Chapter 4

Optimal Government Size in Turkey: Insights from Fourier Augmented ARDL

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Abstract

This study investigates the optimal size of government in Turkey using annual data for the period 1960-2022. At the same time, the Armey/BARS Curve hypothesis, which implies a quadratic relationship between public expenditures and economic growth, is tested. The research employs Fourier-based econometric techniques. While investigating the optimal government size or the validity of the Armey/BARS Curve hypothesis, trade openness, labor, and capital factors, which are the determinants of economic growth, are also considered. According to the findings, the Armey/BARS Curve hypothesis is valid in Turkey. The optimal government size is 20.74% in the basic model, 23.57% in the labor model, 21.80% in the capital model, 21.42% in the trade openness model, and 23.63% in the comprehensive model, where all factors are combined. The average of all models is 22.23%. In terms of government size, considering that the public expenditure (%GDP) data for 2022 is 28.05%, Turkey has a share above the optimal government size estimates put forward by this study.

1. Introduction

Although it is an ancient debate whether the existence of the government in economic life is a blessing or a curse, it does not seem possible to say or claim that a consensus has been reached yet. However, in actuality, the government is expected to fulfill various economic, social, and political expectations through public expenditures. Over time, these expectations/demands have affected the level of public expenditures depending on factors such as the increase in economic welfare, globalization, and social and demographic changes (Serin and Demir, 2023; Yurdadog et al., 2022).

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Considering that public expenditures (%GDP) are mostly used as a proxy variable in the literature as a measure of the share of the government in the economy, the government size (GS) varies over time and conditions. In this respect, it is an important research area to address the effects of the GS on the economic growth (EG) and to investigate whether there is an optimal level.

There is no consensus in the literature on economics in general and public economics specifically about the relationship between EG and GS. However, Barro (1990), one of the pioneers of endogenous growth models, emphasizes in his impressive study that public policies (public expenditures and taxes) will affect EG by accepting them as production inputs. The Barro model suggests that public services provided by the government (such as infrastructure, security, logistics, communication, judiciary, etc.) will positively affect private sector productivity and thus EG by emitting positive externalities, but emphasizes that as the GS increases (more tax requirements and the distorting effect of taxes), the externality becomes negative and thus damages EG. Therefore, in a sense, this model, which implies a non-linear relationship between GS and EG, is a milestone in the 'optimal GS' literature. Then, Armey (1995) introduced a quadratic function to explain the relationship between optimal GS and EG. In this approach, called the 'Armey Curve' in the empirical and theoretical literature, there is an inverted U-shaped relationship between GS and EG. Accordingly, while the GS positively influences EG up to a specific point, this effect reverses after a turning point. Such a proposition is related to the optimal GS and is consistent with Barro's model. Following the work of Barro (1990) and Armey (1995), the literature on optimal GS continued to develop with the contributions of Rahn and Fox (1996) and Scully (1994). According to Şen and Kaya (2019), the theoretical and empirical contributions of these pioneering studies, which addressed the relationship between EG and GS, paved the way for the subject to become more popular and controversial. In the literature on optimal GS, researchers define the "BARS" curve in honor of the aforementioned pioneer authors.

There is a considerable number of international and national studies on the 'Armey/BARS Curve' or optimal GS in the related empirical literature. Although empirical studies have confirmed the validity of the Armey/BARS curve hypothesis, they have reached different conclusions on the optimal GS. A similar situation is also valid for the studies on Turkey. However, researchers often neglect other determinants of EG when testing the related hypotheses. Within this scope, this investigation aims to contribute to the literature by testing the aforementioned hypothesis and revealing the optimal

GS that considers the main determinants of EG, such as labor, capital, and trade openness. Moreover, while doing so, it is planned to minimize biased results and produce reliable results by following an econometric methodology that considers structural breaks, which most researchers neglect. In sum, this paper aims to test the validity of the Armey/BARS curve hypothesis in Turkey under the main determinants of EG and structural breaks and to provide optimal GS calculations based on alternative models.

The study's sections include the empirical literature review, model and methodology, empirical findings, and conclusions.

2. Evaluation of the Literature

The empirical literature review consists of two parts. In the first stage, international studies investigating the Armey/BARS Curve hypothesis or optimal GS are discussed (Table 1). Then, empirical studies on Turkey (Table 2) are evaluated.

The common finding of the international studies in Table 1 implies that there is a limit to public expenditures in terms of promoting EG. In other words, empirical investigations agree on the validity of the Armey/BARS Curve hypothesis, regardless of the sample. Therefore, the existence of an optimal GS is accepted. However, there are different GS for different and similar samples. For example, in studies on the European Union using the panel data method, Karras (1997) offered an estimate between 13% and 18%, while Forte and Magazzino (2011), Mutascu and Milos (2009), and Pevcin (2004) estimated the optimal GS between 30.42% and 42.12%. If this heterogeneity is considered in terms of a large sample, Karras (1996) and Asimakopoulos and Karavias (2016) found the optimal GS to be 23% (118 countries) and 18.03% (129 countries), respectively. In terms of optimal GS, estimates such as 9% in 5 Gulf countries (Aly and Strazicich, 2000), 11% in Romania (Olaleye et al. 2014), and 11.89% in India (Jain and Sinha, 2022) are quite interesting. In summary, while the international empirical literature strongly supports that there is a limit to GS, it does illustrate that one size does not fit all.

