (2012) found that the debt to GDP ratio tended to return to average between 1861 and 2009 in Italy. Fiscal policymakers reacted to debt accumulation by taking corrective actions to exclude long-term sustainability problems. De Mello (2005) estimated the FRFs of Brazil at different state levels and analyzed the sustainability of public debt dynamics. In the period of 1995–2004, it was observed that the central government strongly responded to changes in the debt level by setting the primary balance targets. Simonassi et al. (2014) also analyzed the sustainability of Brazil's fiscal policy. They analyzed monthly data for the period of 1991–2008. They found that a structural change occurred in May 1994 and February 2003. Although the fiscal policy was sustainable in Brazil, the sensitivity of the public sector to the increase in debt has been effective since May 1994. Hence, the government needs to be able to increase public spending and

implement more flexible policies to avoid the effects of the international financial crisis without compromising its fiscal objectives.

Baharumshah et al. (2017) analyzed the sustainability of fiscal policy in Malaysia during the period of 1980–2014. The results show that policymakers primarily follow a sustainable fiscal policy, except for during short periods of economic difficulties. The study reveals that public debt should be reduced after exceeding a certain threshold level (above 55% of GDP).

There are alternative methodologies for non-linear fiscal reaction functions have been employed at a state-space framework in the literature. Paniagua et al. (2017) analyzed the sustainability of public finances in the Eurozone especially after the 2007 financial crisis with a time-varying fiscal reaction function. The results of the study explained that Greece, Ireland, Portugal and Spain have not been reacting in a systematic way to debt accumulation.

Another study belongs to Fincke and Greiner (2011). They examined the public debt in Japan, Germany and the United States, by analyzing whether governments follow a sustainable debt policy. The time-varying parameters have been taken into consideration for changing government policies. The results of the study demonstrate that the country-specific characteristics of public finances are evidence of the sustainability of public debt in all selected countries. Fincke and Greiner (2012) discuss the study proposed by Bohn (1998), which proposes to examine whether the primary surplus relative to GDP is a positive function of the ratio of public debt to GDP. Thus, it is determined whether debt policies are sustainable. The study argues that for countries where the debt/GDP ratio may increase, additional tests should be completed. The proposed analyses are applied to the Euro area. Although there are country-specific differences in debt policies, empirical evidence shows that fiscal policies are sustainable for the countries.

Studies suggesting that the inability of the governments to pay off their debts will not create any negative fiscal situations. In addition, there is no clear value for the debt limits of the countries (Catarelli et al., 2010; Ostry et al., 2015). Cottarelli et al. (2010) claim that if governments fail to meet their obligations, it does not reduce the need for fiscal adjustments to the economy. This is because, in developed countries, the main problem arises from primary deficits, rather than interest rates. Over the last decade, economies have been in default as a result of high external shocks and high debt service costs.

According to Ostry et al. (2015), it is difficult to determine a secure debt level and it is not possible to define certain threshold values. Therefore, it is more beneficial to divide the debt levels of countries into three regions. The first region is a green area, where the fiscal space is wide. The second region is a yellow area, where the risks are significant. The third region is a red area, where the fiscal space is exhausted. Countries with a large green area should not rush to pay off their debts. At this point, reducing debt creates an undesirable situation, because the costs incurred are greater than the benefits achieved.

In the literature, there are many studies dealing with the phenomenon of fiscal fatigue for different countries. But none of them investigated the fiscal fatigue in Turkey. According to our knowledge, this is the first study to address the fiscal fatigue phenomenon for Turkey by using empirical analysis. So, it is expected to fulfill this gap in the literature.

3. Data and Empirical Methodology

3.1. Data

Quarterly data used in this study covers the period from the first quarter of 2001 to the third quarter of 2018. Our variables include Turkey's primary balance (% of GDP), gross public debt (% of GDP) and output gap (% of potential GDP). Table 1 illustrates the symbols, descriptions and sources of the data. The Hodrick-Prescott (HP) filter design is used to calculate the output gap and potential GDP. All variables are seasonally adjusted with Tramo-Seats methodology.

