ECONOMIC ANNALS, Volume LXVII, No. 232 / January – March 2022
UDC: 3.33 ISSN: 0013-3264

https://doi.org/10.2298/EKA2232153D

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TESTING THE VALIDITY OF THE BARS CURVE FOR TURKEY

ABSTRACT: *This study has two main aims: to test the validity of the BARS curve in Turkey for the period 1974–2016 and to estimate the optimal government size for that period and compare it with the current situation. It uses the Autoregressive Distributed Lag bounds test and quadratic equation methods. The empirical findings of the study confirm the validity of the BARS curve by providing strong evidence for the existence of an inverted U-shaped long-run relationship between government size and economic growth. Unlike many previous studies that use a single proxy measure for government size, this study uses all available fundamental indicators and their sub-components. The empirical results show that for the period studied all proxy measures of government size exceed the optimal except for total central government budget expenditure and defence expenditure. Therefore, decreasing the size of the government, other than for these two indicators, will increase economic growth in the long run.*

KEY WORDS: *government size, economic growth, ARDL bounds test, Turkey*

JEL CLASSIFICATION: H11, H20, H50, O40, C19

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** This paper is extracted from the author's PhD thesis submitted to the Ankara Yıldırım Beyazıt University, Institute of Social Sciences, Department of Public Finance.
Acknowledgements: The author is grateful to her thesis advisor Prof. Hüseyin Şen for his valuable comments and suggestions.

1. INTRODUCTION

Although the relationship between government size and economic growth has long been discussed in economic and public finance literature, there is still no consensus on whether there is a significant relationship between these variables. In addition, those that argue that there is a relationship have different approaches to determining whether this relationship is linear, non-linear, positive, or negative. The BARS curve (after the initials of its originators Barro, Armey, Rahn, and Scully) is one of these approaches.

The BARS curve can be briefly defined as showing that increases in government expenditure will increase economic growth up to a certain point but will tend to decrease growth after that point. This issue has attracted great interest in both academic and policymaking circles due to its importance in terms of public policy, resource allocation, and deciding the composition of expenditures. The many studies on this subject have yielded different results, mainly due to a lack of consensus regarding the variable(s) used as proxies for government size.

Choosing an appropriate proxy measure for government size is critically important for accurately estimating the growth-maximizing government size. To obtain reliable results the main criterion for selecting a proxy measure or measures would be a rational assessment of the specific characteristics of a country. If the proxy for government size is not chosen correctly the results will be misleading, and the policy recommendations will not result in economic growth. Therefore, both the estimation of the growth-maximizing government size and the proxy measure of the government size chosen for this estimation have been the subject of intense discussion in the literature. In contrast to many previous studies that consider a single proxy measure, this study uses all the main indicators of government size whose data can be accessed, as well as their sub-components.

Accurate determination of the relationship between government size and economic growth is a very important issue in terms of rational task sharing between public and private sector. As there is a shortage of resources in developing countries it is especially important to use existing resources effectively. It is more difficult for developing countries to recover from incorrectly allotted expenditures than it is for developed countries. Estimating the optimal

size of government to maximize growth is crucial for both task-sharing between public and private sectors and for effective public policymaking in relation to public expenditure and taxes. This paper contributes to the discussion by estimating the optimal government size for a developing country, Turkey, using 11 alternative proxy measures and comparing the obtained values with current values.

The remainder of the paper proceeds as follows. Section 2 provides the theoretical background and section 3 reviews the relevant literature. Section 4 describes the data set, methodology, and models. Section 5 presents and explains the results obtained, while Section 6 presents a robustness check of the results. Section 7 concludes.

2. THEORETICAL DISCUSSIONS ON THE BARS CURVE

The linkage between government size and economic growth is controversial. As the size of a government increases, more resources are allocated to the public sector. The government becomes the most powerful economic agent in an economy and very important for growth (Sala-i-Martin, 2002: 70). Three main mechanisms show that the positive effects of increased government size on economic growth gradually diminish and eventually become negative (Gwartney et al., 1998: 3).

Raising taxes and/or borrowing to finance increased government expenditure hurts the economy. As taxes increase the private sector's motivation to invest and increase productivity decreases. Thus, as resources are shifted from the private to the public sector, even if the efficiency of government expenditure is not diminished the disincentive effects of taxation and the crowding-out effect of domestic borrowing will harm economic growth.

As the public sector becomes larger than the private sector the diminishing returns law becomes more important. When the public sector is working properly it is expected to provide an infrastructure for the productive functioning of the private sector that includes protecting property rights, ensuring an impartial legal system, developing a stable monetary framework, and ensuring national defence, thus increasing economic growth. However, if the public sector passes its optimal growth point, government expenditure will be directed towards increasingly less

productive activities, resulting in diminishing returns and slowing economic growth.

The public sector is much less dynamic than the private sector and changes in the public sector take place much more slowly. Compared to the private sector, the time required to identify problems and to adapt to changing conditions and new knowledge and technologies is longer. This means missing opportunities for better and more efficient production. Therefore, an increase in the size of the government slows down economic growth after a threshold point.

Barro's (1990) influential paper explains the impact of government size on growth through the public policy model, a specification of endogenous growth models. According to Barro (1990), who accepts public policies as an input of production, government expenditure financed by taxes has a positive impact on economic growth up to a certain point of efficiency. However, after this effect exceeds the optimal level it starts to show negative effects on growth and leads to an inverse U-shaped association between government size and economic growth. The curve corresponding to this process is called the Barro curve and determines optimal government size. Armey (1995) also studied the relationship between government size and economic growth. The Armey curve is an inverse U-shaped non-linear curve that reveals the optimal government size by developing a quadratic function.