Table 1. Summary of Literature for the International Sample

Author(s)	Sample	Method	Armey/ BARS Curve Hypothesis	Optimal GS
Karras (1996)	118 Country 1960-1985	Panel Data	✓	%23 (118 Country) %20 (Afrika) %16 (N.America) %33 (S. America) %25 (Asia) %18 (Europe)
Karras (1997)	20 EU Countries 1950-1990	Panel Data	✓	%13-%18
Aly and Strazicich (2000)	5 Gulf Countries 1970-1992	Panel Data	✓	%9
Pevcin (2004)	12 EU Countries 1950-1996	Panel Data	✓	%36.56-%42.12
Mutascu and Milos (2009)	15 EU ve 12 New EU Countries 1999-2008	Panel Data	✓	%30.42 (15 EU Countries) %27.46 (12 New EU Countries)
Facchini and Melki (2011)	France 1871-2008	OLS	✓	%28-%29
Forte and Magazzino (2011)	EU Countries 1970-2009	Difference GMM	✓	%37.29
Olaleye et al. (2014)	Romania 1983-2012	Johansen Cointegration	✓	%11
Asimakopoulos and Karavias (2016)	129 Countries 1980-2009	Dynamic Panel Threshold Regression	✓	%18.03 (129 Country) %19.12 (Developing) %17.96 (Developed)
Makin et al. (2019)	Australia 1970Q1-2017Q3	ARMAX	✓	%31
El Husseiny (2019)	Egypt 1981-2015	Johansen Cointegration	✓	%30.5-%31.2
Bozma et al. (2019)	G-7 1981-2014	ARDL	✓	%12.46 (USA) %23.57 (France) %18.93 (Canada)
Nouira and Kouni (2021)	15 MENA ve 21 Developing Countries 1988-2016	CS-ARDL CS-DL	✓	%10-%30 (All Sample) %20-%30 (MENA) %10-%20 (Developing)
Al-Abdulrazag (2021)	Saudi Arabia 1971-2019	ARDL	✓	%26.9
Jain and Sinha (2022)	India 1961-2018	ARDL	✓	%11.89
Zungu and Greyling (2022)	10 African Countries 1988-2019	Panel Smooth Transition Regression	✓	%27.84

Table 2. Literature Review for Turkey

Author(s)	Sample	Method	Armey/ BARS Curve Hypothesis	Optimal GS
Altunç and Aydın (2012)	1975-2010	Engle-Granger Cointegration	✓	%15.8
Altunç and Aydın (2013)	1995-2011	ARDL	✓	%25.21
Turan (2014)	1970-2012	OLS	✓	%15.4
Başar et al. (2016)	1960-2015	Maki Cointegration	✓	%23.6
Pamuk and Dündar (2016)	1950-2006	Johansen Cointegration	✓	%23.5
İyidoğan and Turan (2017)	1998Q1–2015Q1	Threshold Regression	✓	%16.5
Yamak and Erdem (2018)	1998Q1-2016Q2	ARDL	✓	%16
Yüksel (2019)	1981-2008	ARDL	✓	%16
Şen and Kaya (2019)	2006Q1-2016Q2	Threshold Autoregressive Model	✓	%25
Altunakar and Buyrukoğlu (2020)	1980-2019	ARDL	✓	%19.1
Kalabak et al. (2021)	1960-2019	OLS	✓	%26.04
Yıldız and Demirkılıç (2022)	1970-2020	ARDL	✓	%23.84
Durucan (2022)	1974-2016	ARDL	✓	%23.85
Kasal (2023)	1998Q1-2020Q4	Fourier Shin Cointegration	✓	%18.5
Toptaş (2024)	1991-2021	ARDL	✓	%12.62

The empirical analyses in Table 2 for Turkey agree on the validity of the Armey/BARS Curve hypothesis. This finding implies the existence of optimal GS in Turkey in terms of EG. However, calculations of the optimal GS vary. While the lowest rate is 12.62% (Toptaş, 2024), the highest rate is 26.04% (Kalabak et al., 2021). The average of the empirical literature is 20.06%. While a significant portion of the researchers utilized the ARDL method, traditional cointegration methods and the least squares method were used in some studies. Only Başar et al. (2016) and Kasal (2023) take structural breaks into account. However, researchers have primarily focused on the optimal GS while neglecting other determinants of EG. A few studies (e.g., Turan, 2014; İyidoğan and Turan, 2017; Kasal, 2023) have addressed this issue.

Apart from these, in empirical studies on Turkey, Altunç and Aydın (2012) and Iyidogan and Turan (2017) addressed the issue in terms of current, transfer, and investment expenditures as well as total expenditures. They provided evidence for the validity of the Armey/BARS curve in terms of current and transfer expenditures. Şen and Kaya (2019) and Durucan (2022) also tested the validity of the Armey/BARS curve hypothesis by considering the composition of public expenditures.

3. Model and Methodology

This study aims to analyze the optimal GS in Turkey by using annual data from 1960-2022. Accordingly, details regarding the data sources and empirical models employed in the study are provided in Table 3 and equations (1-5), respectively.