Table 1. Data sources**.**

Symbol	Data	Description	Data Source
pb	Primary balance	Primary balance (% of GDP)	The Central Bank of the Republic of Turkey (Electronic Data Delivery System)
d	Debt	Gross public debt (% of GDP)	The Ministry of Treasury and Finance (Electronic Data Delivery System)
gap	Output gap	Output gap (% of potential GDP)	The Central Bank of the Republic of Turkey (Electronic Data Delivery System) and the author's calculations

Table 2 presents the basic statistics of the three primary variables. The primary balance of Turkey is oscillating between −3.996% and 5.158%; its mean value (−0.073%) is very close to zero during the investigated period. The output gap fluctuates between the value of −8.328% and 10.166%. It has a mean value of −0.019%. The gross public debt follows a path with a maximum value of 79.971% and minimum value of 30,095% and mean value of 45.588%.

Table 2. Basic statistics of data.

	pb	d	gap
Mean	−0.073	45.588	−0.019
Median	−0.584	41.704	−0.125
Maximum	5.158	79.971	10.166
Minimum	−3.996	30.095	−8.328
Standard Deviation	2.010	14.073	3.141

Note: pb: primary balance; d: debt; gap: output gap.

The development of Turkey's primary balance, debt and output gap are presented in Figure 1. The primary balance exhibits cyclical patterns. The primary balance and debt also follow a similar path. Both series have a downward trend from the beginning to the end of the sample, except between 2008 and 2010. We propose some reasons for this. Firstly, from the beginning of the 2008 global crisis, Turkey encountered a fast fall in the primary balance and a significant increase in debt. The government responded by implementing fiscal policies (e.g., tax reductions, fiscal incentives, increases in public expenditures) to eliminate the unfavorable consequences of the crisis. The fall in

the primary balance was precluded from the beginning of 2009. Secondly, the gross public debt continues its increase until the end of 2009. This is due to the increased borrowing requirements of the private sector.
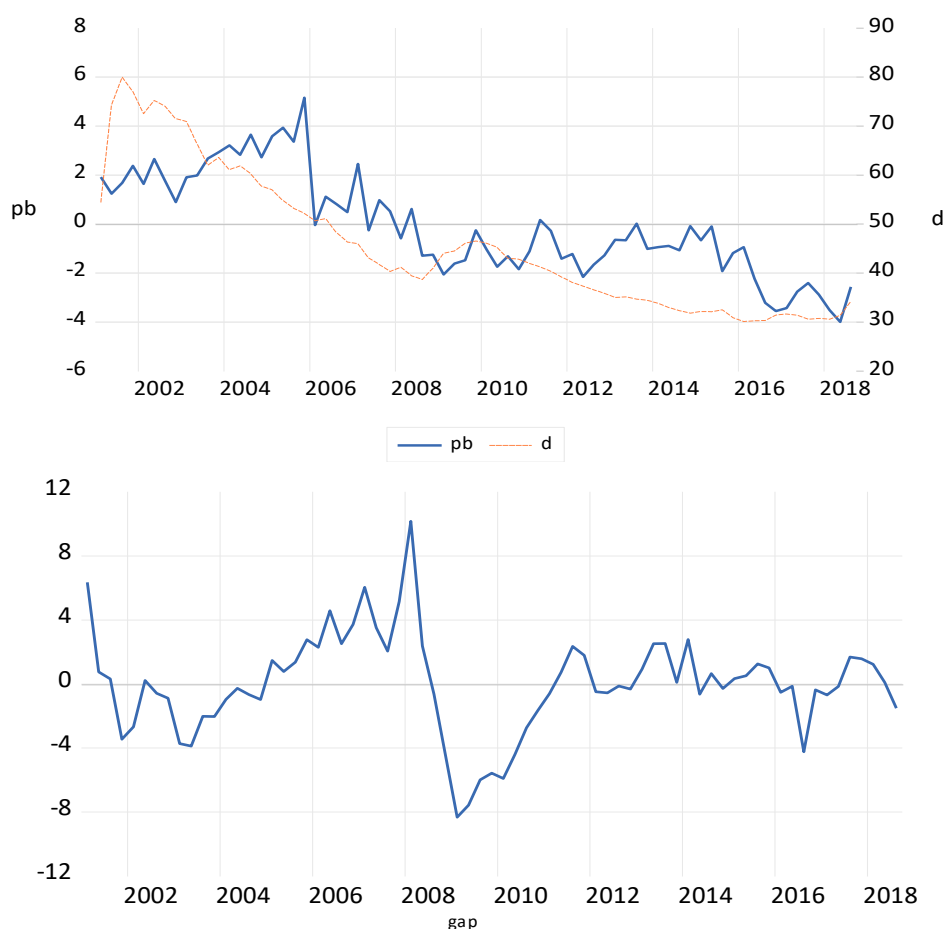