Several studies, including Barro (1990), King and Rebelo (1990), Jones et al. (1993), and Devarajan et al. (1996), developed endogenous growth models that incorporate fiscal policy instruments (i.e., taxes and government expenditure), assuming that such public sector policies are among of the drivers of economic growth. Barro (1990) was the most influential study on the relationship between government size and growth within the endogenous growth model framework and inspired many researchers. Armey (1995) reiterates the existence of an inverse U-shape, corresponding to a non-linear linkage between government size and growth. This non-linear linkage or 'Armey curve' shows that increased government expenditure will increase economic growth to a certain level, beyond which it will tend to lower growth. Growth-enhancing/productive government expenditure increases to a level which Armey determines as the optimal government size for maximizing growth. Increased government expenditure after

this level will lead to the law of diminishing returns and have negative consequences for economic growth.

Following Armey (1995), empirical studies by Rahn and Fox (1996) and Scully (1998, 2003) further advanced the literature on the relationship between government size and economic growth, and the curve became known the BARS curve, taking the initial letters of the surnames of Barro, Armey, Rahn, and Scully. The horizontal axis of this curve represents the government-expenditure-to-GDP ratio or government size indicator, while the vertical axis represents the real GDP growth rate. The BARS curve estimates the optimal government size to maximize economic growth and thus determines the share of the public and private sectors in a national economy and the rational policies to reach this share.

3. EMPIRICAL LITERATURE ON THE BARS CURVE

The determination of government size is a global issue. The relationship between government size and economic growth is important for determining countries' macroeconomic policies. Although a vast number of empirical studies exist, there is no consensus on the effect of government size on growth.

The empirical literature includes single-country studies that explore the optimal government size for developing countries. Rezk (2005) explores the growth-maximizing level of government size for Argentina for the period 1993–2003 and finds the optimal level of government expenditure to be as high as 30% of GDP. Herath (2009) analyses the optimal government size for Sri Lanka for the period 1959–2003 and estimates it as 27% of GDP. Abounoori and Nademi (2010) investigate the optimal government size for Iran during the period 1956–2006 and find it to be 34.7%. Alimi (2014) researches the optimal government size in Nigeria for the period 1970–2012 and concludes that it should be 19.81%. Using quarterly data for Brazil from 2000:1 to 2013:3, a more recent study by de Mendonça and Cacicedo (2015) applies the OLS and generalized method of moments (GMM) tests to Brazil for the period 2000–2013 and concludes that an increase in government size contributes positively to growth and that the optimal size for the Brazilian government is roughly 22% of GDP. A study by Şen and Kaya (2019) on Turkey estimates the optimal government size using 14 different proxy measures for the period 2006:1–2016:2. They show that the optimal

government size varies with the proxy measure used. El Husseiny (2019) examines the optimal government size for Egypt over the period 1981–2015 and finds that the value should be between 30.5% and 31.2% of GDP.

Other empirical single-country studies examine the optimal government size for developed countries. Grossman (1987) explores the optimal government size for the USA during the period 1929–1982 and concludes that it is around 19% of GDP. Peden (1991) analyses the growth-maximizing level of government size for the same country for the 1929–1986 period and finds it to be in the range of 17%–20% of GNP. Scully (1994) asserts that it should be between 21.5% and 22.9% of GNP for the USA. Likewise, Gwartney et al. (1998) explore the growth-maximizing level of government size for the USA during the 1960–1990 period and conclude that it is lower than 20% of GDP.

Chao and Grubel (1998) examine the growth-maximizing government size for Canada for the 1929–1996 period and find it to equal about 34% of national income. Vedder and Gallaway (1998) analyse the growth-maximizing government size for the USA during the period 1947–1997 and find it to be 28.87% of GDP. A study by Mittnik and Neumann (2003) examines the optimal government size for West Germany for the period 1968–1994 and concludes that it should be 20% of GDP. Mavrov (2007) examines the optimal government size for Bulgaria for the 1990–2004 period and concludes that it should be 21.4%. Scully (2008) explores the growth-maximizing level of government size for the USA during the 1960–1990 period and concludes that the ratio should be 19.3% of GDP. For France, Facchini and Melki (2013) analyse the growth-maximizing government size for the period 1896–2008 and estimate it to be around 30% of GDP. Magazzino (2014) and Forte and Magazzino (2016) analyse the relationship between government size and economic growth in Italy using a very long-term data set from 1861 to 2008 and find a non-linear relationship between the two. Di Liddo et al. (2018) investigate the relationship between government size, decentralization, and economic growth using a panel dataset for 20 Italian regions over the period 1996–2009 and find that the optimal government size is around 52%. A more recent study by Forte and Magazzino (2018) examines the optimal government size for Italy for the period 1961–2011 and report this value to be 20.6% of GDP. Makin et al. (2019) use data from 1970:1 to 2017:3 for Australia to investigate optimal government size and conclude that it should be 31%.

Other studies estimate the optimal government size in multiple countries. Karras (1996) examines the optimal government size for 118 countries over the period 1960–1985 and finds it be 23% of GDP. Karras (1997) studies the growth-maximizing level of government size for 20 European countries over the 1950–1990 period and finds it to be roughly 16% of GDP (+/–3%). Afonso et al. (2003) investigate the optimal government size for 23 OECD countries for the period 1990–2000 and conclude it should be 35%. Pevcin (2004) analyse the growth-maximizing level of government size for 12 European countries during the period 1950–1996 and finds that it to be between approximately 36% and 42% of GDP. Günalp and Dinçer (2005) research the growth-maximizing level of government size for 20 transition countries during the period 1990–2000 and estimate it to be 17.3% (+/–3%). Chobanov and Mladenova (2009) explore the optimal government size for 28 EU countries during the period 1970–2009 and conclude that it should be 25%. Forte and Magazzino (2011) explore the optimal government size for 27 EU countries during the 1970–2009 period and find that it should be between 35.39% and 43.50%. Christie (2014) examines the optimal government size for 136 countries for the 1971–2005 period and concludes that it should be 35% of GDP. Hok et al. (2014) explored the optimal government size for 8 Asian countries for the period 1995–2011 and conclude that it should be 28.50% of GDP. A more recent study by Amgain (2017) scrutinizes the optimal government size for 32 Asian countries over the period 1991–2012 and finds this value to be 18%.