Table 3. Data Sources

Variables	Symbol	Measure	Source
Economic Growth	GDP	Per Capita (2015 $ Constant Prices)	WDI
Public Expenditure	GOV	%GDP	IMF
Employment	LAB	Million Persons	PWT and IMF[2]
Gross Fixed Capital Formation	GFIX	%GDP	WDI
Trade Openness	TOP	%GDP	WDI

$$\ln gdp_t = \beta_0 + \beta_1 \ln gov_t + \beta_2 \ln gov^2{}_t + \varepsilon_t \tag{1}$$

$$\ln gdp_t = \beta_0 + \beta_1 \ln gov_t + \beta_2 \ln gov^2{}_t + \beta_3 \ln lab_t + \varepsilon_t \tag{2}$$

$$\ln gdp_t = \beta_0 + \beta_1 \ln gov_t + \beta_2 \ln gov^2{}_t + \beta_3 \ln gfix_t + \varepsilon_t \tag{3}$$

$$\ln gdp_t = \beta_0 + \beta_1 \ln gov_t + \beta_2 \ln gov^2{}_t + \beta_3 \ln top_t + \varepsilon_t \tag{4}$$

2 Since employment data for the period analyzed by the study is available in Penn World Tables until 2019, data for the 2020-2022 period were obtained from the IMF, which is compatible with the relevant database.

$$\ln gdp_t = \beta_0 + \beta_1 \ln gov_t + \beta_2 \ln gov^2{}_t + \beta_3 \ln lab_t + \beta_3 \ln gfix_t + \beta_3 \ln top_t + \varepsilon_t \quad (5)$$

Coefficients β_1 and β_2 in Equations (1-5) represent the coefficients of public expenditures and the square of public expenditures, respectively. ε_t and β_0 denote error term and constant coefficient, respectively. Equation (1) tests the validity of the Armey/BARS Curve hypothesis or the optimal GS, which researchers traditionally use. However, excluding other determinants of EG may lead to biased results. In this context, testing the relevant hypothesis within the scope of labor, capital, and trade openness, which are the main determinants of EG, will provide a more accurate approach. There are also studies in the empirical literature that pay attention to this point by including trade openness (Turan, 2014; Asimakopoulos and Karavias, 2016; El Husseiny, 2019; Zungu and Greyling, 2022; Kasal, 2023), capital (Karras, 1996); Karras, 1997; Aly and Strazicich, 2000; Zungu and Greyling, 2022) and labor (Asimakopoulos and Karavias, 2016; El Husseiny, 2019) in the model in equivalence (1). Accordingly, the validity of the Armey/BARS Curve hypothesis is investigated by including the relevant variables separately in the basic model in equations (2-4). Moreover, as shown in equation (5), an approach that considers all these factors together is followed. In this way, the effect of other factors on the calculation of the optimal GS is taken into account, and the findings can be compared with each other, and robustness results are presented.

The Fourier-based econometric methodological framework is followed to analyze these models. One of the most important issues in time series analyses is structural breaks. In particular, economic crises, political tensions, or undesirable disasters that may occur in a country may affect the structure of the series. In this context, taking smooth structural breaks into account using Fourier terms allows more reliable and sensitive results to be produced (Aydin and Bozatli, 2023).

In the first step of the analysis, the unit root properties of the series are investigated. Enders and Lee (2012), who provide a unit root test that enables consideration of smooth structural breaks in the series, create a deterministic term that can catch it's using sine and cosine functions, as illustrated below:

$$\alpha(t)=\alpha_0+\gamma_1\sin\left(\frac{2\pi kt}{T}\right)+\gamma_2\cos\left(\frac{2\pi kt}{T}\right) \quad (6)$$

where k stands for Fourier terms. The Fourier ADF (FADF) unit root test is formed by including the deterministic term in the conventional ADF equation.

$$\Delta y_t = \alpha_1 + \delta t + \beta y_{t-1} + \gamma_1 \sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) + \sum_{i=1}^{p} \vartheta_i \Delta y_{t-i} + u_t \qquad (7)$$

Enders and Lee (2012) propose a two-phase implementation of the FADF test. In the first phase, the model with the lowest sum of residual squares is selected for estimating $1 \leq k \leq 5$. In the second phase, the significance of the deterministic terms is investigated using the F-test. If it is significant, the FADF results can be trusted. Otherwise, they suggest resorting to the traditional ADF process.

Due to the flexibility, it provides in empirical analyses (such as mixed integration of independent variables under the assumption that the dependent variable is I(1)), researchers frequently use the ARDL model developed by Pesaran et al. (2001). In the ARDL model, as suggested by Pesaran et al. (2001), the dependent variable should be I(1), and the validity of the t-limits test should be considered. If the points they emphasize are not considered, degenerate cases may arise, leading to incorrect results (Sam et al., 2019). Therefore, to overcome the above-mentioned problems, McNown et al. (2018) and Sam et al. (2019) proposed the F-test for independent variables in addition to the two tests. These three test statistics used to determine the cointegration relationship in a model with four independent variables to explain the hypothetical dependent variable can be expressed as follows:

a) $F-overall \mid H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$

b) $t-dependent \mid H_0 : \beta_1 = 0$

c) $F-independent \mid H_0 : \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$