Figure 1. Turkey's primary balance (pb) (% of GDP), debt (d) (% of GDP) and output gap (gap) (% of potential GDP).

3.2. Model specification

The starting point of our model specification process is the simplest case of linear FRF proposed by Bohn (1998):

$$pb_t = \beta d_{t-1} + \varepsilon_t \tag{1}$$

In Equation (1), d_{t-1} is a one period lag of debt. The coefficient of β is expected to be positive and very small (i.e., below 0.10). By adding a set of stationary variables Z into Equation (1) to monitor the cyclical effects, we develop Equation (2):

$$pb_t = \beta_0 + \beta_1 d_{t-1} + \sum_i \phi_i Z_i + \varepsilon_t \tag{2}$$

The output gap, inflation, trade openness, implied interest rate, current account balance, and government expenditures are Z variables that can be included in Equation (2). In addition to the stationary variables, some empirical studies use dummy variables that represent elections, fiscal programs, crises or any other country-specific events (Everaert and Jansen, 2018; Di Iorio and Fachin, 2019).

Ghosh et al. (2013) made a significant contribution to the literature by proposing the non-linear specification of the FRF function, which accounts for the fiscal fatigue in the context of the cubic polynomial specification. Fiscal fatigue can be described as "the existence of mean reversion properties in the primary balance for high levels of public debt" (Checherita-Westphal and Žďárek, 2017). The baseline cubic specification of the non-linear FRF function is as follows:

$$pb_t = \beta_0 + \beta_1 d_{t-1} + \beta_2 d_{t-1}^2 + \beta_3 d_{t-1}^3 + \varepsilon_t \tag{3}$$

The fiscal fatigue proposition is met if $\beta_3 < 0$ in Equation (3). In this case, a slowing response of the primary balance to the rising debt is incurred. In parallel to the logic used in the linear FRF, the non-linear FRF in Equation (3) can be expanded to develop Equation (4):

$$pb_t = \beta_0 + \beta_1 d_{t-1} + \beta_2 d_{t-1}^2 + \beta_3 d_{t-1}^3 + \sum_i \phi_i Z_i + \varepsilon_t \tag{4}$$

Following the recommendations in Ermini and Granger (1993) and Di Iorio and Fachin (2019), for the linear long-run FRF, pb_t and d_t must satisfy the balanced equation conditions. These conditions can be summarized as: (i) pb_t and d_t must be in the same order of integration, and (ii) pb_t and d_t must depend on the linear trends of the same order. If it is necessary to extend these conditions to the non-linear FRF, it should be investigated as to whether or not polynomial transformations like Equations (3) and (4) will have a polynomial time trend and autocorrelations similar to those of an I (1) process. Briefly, if pb_t and d_t have the same order of integration and deterministic structure, the linear model will be the appropriate specification. If they have the same order of integration, but a different deterministic structure, a non-linear specification will be more suitable.

We continued our model specification process by checking the balanced equation conditions for the linear FRF. This involved conducting unit root tests to determine the integration order of pb_t and d_t Table 3 illustrates the Augmented Dickey-Fuller (ADF) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test results. The test results indicate that both variables are I(1).[†]

[†] We performed the Zivot Andrews unit root tests with a structural break in both the intercept and trend for the "d" variable. The results show that "d" variable is I(1).