Studies by Asimakopoulos and Karavias (2016) and Kim et al. (2018) show that the effect of government size on economic growth varies according to the group of countries examined. Asimakopoulos and Karavias (2016) implement three different econometrical methods – non-linear panel, GMM, and dynamic panel threshold estimation – for 129 developing and developed countries for the period 1980–2009. They observe that for developing countries the negative impact on economic growth is more pronounced in governments above optimal size than in those below the optimal size, and that the optimal government size is different for developing and developed countries: 19.12% of GDP for developing countries, 17.96% for developed countries, and 18.04% for the total of studied countries. Kim et al. (2018) examine the positive and negative effects of government size on economic growth for different threshold levels in multiple developing and developed countries. Using panel smooth transition regression (PSTR) to study

government size in 47 developing and developed countries during 1984–2012, they conclude that good governance supports government size, increases productivity, and produces economic growth; while larger government supports governance, increases productivity, and hence ensures economic growth. However, government size becomes detrimental to growth above a threshold level of government size.

4. DATA, MODEL, AND METHODOLOGY

4.1. Data

This paper uses annual time series data for Turkey spanning 1974 to 2016, which corresponds to 43 observations and is the largest timespan available. The expenditure variables used are based on the functional classification of government expenditure, thus allowing us to analyse and assess government expenditures according to their function. All variables are expressed as a percentage of GDP. Central government data are used throughout the study. The definitions of the variables and the data sources are presented in Table 1.

Descriptive statistics of the main variables are presented in Table A1 in the Appendix. Visual representations of the series are presented in Figure 1, and the justification of the variables is reported in Section 4.2.

Table 1: Definition of variables and data source

Variable		Abbrev.	Definition	Data Source
Dependent Variable		**RGdpG**	Annual Percentage Change in real GDP over the previous year *	Presidency of Strategy and Budget Office
Independent Variables	Alternative Interest Variables (Alternative Proxy Variables for Government Size)	**ECenGov**	Budget Expenditures**	General Directorate of Budget and Fiscal Control (GDBF)
		EE	Education Expenditures**	GDBF
		HE	Health Expenditures**	GDBF
		EHE	Total Health and Education Expenditures**	GDBF
		DE	Defence Expenditures**	GDBF
		CE	Final Consumption Expenditures	World Bank (WB)
		IE	Investment Expenditures	GDBF
		CIE	Total and Real Expenditures**	WB, GDBF
		RCenGov	Budget Revenues	GDBF
		RDirT	Direct Tax Revenues	GDBF
		RIndT	Indirect Tax Revenues	GDBF
	Control Variables	**DCPS**	Domestic Credit to Private Sector as a percentage of GDP is a proxy for financial sector development	WB
		INF	Inflation Rate Change in consumer price index (CPI, %)	WB
		FDI	Foreign Direct Investment (Inflows) GDP (%)	WB
		EMP	Employment Participation Rate (%) (15+)	Bulutay (1995), OECD
		CD	Crisis dummy for economic crises in the years 1980, 1994, 1999, 2001, 2009.	

* http://www.sbb.gov.tr/ekonomik-veriler/#1540461995857-3570233a-09e6

** Data for 1974–1983 is calculated by the author using Realizations of Government Expenditures and Revenues (1924–1995), Revised 2nd Edition. Data for 1983–2016 is taken from annual budget justifications.