The test constraints denoted as a and b here are the general F- and t-tests proposed by Pesaran et al. (2001). The other one is the F-independent test proposed by Sam et al. (2019). All three test statistics calculated for the existence of a cointegration relationship are required to be greater than the critical values presented by Narayan (2005), Pesaran et al. (2001), and Sam et al. (2019), respectively. Otherwise, degenerate cases occur, and the cointegration is invalid (Akça, 2021; Sam et al., 2019). In order to investigate the long-run relationship stated in equations (1-5), Pesaran et al. (2001) suggested the below ARDL model:

$$\Delta y_t = \alpha_0 + \sum_{i=1}^{p-1}\alpha_i \Delta y_{t-i} + \sum_{i=1}^{p-1}\gamma_i \Delta x_{t-i} + \sum_{i=1}^{p-1}\delta_i \Delta z_{t-i} + \sum_{i=1}^{p-1}\upsilon_i \Delta \ln w_{t-i} + \sum_{i=1}^{p-1}\delta_i \Delta \ln q_{t-i} + \beta_1 y_{t-1} + \beta_2 x_{t-1} + \beta_3 z_{t-1} + \beta_4 w_{t-1} + \beta_5 q_{t-1} + v_t \quad (8)$$

where α_0 is the constant term and v_t is the error term. $\alpha_i, \gamma_i, \delta_i, \upsilon_i, \delta$ and $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ denote the short and long run coefficients, respectively. However, a significant drawback of the Augmented ARDL approach is that it ignores structural changes. To overcome this problem, Fourier terms are included in the extended ARDL model following the approaches of Syed et al. (2023), Bozatli and Akca (2024), and Aydin et al. (2024), and smooth structural breaks are modeled.

$$\Delta y_t = \alpha_0 + \sum_{i=1}^{p-1}\alpha_i \Delta y_{t-i} + \sum_{i=1}^{p-1}\gamma_i \Delta x_{t-i} + \sum_{i=1}^{p-1}\delta_i \Delta z_{t-i} + \sum_{i=1}^{p-1}\upsilon_i \Delta \ln w_{t-i} + \sum_{i=1}^{p-1}\delta_i \Delta \ln q_{t-i} + \beta_1 y_{t-1} + \beta_2 x_{t-1} + \beta_3 z_{t-1} + \beta_4 w_{t-1} + \beta_5 q_{t-1} + \beta_6 \sin\left(\frac{2\pi kt}{T}\right) + \beta_7 \cos\left(\frac{2\pi kt}{T}\right) + e_t \quad (9)$$

If the cointegration relationship and model assumptions (such as autocorrelation, heteroscedasticity, normality) are met, the long-run coefficients for the models in equations (1-5) are estimated by the Fourier-based ARDL method.

4. Empirical Findings

In the first stage of the empirical analysis, the series' unit root properties were tested using the FADF method. The findings are presented in Table 4.

Table 4. Unit Root Tests

	FADF				ADF		ADF with break	
Variables	**I(0)**	**k(p)**	**I (1)**	**k(p)**	**I(0)**	**I(1)**	**I(0)**	**I(1)**
GDP	-4.002	1(0)	-7.852*	1(0)	-1.783	-7.763*	-3.470	8.511*
GOV	-3.063	2(2)	-5.193*	2(1)	-2.009	-9.381*	-3.808	-10.494*
GOV^2	-3.199	2(2)	-4.996*	2(1)	-1.909	-8.789*	-3.825	-9.720*
TOP	-4.553**	1(1)	-	-	-3.275***	-	-6.944*	-
GFIX	-4.399*	4(0)	-	-	-4.000**	-	-4.776***	-
LAB	-3.163	2(0)	-6.916*	5(0)	-2.010	-6.498*	-3.571	-7.648*

Notes:* *, ** and *** indicate that the null hypothesis is rejected at 1%, 5% and 10% significance level, respectively. Optimum lag lengths (p) are chosen using SIC. k denotes the frequency number of Fourier terms.

The FADF findings in the unit root tests in Table 4 reveal that trade openness and gross fixed capital investment series are stationary at the level. At the same time, the other variables are stationary at first difference. However, since the F-test applied to the series was statistically insignificant, the conventional ADF test procedure was followed. However, the results remain unchanged. Moreover, the initial results are confirmed when the ADF test with a sudden break is applied to the series. Accordingly, since the condition that the dependent variable is I(1) while the other variables are not I(2) is met, the Fourier Augmented ARDL procedure is applied, and the findings are reported in Table 5:

Table 5. Cointegration Tests

Fourier Augmented ARDL Bound Test					
Model		**F-general**	**t-dependent**	**F-independent**	**Result**
Model 1		12.085*	-5.065*	4.463***	✓
Model 2		10.071*	-5.119*	3.994***	✓
Model 3		22.349*	-6.474*	18.102*	✓
Model 4		10.495*	-5.181*	4.419*	✓
Model 5		20.134*	-7.242*	15.895*	✓
Diagnostic Tests					
Model		**LM**	**HET**	**NORM**	**Cusum and CusumSq**
Model 1	0.597 (0.990)	0.502 (0.608)	0.771 (0.642)	0.019 (0.990)	Stable Stable
Model 2	1.862 (0.178)	1.180 (0.316)	0.644 (0.768)	0.053 (0.973)	Stable Stable
Model 3	0.811 (0.372)	0.359 (0.700)	1.422 (0.190)	1.160 (0.559)	Stable Stable
Model 4	1.496 (0.141)	1.670 (0.200)	1.012 (0.456)	1.719 (0.423)	Stable Stable
Model 5	0.339 (0.563)	1.497 (0.236)	1.265 (0.261)	0.940 (0.624)	Stable Stable

Notes: * ***and*** *** ***indicate statistical significance at 1% and 10% levels, respectively. Probability values are shown in parentheses. The lower and upper bounds for the critical values for F-general, t-dependent and F-independent statistics are given in Narayan (2005), Pesaran et al. (2001) and Sam et al. (2019), respectively.***

The findings in Table 5 imply that the cointegration relationship is valid in all models. Diagnostic tests also show that the necessary assumptions of the ARDL model are met. Accordingly, it is determined that the normal distribution is provided, there is no autocorrelation and heteroscedasticity problem, and the functional form is significant. Moreover, the Cusum and Cusumsq test results (in Figures A1-A5 in the Appendix) indicate that the models are stable. Therefore, there is no obstacle in calculating the long-run relationship. The models presented in equations (1-5) are estimated and reported in Table 6.