Table 3. Unit Root and Stationarity Tests.

		ADF	KPSS
pb	C	−0.475	0.904***
	C&T	−2.864	0.090*
Δpb	C	−6.856***	0.043
	C&T	−6.823***	0.042
d	C	−0.796	0.976***
	C&T	−2.611	0.198**
Δd	C	−11.929***	0.133
	C&T	−12.305***	0.138

Note: The lag length is automatically selected by the Schwarz Information Criterion (SIC) for ADF tests.

The bandwidth is automatically selected by the Newey-West procedure for KPSS tests.

***significant at 0.01, **significant at 0.05, and * significant at 0.10

C: with constant; C&T: with constant and trend

The deterministic structure of the variables is analyzed to determine whether it is compatible or not. For this purpose, AR (8) models in differences are estimated with a constant and a trend. The estimation results are presented in Tables 4 and 5. The results reveal that, unlike pb_t, d_t has a significant positive drift. This implies that the variables do not have the same deterministic structure. Thus, we use the long-run non-linear FRF from Equations (3) and (5).[‡]

$$pb_t = \beta_0 + \beta_1 d_{t-1} + \beta_2 d_{t-1}^2 + \beta_3 d_{t-1}^3 + \phi gap + \varepsilon_t \tag{5}$$

We estimate the FRF parameters by using FM-OLS regression. FM-OLS regression was created by Phillips and Hansen (1990) to ensure optimal estimates of cointegration regressions. The method changes the least-squares that take into account the effects of serial correlation and endogeneity in the regressors resulting from the presence of the cointegration relationship. FM-OLS is used in models with cointegrated I(1) regressor. The limit theory for FM estimates of the stationary regressors is equal to that of OLS, while the FM estimates of non-stationary regressors keep their optimality. This feature is shared by the FM-OLS estimator when OLS estimates of fixed components are optimal. FM-OLS can be applied even in models with stationary regressors and in this case, has the same limit theory as OLS (Phillips, 1995).

[‡] We tried to use other variables in the FRF (e.g., implied interest rate, inflation, current account balance, trade openness, output gap in the FRF). However, we couldn't find any statistically significant coefficients for the variables, except for the output gap.

Table 4. Primary Balance: AR Models with a Constant and a Trend.

Δpb	AR(8)		Best Specification	
	Coefficient	Standard Error	Coefficient	Standard Error
Constant	−0.029	0.159	−0.026	0.456
Trend	−0.001	0.004	−0.001	0.003
AR(1)	−0.432***	0.141	−0.475***	0.117
AR(2)	−0.029	0.152	−0.094	0.130
AR(3)	−0.105	0.151	−0.168	0.130
AR(4)	−0.434***	0.151	−0.462***	0.116
AR(5)	0.122	0.152		
AR(6)	0.133	0.153		
AR(7)	−0.055	0.154		
AR(8)	−0.103	0.140		

Note: ***significant at 0.01, **significant at 0.05, and * significant at 0.10.

Table 5. Debt: AR Models with a Constant and a Trend.

Δd	AR(8)		Best Specification	
	Coefficient	Standard Error	Coefficient	Standard Error
Constant	−1.606***	0.473	−1.699***	0.359
Trend	0.027***	0.011	0.029***	0.009
AR(1)	0.146	0.141	0.037	0.118
AR(2)	0.113	0.140	−0.084	0.064
AR(3)	0.147	0.140		
AR(4)	−0.247	0.131		
AR(5)	0.050	0.123		
AR(6)	0.042	0.124		
AR(7)	−0.013	0.117		
AR(8)	−0.083	0.060		

Note: ***significant at 0.01, **significant at 0.05, and * significant at 0.10.