Figure 1: Visual representation of the series from 1974 to 2016

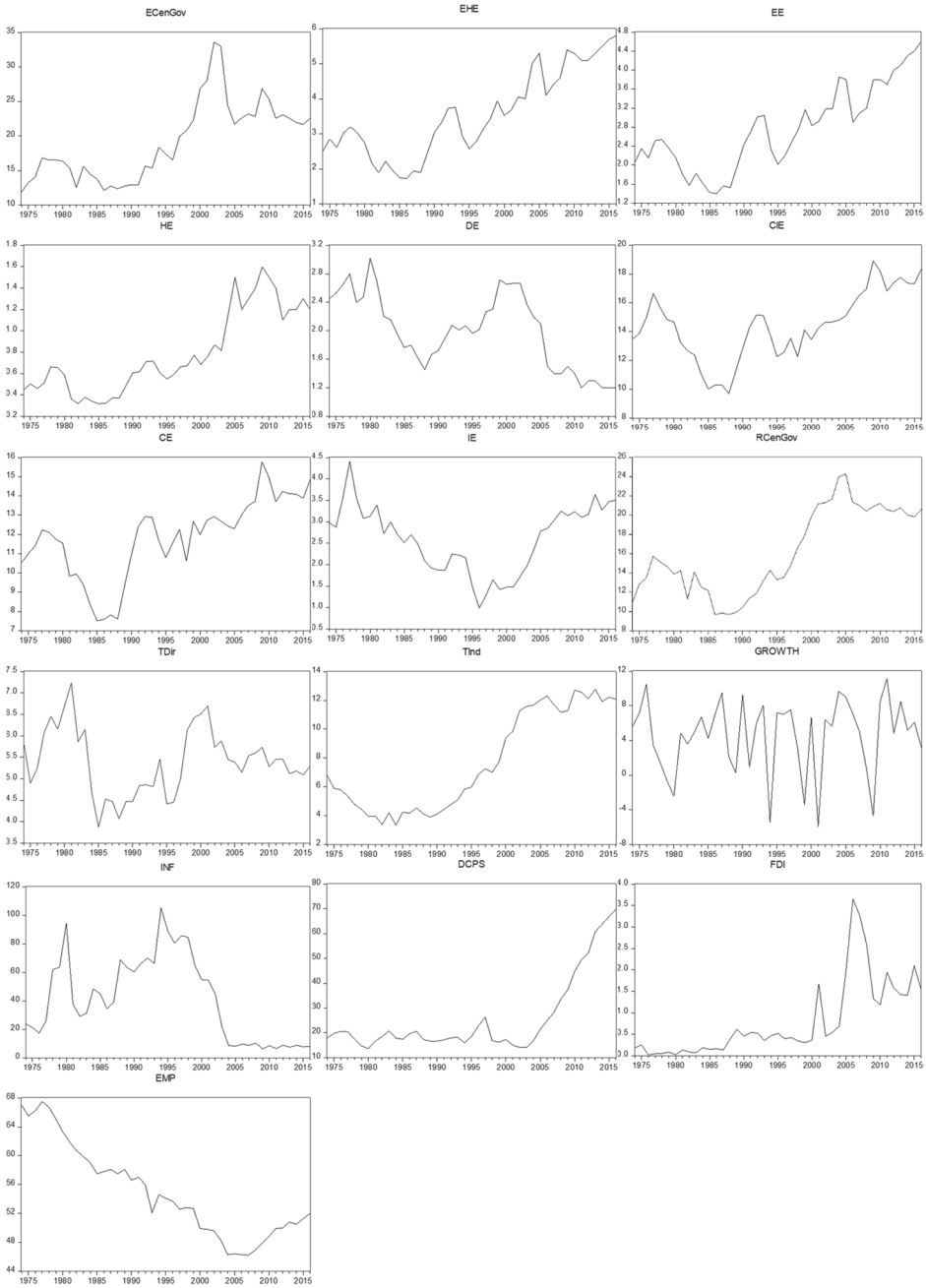


Figure 1 shows that RGdpG is affected negatively and faced sharp declines particularly in the pre-1994 crisis period, 1999 bottleneck, 2001 crisis, and 2008/09 global crisis. ECenGov has an increasing trend about until 2002, and is especially negatively affected by the 2001 crisis. It also has an increasing trend from 2005 to 2009 and is negatively influenced by the 2008/09 global crisis. The CIE decreased from the early 1980s to the early 1990s due to liberal policies, after which, except for the crisis years, it shows an increasing trend in general terms. EHE has a mostly increasing trend, but is especially negatively affected by the 1994, 2001, and 2008 crises. DE decreased from the 1980s to the beginning of the 1990s with participation in the NATO alliance and the commencement of military aid. From the 1990s to the 2000s it has an increasing trend due to the increase in terror incidents, but after 2002 it tends to decrease again. RCenGov starts to increase from 1985 due to the implementation of Value Added Tax (VAT) and peaks with the contribution of privatisation revenues in 2005, but after 2005 it decreases until 2008. RDirT, the share of direct taxes, decreased with the effect of liberalisation after 1980. RIndT started to increase from the beginning of 1990 due to the introduction of VAT, like RCenGov.

4.2. Model

The control variables are (1) inflation rate (INF), (2) domestic credit to private sector (DCPS), (3) foreign direct investment (FDI), (4) employment participation rate (EMP), and (5) a dummy variable for the economic and political crisis. To eliminate possible seasonality problems in prices, INF refers to annual changes in the consumer price index over the previous year. Empirical studies in the literature have produced mixed results regarding the linkage between inflation and growth. Barro (1996), Andres and Hernando (1999), and Gillman and Harris (2010) find a negative effect of inflation on growth, while Kormendi and Meguire (1985) and Mallik and Chowdhury (2001) report the opposite result in the long run. Considering these studies, we posit that the link between inflation and growth may be positive or negative.

The second variable is domestic credit to the private sector (DCPS), which is widely accepted as a proxy for financial sector development. DCPS plays a very important role in increasing investment and employment in an economy, not only providing efficiency and productivity but also enhancing economic growth (Begum and Aziz, 2019). Bencivenga et al. (1996) conclude that the development

of the financial sector through increased liquidity positively affects economic growth. On the other hand, it has been argued that financial sector development is negatively related to economic growth. For example, Olowofeso et al. (2015: p.82) point out that "the efficient provisioning of credit has a positive and significant effect on output and employment opportunities, while a low level of financial development and its attendant inefficient private sector credit system distorts economic growth". In this paper the expected sign of financial sector development is negative, since Turkey is a developing country with an insufficiently developed and illiquid financial market and there are limited opportunities for it to significantly impact economic growth.

The third control variable is foreign direct investment (FDI). The literature on the FDI–growth nexus has yielded mixed results. Borensztein et al. (1998) find that FDI is a significant mechanism for the transfer of technology and its contribution to economic growth is more positive than domestic investment. On the other hand, there are some situations in which FDI may adversely affect the host country's economy. The high competitiveness of the investing country can adversely affect companies in the host country and reduce their market share (Kahveci and Terzi, 2017). However, when assessing the impact of FDI on growth the type of investment should be taken into account. FDI can be realised as new investment, acquisitions, or mergers. If FDI is realised as an acquisition or merger it is expected that the investment will create a new production area and will have a positive effect on growth. Hence, there is no agreed consensus on the sign of this variable: FDI can enter the model with a positive or negative sign.

Our fourth control variable is the employment participation rate (EMP). Only a few studies in the literature examine the association between employment and economic growth, and they show mixed results. Saget (2000) finds mixed results for different countries: the relationship between employment and economic growth has a positive effect on economic growth in Hungary, Poland, the Czech Republic, Slovakia, and Russia, a negative impact in Romania, and no effect in Bulgaria and Ukraine. Yam et al. (2002) find the relationship to be positive, whereas Abdullah et al. (2011) find no significant link between the variables. Thus, there is no consensus about the sign of the employment participation rate variable.

Our fifth control variable is the crisis dummy. This dummy variable posits the years with negative economic growth as crisis years. The crisis years for the Turkish economy are 1980, 1994, 1999, 2001, and 2009. This dummy variable removes the effect of the crisis from the effect of government size on growth. Thus, the expected sign of the crisis dummy in this paper is negative.

Our sixth and main variable is government size. In the literature there are different proxy measures for government size. However, the ratio of government expenditure to GDP is the most commonly used proxy measure.