Table 6. Long Run Relationship Estimation with Fourier Augmented ARDL

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
GOV	0.927^{*} (2.832)	0.785^{*} (2.974)	0.418^{**} (2.033)	1.076^{*} (3.356)	0.589^{*} (3.425)
GOV^2	-0.152^{*} (-2.851)	-0.124^{*} (-2.841)	-0.067^{**} (-2.033)	-0.174^{*} (-3.366)	-0.093^{*} (-3.276)
LAB		0.212^{***} (1.954)			0.161^{**} (2.359)
GFIX			0.170^{*} (4.412)		0.155^{*} (5.460)
TOP				0.051 (1.081)	-0.032^{***} (-1.839)
Optimal Goverment Size	%20.74	%23.57	%21.80	%21.42	%23.63

Note: *, ** ***and*** *** ***denote statistical significance at 1%, 5% and 10% significance level, respectively.***

The findings presented in Table 6 confirm the validity of the Armey/BARS Curve hypothesis in Turkey under all models. Accordingly, while public expenditures positively affect EG up to a certain point, this effect reverses after a turning point. While the optimal GS is 20.74% in the baseline model, this value is higher in all other models where other factors are considered. In the models where labor, capital, and trade openness are considered separately, the optimal GS is 23.57%, 21.80%, and 21.42%, respectively. In Model 5, where all factors are considered, the optimal GS is 23.63%. The average of all models shows that the optimal GS in Turkey is 22.23%.

Figure 1 compares the data on the GS (public expenditure % GDP) in Turkey from 1960-2022 with the forecasts obtained from this study. From

1960 to 1995, the GS remained below the estimated optimal GS (Model 5 and Average) or slightly above it and fell below it again. As of 1996, the GS in Turkey started to rise above the optimal point and reached its highest level in 2001. In the following period, the GS decreases in a way that converges to the optimal points.

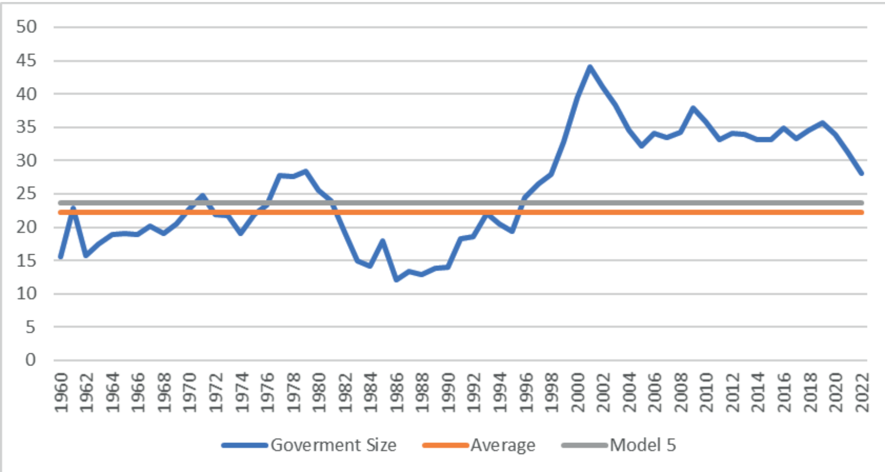


Figure 1. Optimal and Actual GS in Turkey

Figure 2 compares the findings of empirical studies on the optimal GS in Turkey, including the findings of this study, to evaluate the findings.