4. Empirical results

The FM-OLS estimation results of the long-run non-linear FRF, with and without gap_t, are presented in Table 6.[§] The estimated coefficients of β_1 and β_3 are negative. β_2 has a positive sign. All of these variables are statistically significant. The diagnostic tests illustrate that the model is adequately specified. According to the Phillips–Ouliaris Cointegration test results, the null hypothesis of no co-integration is rejected. The findings suggest the presence of a fiscal fatigue phenomenon in Turkey. The X-Y plot of the FRF, based on the estimation results for Turkey, is displayed in Figure 2. As can be seen from Figure 2, FRF plot has a sinusoidal shape. This plot also provides evidence of the fiscal fatigue phenomenon. The primary balance has a minimum value at

[§] We tried to include some other variables (e.g., inflation, trade openness, current account balance, interest rate) in the fiscal reaction function. However, we did not obtain any statistically significant results.

about the debt level of 30% and a maximum value at about 80%. It begins to decrease after the maximum value is achieved and reaches negatives values at about the debt level of 110%.

Table 6. Long Run Non-Linear Fiscal Reaction Function, FM-OLS Estimates.

	Coefficient	Standard Error	Coefficient	Standard Error
cons	11.655*	9.299	15.320*	10.483
d_{t-1}	−1.136**	0.580	−1.369***	0.654
d_{t-1}^2	0.028***	0.012	0.033***	0.013
d_{t-1}^3	−0.0002***	0.0001	−0.0002***	0.0001
gap_t	0.186***	0.057		
Diagnostic Tests				
$AdjR^2$	0.75		0.68	
Jarque − Bera Normality	1.113		2.534	
$Q^2(4)$	4.488		2.814	
$Q(4)$	3.573		1.895	
Phillips − Ouliaris Cointegration Test	−5.943***		−4.849***	

Note: ***significant at 0.01, **significant at 0.05, and * significant at 0.10.
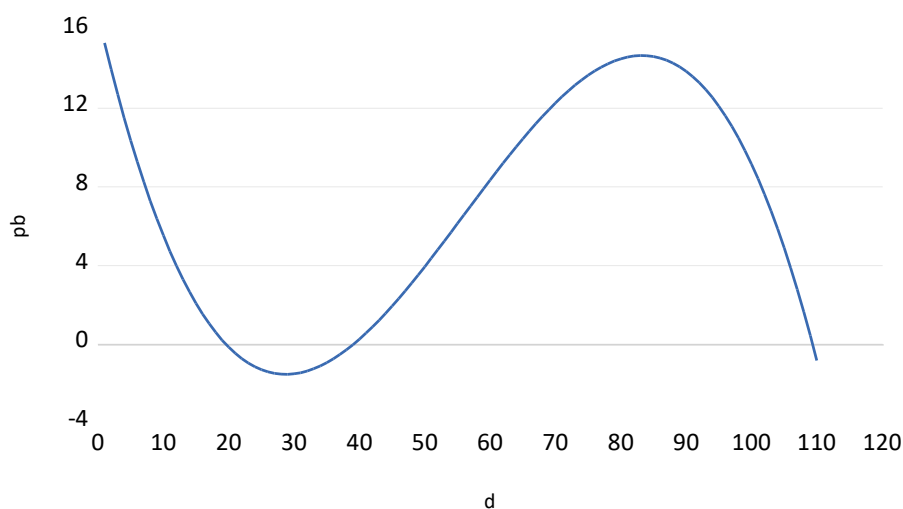

Figure 2. Estimated Non-Linear Fiscal Reaction Function.

5. Robustness check

It is possible to check the robustness of the results from the non-linear FRF. We used the following threshold model, instead of the cubic specification of the FRF, for this purpose:

$$pb_t = \beta_0 + \beta_1 d_{t-1} + (\alpha_0 + \alpha_1 d_{t-1})I(d_{t-1} > \tau) + \phi gap + \varepsilon_t \qquad (6)$$

where I$(.)$ is a regime indicator defined by d_{t-1}. If d_{t-1} is above the estimated threshold level of τ, the $(\alpha_0 + \alpha_1 d_{t-1})$ part of Equation (6) will be active. Otherwise, the equation will turn into a simple linear model. It is obvious that the τ value is unknown at the beginning of the analysis. It is also estimated with other parameters during the estimation process. To confirm the presence of a fiscal fatigue phenomenon, the debt should have a positive effect on the primary balance until a certain threshold value in the low debt regime. This relationship should become negative in a high debt regime. Thus, it is expected that we will estimate a statistically significant positive β_1 and a negative $(\beta_1 + \alpha_1)$.