The first eight models (Model 1 through Model 8 that are presented in below) are based on the government expenditures while further three models (Model 9 through Model 11) are based on government revenues.

$$RGdpG = f(INF, DCPS, FDI, EMP, CD, EcenGov, EcenGov^2) \quad (1)$$

$$RGdpG = f(INF, DCPS, FDI, EMP, CD, EE, EE^2) \quad (2)$$

$$RGdpG = f(INF, DCPS, FDI, EMP, CD, HE, HE^2) \quad (3)$$

$$RGdpG = f(INF, DCPS, FDI, EMP, CD, EHE, EHE^2) \quad (4)$$

$$RGdpG = f(INF, DCPS, FDI, EMP, CD, DE, DE^2) \quad (5)$$

$$RGdpG = f(INF, DCPS, FDI, EMP, CD, CE, CE^2) \quad (6)$$

$$RGdpG = f(INF, DCPS, FDI, EMP, CD, IE, IE^2) \quad (7)$$

$$RGdpG = f(INF, DCPS, FDI, EMP, CD, CIE, CIE^2) \quad (8)$$

$$RGdpG = f(INF, DCPS, FDI, EMP, CD, RCenGov, RCenGov^2) \quad (9)$$

$$RGdpG = f(INF, DCPS, FDI, EMP, CD, RdirT, RdirT^2) \quad (10)$$

$$RGdpG = f(INF, DCPS, FDI, EMP, CD, RindT, RindT^2) \quad (11)$$

4.3. Methodology

To research the presence of a possible long-run linkage between government size and growth, first, the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller 1979) and Phillips-Perron (PP) test (Phillips and Perron 1988) are used to determine the appropriate estimation technique. These unit root tests are used to scrutinize the stationarity properties of the level and first difference of the variables. Second, the cointegration relationship between the variables is estimated using the ARDL bounds test (Pesaran et al., 2001).

5. EMPIRICAL FINDINGS

5.1. Unit root test results

The ADF and the PP unit root tests were applied to empirically examine the stationarity of all the variables. The ADF and the PP tests of the null hypothesis of non-stationarity are tested against the alternative of stationarity. The results of the tests are represented in Tables 2 and 3. ECenGov, EHE, EE, HE, DE, CIE, CE, IE, RCenGov, RdirT, RindT are stationary at the first difference I(1) for both models. However, RGdpG is stationary at level I(0) for both models, FDI is stationary at level I(0) for the constant and trend model, and RdirT is stationary at level I(0) for the constant model. Thus, the results show that the series are stationary at different orders. Because the variables have different integration orders and there is no I(2) data, we can safely use the ARDL bounds test.

Table 2: Unit root test results, 1974–2016

Series	ADF unit root test						PP unit root test					
	Level Constant	Critical Values		Level Constant and Trend	Critical Values		Level Constant	Critical Values		Level Constant and Trend	Critical Values	
		5%: –2.93	1%: –3.59		5%: –3.52	1%: –4.19		5%: –2.93	1%: –3.59		5%: –3.52	1%: –4.19
RGdpG	–6.26(0)***			–6.23(0)***			–6.26***			–6.29***		
CE	–1.10(0)			–2.06(0)			–1.32			–2.30		
IE	–1.28(0)			–1.20(0)			–1.36			–1.10		
CIE	–0.83(0)			–2.03(0)			–1.15			–1.84		
HE	–1.00(0)			–2.19(0)			–0.94			–2.24		
EE	–0.34(0)			–2.81(1)			–0.20			–2.21		
EHE	–0.45(0)			–2.28(0)			–0.19			–2.17		
DE	–1.02(0)			–1.65(0)			–1.20			–1.95		
ECenGov	–1.59(0)			–2.24(1)			–1.66			–2.07		
RCenGov	–1.04(0)			–2.04(2)			–1.12			–1.59		
RdirT	–2.52(0)			–2.48(0)			–2.62*			–2.59		
RindT	0.11(0)			–2.82(0)			–0.18			–2.77		
FDI	–1.94(0)			–3.65(1)**			–1.82			–2.69		
DCPS	2.79(0)			0.74(0)			2.41			0.55		
INF	–1.61(0)			–2.18(0)			–1.56			–2.09		
EMP	–2.05(0)			–0.21(0)			–2.03			–0.06		

Note: The numbers in parentheses indicate the chosen lag order of the ADF models. Lags are selected based on AIC. Asterisks (*), (**), (***) denote statistical significance at 10%, 5%. and 1%, respectively. E-Views 10 was used for computations.

Table 3: Unit root test results, 1974–2016

ADF unit root test							PP unit root test					
Series	**First Difference Constant**	**Critical Values**		**First Difference Constant and Trend**	**Critical Values**		**First Difference Constant**	**Critical Values**		**First Difference Constant and Trend**	**Critical Values**	
		5%:–2.93	**1%: –3.60**		**5%: –3.52**	**1%: –4.20**		**5%: –2.93**	**1%: –3.60**		**5%: –3.52**	**1%: –4.19**
D(RGdpG)	–7.11(1)***			–7.04(1)***			–19.81***			–19.64***		
D(CE)	–5.98(0)***			–5.95(0)***			–5.99***			–5.96***		
D(IE)	–5.50(1)***			–5.89(1)***			–5.93***			–6.05***		
D(CIE)	–5.22(0)***			–5.26(0)***			–5.20***			–5.25***		
D(HE)	–6.22(0)***			–6.15(0)***			–6.23***			–6.15***		
D(EE)	–5.59(0)***			–4.82(1)***			–5.57***			–6.13***		
D(EHE)	–5.81(0)***			–5.11(1)***			–5.88***			–7.34***		
D(DE)	–2.81(2)*			–2.74(2)			–5.69***			–5.62***		
D(EcenGov)	–5.58(0)***			–5.52(0)***			–5.58***			–5.52***		
D(RcenGov)	–6.35(0)***			–6.26(0)***			–6.35***			–6.26***		
D(RdirT)	–7.00(0)***			–6.92(0)***			–6.99***			–6.90***		
D(RindT)	–3.28(1)**			–3.27(1)***			–6.18***			–6.29***		
D(FDI)	–5.64(2)***			–5.55(2)***			–10.60***			–10.38***		
D(DCPS)	–4.05(0)***			–5.09(0)***			–4.00***			–5.05***		
D(INF)	–6.83(0)***			–6.91(0)***			–6.89***			–7.17***		
D(EMP)	–6.08(0)***			–6.59(0)***			–6.14***			–6.59***		

Note: The numbers in parentheses indicate the chosen lag order of the ADF models. Lags are selected based on AIC. Asterisks (*), (**), (***) denote statistical significance at 10%, 5%, and 1%, respectively. E–Views 10 was used for computations.