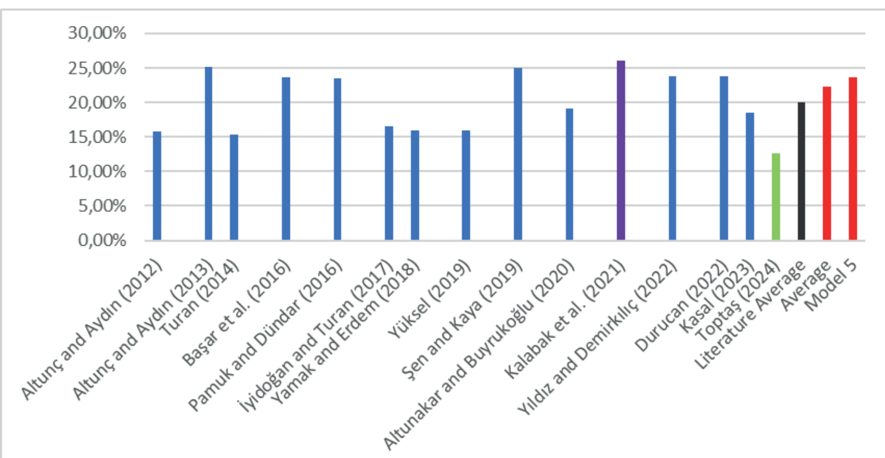


Figure 2. Optimal GS Calculations in Turkey

The lowest (12.62%) and highest (26.04%) estimates in empirical studies are put forward by Toptaş (2024) and Kalabak et al. (2021), while the average of empirical findings is 20.06%. The average and the most comprehensive results of this study in Model 5 suggest that the optimal GS in Turkey is 22.23% and 23.63%, respectively. Therefore, it is possible to say that the findings of this study are above the average of the empirical literature. However, it produces results that are individually estimated to be close to those of most empirical studies. The main reason for this is that this study, unlike the others, models other determinants of EG and follows a Fourier-based econometric methodology. Moreover, considering the model in equation (1), followed by the majority of the empirical literature, the threshold value of 20.74% is reached in this study. This is very close to the average of the empirical literature. However, it is believed that calculating the optimal GS by considering the role of labor and capital under the assumption of an open economy or testing the validity of the Armey/BARS Curve hypothesis would produce more inclusive/realistic results. There are numerous crises considering Turkey's economic, political, and fiscal history. In the empirical literature, only Başar et al. (2016) and Kasal (2023) consider sudden and smooth breaks, respectively. Accordingly, this study provides strengthened results regarding optimal GS by considering the main determinants of economic welfare and preferring an econometric methodology that allows modeling smooth structural breaks.

5. Conclusion

This study investigates the validity of the Armey/BARS Curve hypothesis in Turkey with Fourier-based econometric methods, and the optimal GS is calculated. In this context, five different models were designed. Evidence favoring the validity of the Armey/BARS Curve hypothesis is found in all models. However, the optimal GS may vary in the models. In the first model, following the traditional literature, only the relationship between GS and EG is considered. Accordingly, in the baseline model, the optimal GS in Turkey is 20.74%. In the other models, unlike the empirical literature, the main determinants of EG are considered. Accordingly, in three different models where the effects of labor, capital, and trade openness are considered, the optimal GS are 23.57%, 21.80%, and 21.42%, respectively. In the last model, all factors were considered together, and the optimal GS was found to be 23.63%. In the average of the five models, the optimal GS in Turkey is 22.23%. Considering that Turkey's public expenditure (GDP) in 2022 is 28.05%, the GS is above the optimal points calculated by this study. This harms economic welfare, ceteris paribus. Especially considering the expectation that the earthquake that occurred in 2023 will significantly increase public expenditures in the short/medium term (Serin et al., 2023), it is inevitable that the GS will increase further. Moreover, there is evidence that natural disasters cause significant increases in public expenditures (Melecky and Raddatz, 2011; Nishizawa et al., 2019). Therefore, policymakers should take measures to reduce the share of government in the economy and pursue policies that increase efficiency in public expenditures. Otherwise, public services for removing the earthquake damage and the reconstruction process may further push the GS away from the optimal point and negatively affect economic development. Future studies that investigate the optimal GS by considering the composition of public expenditures, other determinants of EG, and the impact of structural changes will provide important guidance to policymakers/researchers.

References

Akca, H. (2021). Environmental Kuznets Curve and financial development in Turkey: evidence from augmented ARDL approach. *Environmental Science and Pollution Research*, *28*(48), 69149-69159.

Al-Abdulrazag, B. (2021). The optimal government size in the kingdom of Saudi Arabia: an ARDL bounds testing approach to cointegration. *Cogent Economics & Finance*, *9*(1), 2001960.

Altunakar, Ş., & Buyrukoğlu, S. (2020). Türkiye'de Abrams ve Armey eğrilerinin geçerliliği. *Elektronik Sosyal Bilimler Dergisi*, *19*(76), 1862-1878.

Altunc, O. F., & Aydın, C. (2013). The relationship between optimal size of government and economic growth: Empirical evidence from Turkey, Romania and Bulgaria. *Procedia-Social and Behavioral Sciences*, *92*, 66-75.

Altunç, Ö. F., & Aydın, C. (2012). Türkiye'de kamu sektörü büyüklüğü ve ekonomik büyüme ilişkisinin ampirik analizi. *Ekonomik Yaklaşım*, *23*(82), 79-98.

Aly, H., & Strazicich, M. (2000). Is government size optimal in the gulf countries of the middle east? An empirical investigation. *International review of applied economics*, *14*(4), 475-483.

Armey, D. (1995). The Freedom Revolution, Washington, Regnery Publishing.

Asimakopoulos, S., & Karavias, Y. (2016). The impact of government size on economic growth: A threshold analysis. *Economics Letters*, *139*, 65-68.

Aydin, M., & Bozatli, O. (2023). The impacts of the refugee population, renewable energy consumption, carbon emissions, and economic growth on health expenditure in Turkey: new evidence from Fourier-based analyses. *Environmental Science and Pollution Research*, *30*(14), 41286-41298.

Aydin, M., Degirmenci, T., Bozatli, O., & Balsalobre-Lorente, D. (2024). Fresh evidence of the impact of economic complexity, health expenditure, natural resources, plastic consumption, and renewable energy in air pollution deaths in the USA? An empirical approach. *Science of the Total Environment*, *921*, 171127.

Barro, R. J. (1990). Government spending in a simple model of endogeneous growth. *Journal of political economy*, *98*(5, Part 2), 103-125.

Başar, S., Bozma, G., & Eren, M. (2016). Türkiye'de Kamu Harcamalarının Optimum Düzeyi Ne olmalıdır?. *Uluslararası Ekonomi Konferansı, Türkiye Ekonomi Kurumu, UEK-TEK*, 1799-1811.

Bozatli, O., & Akca, H. (2024). Does the composition of environmental regulation matter for ecological sustainability? Evidence from Fourier ARDL under the EKC and LCC hypotheses. Clean Technologies and Environmental Policy, 1-19.