The estimation results of the threshold model are reported in Table 7. The estimated threshold value of τ is 53.208%, in the low debt regime, the lagged debt positively affects the primary balance with a significant coefficient value of 0.125. On the other hand, the primary balance is negatively affected by the lagged debt in the high debt regime with a significant coefficient of −0.056. The findings from the threshold model estimation confirm the fiscal fatigue phenomenon.

Table 7. Threshold Model Estimates.

	Coefficient	Standard Error
$const$	−5.950***	0.754
d_{t-1}	0.125***	0.019
$const_{I(d_{t-1}>\tau)}$	6.475***	1.655
$d_{t-1_{I(d_{t-1}>\tau)}}$	−0.056**	0.025
gap_t	0.160**	0.036
$threshold(\tau)$	53.208**	

Note: ***significant at 0.01, **significant at 0.05, and * significant at 0.10.

6. Conclusions

Countries continually strive to obtain sustainable budgets and sustainable debt. Countries need both fiscal and monetary policy assistance in accordance with the cyclical structure to solve economic problems, especially during crisis times. With the recent global financial crisis (2018), the credibility and fiscal risks of countries have become questionable. Hence, it is very important for countries to have a solid budget balance and a sustainable debt stock. FRFs are effective instruments for determining debt limits and the primary balance's response to debt. The phenomenon of fiscal fatigue, related to debt sustainability, is described as the failure of the primary balance to meet interest payments at high debt levels.

In this study, fiscal fatigue in Turkey is investigated using quarterly data for the period of 2001–2018. FM-OLS and threshold models are used to analyze the data. The results reveal the presence of the fiscal fatigue phenomenon in Turkey. In the literature, some empirical studies have the results in parallel with ours. For example, Gosh et al. (2013) have provided evidence of fiscal fatigue in some developed countries. Medeiros (2012) in the European Union countries; Legrenzi and Milas (2013) in the euro area; Fournier and Fall (2015) in Greece; Di Iorioa and Fancin (2019) in Greece; Roberton and Tambakis (2016) in Italy; Everaert and Jansen (2018) in Denmark, Portugal, and Japan have found the results that support fiscal fatigue phenomenon. Berti et al. (2016) pointed out that risks

of fiscal fatigue would be considered low in Germany, but the Czech Republic, Lithuania, and Slovakia were identified being at risk of fiscal fatigue. The primary balance has a minimum value at about the debt level of 30%. The maximum value occurs at the debt level of 80%. The primary balance started to decrease after reaching the maximum value. It reached negative values at a debt level of approximately 110%. The results of the threshold model have confirmed the findings of the FM-OLS model. In the low debt regime, the lagged debt positively (0.125) affects the primary balance, whereas in the high debt regime, the effect is negative (−0.056).

The empirical findings reveal that it is possible to propose policy implications for Turkey. More specifically, Turkey should define a tight fiscal policy without political pressure to increase credibility and overcome the economic downturn. While implementing a tight fiscal policy, primary surplus targeting, which is one of the fiscal rules, can be adopted in a manner consistent with the cyclical periods. The existence of such a rule can be helpful for both the debt and fiscal sustainability.

Also, Turkey should carry out structural fiscal reforms as soon as possible to be able to borrow in favorable conditions and adjust the optimal debt level. Political reforms (e.g., the superiority of law, freedom of thought) should be realized. The tax system should be reorganized and the share of indirect taxes should be decreased.

In this context, debt and budget offices can be established within the Ministry of Finance and Treasury for the purpose of specialization and focusing. In conclusion, although positive achievements can be reached through reforms in institutional and economic structures, these measures may be time-consuming and difficult for policymakers to implement.

Acknowledgments

Conflict of interest

The author declares that the submitted paper is not associated with any kind of conflict of interest.

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