5.2. ARDL bounds test results

In the previous subsection, two unit root tests were implemented on both the level and the first differenced forms to capture the appropriate econometric method for estimation. The test results show a group of time series, some I(0), others I(1), but no I(2). The next step investigates the existence of a cointegration relationship among the variables using the bounds test approach (Pesaran et al. 2001). The presence of an inverse U-shaped association between the size of government and growth was estimated using the quadratic equation method, regressing the real GDP growth rate on the size of government and the government size squared. Baseline regressions were performed following Vedder and Gallaway (1998), Chao and Grubel (1998), Pevcin (2004), and El Husseiny (2019). The subsequent specification was tested for Turkey over the period 1974–2016. If the squared coefficient on the proxy measure for government size is negative and statistically significant, it means that economic growth initially increases and eventually decreases with the rise in government size. The growth-maximizing government size can be formulated as follows:

$$\text{Govsize}^{*} = \frac{-\beta_{15}}{2\beta_{16}}$$

$$\begin{aligned}\Delta \boldsymbol{G_{RGdp}}_t = \beta_0 &+ \sum_{i=1}^{p-1} \beta_{1i}\, \Delta \boldsymbol{G_{RGdp}}_{t-i} + \sum_{i=0}^{p_1-1} \beta_{2i}\, \Delta Inf_{t-i} + \sum_{i=0}^{p_2-1} \beta_{3i}\, \Delta DCPS_{t-i} \\ &+ \sum_{i=0}^{p_3-1} \beta_{4i}\, \Delta FDI_{t-i} + \sum_{i=0}^{p_4-1} \beta_{5i}\, \Delta Emp_{t-i} + \sum_{i=0}^{p_5-1} \beta_{6i}\, \Delta CD_{t-i} \\ &+ \sum_{i=0}^{p_6-1} \beta_{7i}\, \Delta \boldsymbol{E_{CenGov}}_{t-i} \\ &+ \sum_{i=0}^{p_7-1} \beta_{8i}\, \Delta \boldsymbol{E_{CenGov}}^{2}{}_{t-i} + \beta_9 \boldsymbol{G_{RGdp}}_{t-1} + \beta_{10} Inf_{t-1} \\ &+ \beta_{11} DCPS_{t-1} + \beta_{12} FDI_{t-1} + \beta_{13} Emp_{t-1} + \beta_{14} CD_{t-1} \\ &+ \beta_{15} \boldsymbol{E_{CenGov}}_{t-1} \\ &+ \beta_{16} \boldsymbol{E_{CenGov}}^{2}{}_{t-1} \\ &+ \mu_t \end{aligned} \quad (1)$$

$$\Delta \boldsymbol{G_{RGdp}}_t = \beta_0 + \sum_{i=1}^{p-1} \beta_{1i}\, \Delta \boldsymbol{G_{RGdp}}_{t-i} + \sum_{i=0}^{p_1-1} \beta_{2i}\, \Delta Inf_{t-i} + \sum_{i=0}^{p_2-1} \beta_{3i}\, \Delta DCPS_{t-i} + \sum_{i=0}^{p_3-1} \beta_{4i}\, \Delta FDI_{t-i} + \sum_{i=0}^{p_4-1} \beta_{5i}\, \Delta Emp_{t-i} + \sum_{i=0}^{p_5-1} \beta_{6i}\, \Delta CD_{t-i} + \sum_{i=0}^{p_6-1} \beta_{7i}\, \Delta EE_{t-i} + \sum_{i=0}^{p_7-1} \beta_{8i}\, \Delta {EE^2}_{t-i} + \beta_9 \boldsymbol{G_{RGdp}}_{t-1} + \beta_{10} Inf_{t-1} + \beta_{11} DCPS_{t-1} + \beta_{12} FDI_{t-1} + \beta_{13} Emp_{t-1} + \beta_{14} CD_{t-1} + \beta_{15} EE_{t-1} + \beta_{16} {EE^2}_{t-1} + \mu_t \quad (2)$$

$$\Delta \boldsymbol{G_{RGdp}}_t = \beta_0 + \sum_{i=1}^{p-1} \beta_{1i}\, \Delta \boldsymbol{G_{RGdp}}_{t-i} + \sum_{i=0}^{p_1-1} \beta_{2i}\, \Delta Inf_{t-i} + \sum_{i=0}^{p_2-1} \beta_{3i}\, \Delta DCPS_{t-i} + \sum_{i=0}^{p_3-1} \beta_{4i}\, \Delta FDI_{t-i} + \sum_{i=0}^{p_4-1} \beta_{5i}\, \Delta Emp_{t-i} + \sum_{i=0}^{p_5-1} \beta_{6i}\, \Delta CD_{t-i} + \sum_{i=0}^{p_6-1} \beta_{7i}\, \Delta HE_{t-i} + \sum_{i=0}^{p_7-1} \beta_{8i}\, \Delta {HE^2}_{t-i} + \beta_9 \boldsymbol{G_{RGdp}}_{t-1} + \beta_{10} Inf_{t-1} + \beta_{11} DCPS_{t-1} + \beta_{12} FDI_{t-1} + \beta_{13} Emp_{t-1} + \beta_{14} CD_{t-1} + \beta_{15} HE_{t-1} + \beta_{16} {HE^2}_{t-1} + \mu_t \quad (3)$$