Bozma, G., Başar, S., & Eren, M. (2019). Investigating validation of Armey curve hypothesis for G7 countries using ARDL model. *Doğuş Üniversitesi Dergisi*, *20*(1), 49-59.

Durucan, A. (2022). Testing the validity of the BARS curve for Turkey. *Economic Annals*, *67*(232), 153-192.

El Husseiny, I. A. (2019). The optimal size of government in Egypt: an empirical investigation. *The Journal of North African Studies*, *24*(2), 271-299.

Enders, W., & Lee, J. (2012). A unit root test using a Fourier series to approximate smooth breaks. *Oxford bulletin of Economics and Statistics*, *74*(4), 574-599.

Facchini, F., & Melki, M. (2011). Optimal government size and economic growth in France (1871-2008): An explanation by the State and market failures. https://shs.hal.science/halshs-00654363/

Forte, F., & Magazzino, C. (2011). Optimal size government and economic growth in EU countries. *Economia politica*, *28*(3), 295-322.

Iyidogan, P. V., & Turan, T. (2017). Government Size and Economic Growth in Turkey: A Threshold Regression Analysis. *Prague Economic Papers*, *2017*(2), 142-154.

Jain, N., & Sinha, N. (2022). Re-visiting the Armey curve hypothesis: an empirical evidence from India. *South Asian Journal of Macroeconomics and Public Finance*, *11*(2), 168-184.

Kalabak, A. Y., Karatepe, S. & Avunduk, O. (2021). Devletin Ekonomideki Boyutu Üzerine Ampirik Bir Analiz: 1960-2019 Türkiye Örneği. *Maliye Dergisi*, 181, 72-96.

Karras, G. (1996). The optimal government size: further international evidence on the productivity of government services. *Economic inquiry*, *34*(2), 193-203.

Karras, G. (1997). On the optimal government size in Europe: Theory and empirical evidence. *The Manchester School*, *65*(3), 280-294.

Kasal, S. (2023). Analysing the Armey curve based on the Fourier cointegration approach for Turkey. *Economic Annals*, *68*(236), 139-158.

Makin, A. J., Pearce, J., & Ratnasiri, S. (2019). The optimal size of government in Australia. *Economic Analysis and Policy*, *62*, 27-36.

McNown, R., Sam, C. Y., & Goh, S. K. (2018). Bootstrapping the autoregressive distributed lag test for cointegration. *Applied Economics*, *50*(13), 1509-1521.

Melecky, M. & Raddatz, C. E. (2011). How Do Governments Respond after Catastrophes? Natural-Disaster Shocks and the Fiscal Stance. Policy Research working paper, no. WPS 5564. https://hdl.handle.net/10986/3331

Mutascu, M., & Milos, M. (2009). Optimal size of government spending. The case of European Union member states. *Annales Universitatis Apulensis: Series Oeconomica*, *11*(1), 447.

Narayan, P. K. (2005). The saving and investment nexus for China: evidence from cointegration tests. *Applied economics*, *37*(17), 1979-1990.

Nishizawa, H., Roger, M. S., & Zhang, H. (2019). *Fiscal Buffers for Natural Disasters in Pacific Island Countries* (No. 2019/152). International Monetary Fund. https://www.imf.org/en/Publications/WP/Issues/2019/07/12/Fiscal-Buffers-for-Natural-Disasters-in-Pacific-Island-Countries-47011

Nouira, R., & Kouni, M. (2021). Optimal government size and economic growth in developing and MENA countries: A dynamic panel threshold analysis. *Middle East Development Journal*, *13*(1), 59-77.

Olaleye, S. O., Edun, F., Bello, H. T., & Taiwo, S. B. (2014). Government expenditure and economic growth: An empirical analysis of the Armey Curve in Nigeria. *Romanian Economic Journal*, *17*(51), 47-66.

Pamuk, Y., & Dündar, U. (2016). Kamu harcamalarının optimal boyutu: Türkiye örneği. *Hacettepe Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *34*(3), 23-50.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, *16*(3), 289-326.

Pevcin, P. (2004). Economic output and the optimal size of government. *Economic and Business Review*, *6*(3), 213.

Rahn, R., & Fox, H. (1996). What is the optimum size of government. Vernon K. Krieble Foundation.

Sam, C. Y., McNown, R., & Goh, S. K. (2019). An augmented autoregressive distributed lag bounds test for cointegration. *Economic Modelling*, *80*, 130-141.

Scully, G. W. (1994). What is the optimal size of government in the US?. Policy Report. National Center for Policy Analysis.

Serin, Ş. C., & Demir, M. (2023). Does Public Debt and Investments Create Crowding-out Effect in Turkey? Evidence from ARDL Approach. *Sosyoekonomi*, *31*(55), 151-172.

Serin, Ş. C., Albayrak, M., & Akça, H. (2023). Doğal Afetler ve Kamu Ekonomisi Üzerine Etkileri. Doğal Afetlerle Mücadelede Kamu Politikaları Sosyal, Ekonomik ve Mali Etkiler içinde. Gazi Kitabevi, Ankara.

Syed, Q. R., Apergis, N., & Goh, S. K. (2023). The dynamic relationship between climate policy uncertainty and renewable energy in the US: Applying the novel Fourier augmented autoregressive distributed lags approach. *Energy*, *275*, 127383.

Şen, H., & Kaya, A. (2019). Alternatif göstergeler bazında Türkiye'de optimal kamu kesimi büyüklüğünün tahmini. *Bankacılar Dergisi*, *109*, 49-81.