$$\Delta \boldsymbol{G_{RGdp}}_t = \beta_0 + \sum_{i=1}^{p-1} \beta_{1i}\, \Delta \boldsymbol{G_{RGdp}}_{t-i} + \sum_{i=0}^{p_1-1} \beta_{2i}\, \Delta Inf_{t-i} + \sum_{i=0}^{p_2-1} \beta_{3i}\, \Delta DCPS_{t-i} + \sum_{i=0}^{p_3-1} \beta_{4i}\, \Delta FDI_{t-i} + \sum_{i=0}^{p_4-1} \beta_{5i}\, \Delta Emp_{t-i} + \sum_{i=0}^{p_5-1} \beta_{6i}\, \Delta CD_{t-i} + \sum_{i=0}^{p_6-1} \beta_{7i}\, \Delta EHE_{t-i} + \sum_{i=0}^{p_7-1} \beta_{8i}\, \Delta {EHE^2}_{t-i} + \beta_9 \boldsymbol{G_{RGdp}}_{t-1} + \beta_{10} Inf_{t-1} + \beta_{11} DCPS_{t-1} + \beta_{12} FDI_{t-1} + \beta_{13} Emp_{t-1} + \beta_{14} CD_{t-1} + \beta_{15} EHE_{t-1} + \beta_{16} {EHE^2}_{t-1} + \mu_t \quad (4)$$

$$\Delta \boldsymbol{G_{RGdp}}_t = \beta_0 + \sum_{i=1}^{p-1} \beta_{1i}\, \Delta \boldsymbol{G_{RGdp}}_{t-i} + \sum_{i=0}^{p_1-1} \beta_{2i}\, \Delta Inf_{t-i} + \sum_{i=0}^{p_2-1} \beta_{3i}\, \Delta DCPS_{t-i} + \sum_{i=0}^{p_3-1} \beta_{4i}\, \Delta FDI_{t-i} + \sum_{i=0}^{p_4-1} \beta_{5i}\, \Delta Emp_{t-i} + \sum_{i=0}^{p_5-1} \beta_{6i}\, \Delta CD_{t-i} + \sum_{i=0}^{p_6-1} \beta_{7i}\, \Delta DE_{t-i} + \sum_{i=0}^{p_7-1} \beta_{8i}\, \Delta {DE^2}_{t-i} + \beta_9 \boldsymbol{G_{RGdp}}_{t-1} + \beta_{10} Inf_{t-1} + \beta_{11} DCPS_{t-1} + \beta_{12} FDI_{t-1} + \beta_{13} Emp_{t-1} + \beta_{14} CD_{t-1} + \beta_{15} DE_{t-1} + \beta_{16} {DE^2}_{t-1} + \mu_t \quad (5)$$

$$\Delta \boldsymbol{G_{RGdp}}_t = \beta_0 + \sum_{i=1}^{p-1} \beta_{1i}\, \Delta \boldsymbol{G_{RGdp}}_{t-i} + \sum_{i=0}^{p_1-1} \beta_{2i}\, \Delta Inf_{t-i} + \sum_{i=0}^{p_2-1} \beta_{3i}\, \Delta DCPS_{t-i} + \sum_{i=0}^{p_3-1} \beta_{4i}\, \Delta FDI_{t-i} + \sum_{i=0}^{p_4-1} \beta_{5i}\, \Delta Emp_{t-i} + \sum_{i=0}^{p_5-1} \beta_{6i}\, \Delta CD_{t-i} + \sum_{i=0}^{p_6-1} \beta_{7i}\, \Delta CE_{t-i} + \sum_{i=0}^{p_7-1} \beta_{8i}\, \Delta {CE^2}_{t-i} + \beta_9 \boldsymbol{G_{RGdp}}_{t-1} + \beta_{10} Inf_{t-1} + \beta_{11} DCPS_{t-1} + \beta_{12} FDI_{t-1} + \beta_{13} Emp_{t-1} + \beta_{14} CD_{t-1} + \beta_{15} CE_{t-1} + \beta_{16} {CE^2}_{t-1} + \mu_t \quad (6)$$

$$\Delta \boldsymbol{G_{RGdp}}_t = \beta_0 + \sum_{i=1}^{p-1} \beta_{1i}\, \Delta \boldsymbol{G_{RGdp}}_{t-i} + \sum_{i=0}^{p_1-1} \beta_{2i}\, \Delta Inf_{t-i} + \sum_{i=0}^{p_2-1} \beta_{3i}\, \Delta DCPS_{t-i} + \sum_{i=0}^{p_3-1} \beta_{4i}\, \Delta FDI_{t-i} + \sum_{i=0}^{p_4-1} \beta_{5i}\, \Delta Emp_{t-i} + \sum_{i=0}^{p_5-1} \beta_{6i}\, \Delta CD_{t-i} + \sum_{i=0}^{p_6-1} \beta_{7i}\, \Delta IE_{t-i} + \sum_{i=0}^{p_7-1} \beta_{8i}\, \Delta {IE^2}_{t-i} + \beta_9 \boldsymbol{G_{RGdp}}_{t-1} + \beta_{10} Inf_{t-1} + \beta_{11} DCPS_{t-1} + \beta_{12} FDI_{t-1} + \beta_{13} Emp_{t-1} + \beta_{14} CD_{t-1} + \beta_{15} IE_{t-1} + \beta_{16} {IE^2}_{t-1} + \mu_t \quad (7)$$

$$\Delta \boldsymbol{G_{RGdp}}_t = \beta_0 + \sum_{i=1}^{p-1} \beta_{1i}\, \Delta \boldsymbol{G_{RGdp}}_{t-i} + \sum_{i=0}^{p_1-1} \beta_{2i}\, \Delta Inf_{t-i} + \sum_{i=0}^{p_2-1} \beta_{3i}\, \Delta DCPS_{t-i} + \sum_{i=0}^{p_3-1} \beta_{4i}\, \Delta FDI_{t-i} + \sum_{i=0}^{p_4-1} \beta_{5i}\, \Delta Emp_{t-i} + \sum_{i=0}^{p_5-1} \beta_{6i}\, \Delta CD_{t-i} + \sum_{i=0}^{p_6-1} \beta_{7i}\, \Delta CIE_{t-i} + \sum_{i=0}^{p_7-1} \beta_{8i}\, \Delta {CIE^2}_{t-i} + \beta_9 \boldsymbol{G_{RGdp}}_{t-1} + \beta_{10} Inf_{t-1} + \beta_{11} DCPS_{t-1} + \beta_{12} FDI_{t-1} + \beta_{13} Emp_{t-1} + \beta_{14} CD_{t-1} + \beta_{15} CIE_{t-1} + \beta_{16} {CIE^2}_{t-1} + \mu_t \quad (8)$$