Toptaş, S. (2024). Optimal Kamu Harcaması Oranı: Türkiye İçin Bir Uygulama. *International Journal of Public Finance*, *9*(1), 175-194.

Turan, T. (2014). Optimal size of government in Turkey. *International Journal of Economics and Financial Issues*, *4*(2), 286-294.

Yamak, R., & Erdem, H. F. (2018). Türkiye Ekonomisinde Armey Eğrisi Geçerli Midir?. *Uluslararası İktisadi ve İdari İncelemeler Dergisi*, 335-346.

Yıldız, F., & Demirkılıç, Y. (2022). Türkiye'de "Armey Eğrisi" (1970-2020): Teorik Yaklaşımlar ve Ampirik Sonuçlar. Bir Hipotez Bir Test (Maliye ve İktisat Özelinde) içinde. Ekin Yayınları.

Yurdadog, V., Karadağ, N. C., Albayrak, M., & Bozatlı, O. (2022). Analysis of Non-Tax Revenue: Evidence From European Union. *Amfiteatru Economic*, *24*(60), 485-506.

Yüksel, C. (2019). The size of the public sector and the Armey curve: The case of Turkey. *Critical debates in public finance. Berlin: Peter Lang GmbH*, 137-154.

Zungu, L. T., & Greyling, L. (2022). Government size and economic growth in African emerging economies: does the BARS curve exist?. *International Journal of Social Economics*, *49*(3), 356-371.

APPENDIX

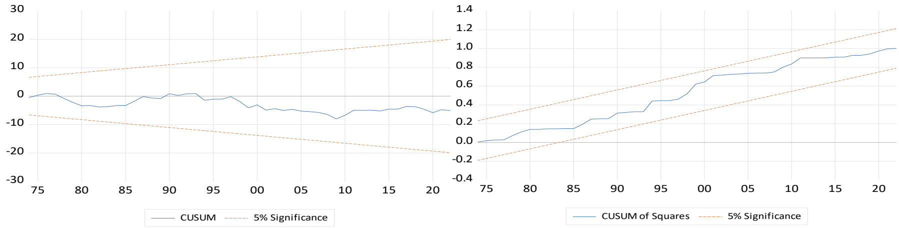


Figure A1. ***Model 1***

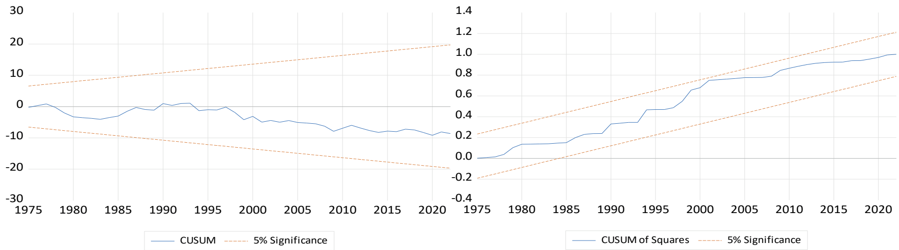
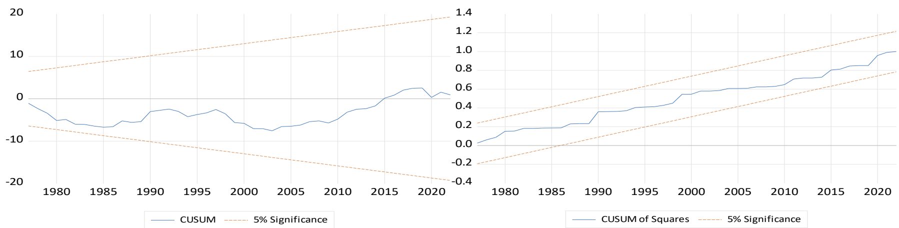


Figure A2. ***Model 2***



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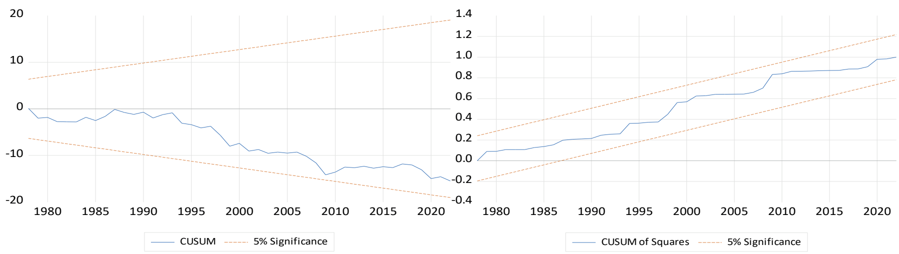

Figure A4. ***Model 4***

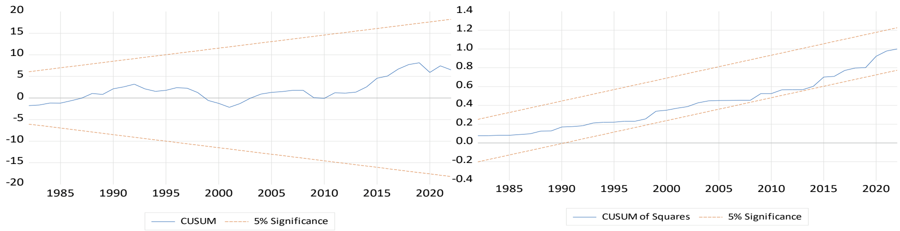

Figure A5. ***Model 5***