$$\Delta \boldsymbol{G_{RGdp}}_t = \beta_0 + \sum_{i=1}^{p-1} \beta_{1i}\, \Delta \boldsymbol{G_{RGdp}}_{t-i} + \sum_{i=0}^{p_1-1} \beta_{2i}\, \Delta Inf_{t-i} + \sum_{i=0}^{p_2-1} \beta_{3i}\, \Delta DCPS_{t-i} + \sum_{i=0}^{p_3-1} \beta_{4i}\, \Delta FDI_{t-i} + \sum_{i=0}^{p_4-1} \beta_{5i}\, \Delta Emp_{t-i} + \sum_{i=0}^{p_5-1} \beta_{6i}\, \Delta CD_{t-i} + \sum_{i=0}^{p_6-1} \beta_{7i}\, \Delta \boldsymbol{R_{CenGov}}_{t-i} + \sum_{i=0}^{p_7-1} \beta_{8i}\, \Delta {\boldsymbol{R_{CenGov}}^2}_{t-i} + \beta_9 \boldsymbol{G_{RGdp}}_{t-1} + \beta_{10} Inf_{t-1} + \beta_{11} DCPS_{t-1} + \beta_{12} FDI_{t-1} + \beta_{13} Emp_{t-1} + \beta_{14} CD_{t-1} + \beta_{15} \boldsymbol{R_{CenGov}}_{t-1} + \beta_{16} {\boldsymbol{R_{CenGov}}^2}_{t-1} + \mu_t \quad (9)$$

$$\Delta \boldsymbol{G_{RGdp}}_t = \beta_0 + \sum_{i=1}^{p-1} \beta_{1i}\, \Delta \boldsymbol{G_{RGdp}}_{t-i} + \sum_{i=0}^{p_1-1} \beta_{2i}\, \Delta Inf_{t-i} + \sum_{i=0}^{p_2-1} \beta_{3i}\, \Delta DCPS_{t-i} + \sum_{i=0}^{p_3-1} \beta_{4i}\, \Delta FDI_{t-i} + \sum_{i=0}^{p_4-1} \beta_{5i}\, \Delta Emp_{t-i} + \sum_{i=0}^{p_5-1} \beta_{6i}\, \Delta CD_{t-i} + \sum_{i=0}^{p_6-1} \beta_{7i}\, \Delta \boldsymbol{R_{DirT}}_{t-i} + \sum_{i=0}^{p_7-1} \beta_{8i}\, \Delta \boldsymbol{R_{DirT}}^2_{t-i} + \beta_9 \boldsymbol{G_{RGdp}}_{t-1} + \beta_{10} Inf_{t-1} + \beta_{11} DCPS_{t-1} + \beta_{12} FDI_{t-1} + \beta_{13} Emp_{t-1} + \beta_{14} CD_{t-1} + \beta_{15} \boldsymbol{R_{DirT}}_{t-1} + \beta_{16} \boldsymbol{R_{DirT}}^2_{t-1} + \mu_t \quad (10)$$

$$\Delta \boldsymbol{G_{RGdp}}_t = \beta_0 + \sum_{i=1}^{p-1} \beta_{1i}\, \Delta \boldsymbol{G_{RGdp}}_{t-i} + \sum_{i=0}^{p_1-1} \beta_{2i}\, \Delta Inf_{t-i} + \sum_{i=0}^{p_2-1} \beta_{3i}\, \Delta DCPS_{t-i} + \sum_{i=0}^{p_3-1} \beta_{4i}\, \Delta FDI_{t-i} + \sum_{i=0}^{p_4-1} \beta_{5i}\, \Delta Emp_{t-i} + \sum_{i=0}^{p_5-1} \beta_{6i}\, \Delta CD_{t-i} + \sum_{i=0}^{p_6-1} \beta_{7i}\, \Delta \boldsymbol{R_{IndT}}_{t-i} + \sum_{i=0}^{p_7-1} \beta_{8i}\, \Delta \boldsymbol{R_{IndT}}^2_{t-i} + \beta_9 \boldsymbol{G_{RGdp}}_{t-1} + \beta_{10} Inf_{t-1} + \beta_{11} DCPS_{t-1} + \beta_{12} FDI_{t-1} + \beta_{13} Emp_{t-1} + \beta_{14} CD_{t-1} + \beta_{15} \boldsymbol{R_{IndT}}_{t-1} + \beta_{16} \boldsymbol{R_{IndT}}^2_{t-1} + \mu_t \quad (11)$$

where Δ symbolizes the first difference, β_0 defines the intercept component, βs indicates the coefficients of variables, and μ is the error term or white noise residuals. The ARDL model estimates Equations (1) through (11) to get the optimal lag order for each variable. The subsequent hypotheses should be tested to decide determine the presence of cointegration among variables. The null hypothesis of no cointegration is as follows (Pesaran et al., 2001):

$$H_0: \begin{bmatrix} \beta_9 \\ \beta_{10} \\ \beta_{11} \\ \beta_{12} \\ \beta_{13} \\ \beta_{14} \\ \beta_{15} \\ \beta_{16} \end{bmatrix} = 0_{8\times1}$$ is tested against the alternative; that is: $H_1: \beta_9 \neq 0$ or $H_1: \begin{bmatrix} \beta_{10} \\ \beta_{11} \\ \beta_{12} \\ \beta_{13} \\ \beta_{14} \\ \beta_{15} \\ \beta_{16} \end{bmatrix} \neq 0_{7\times1}$

The time series are cointegrated if the computed F-statistics are greater than the appropriate higher bounds I(1) and not cointegrated if the computed F-statistics are below the lower bounds I(0) of Pesaran et al. (2001). Equation (1) provides the short-run and long-run effects concurrently after the adjustment is completed. The long-run effects are inferred by the estimates of β_{10}, β_{11}, β_{12}, β_{13}, β_{14}, β_{15} *and* β_{16} that are normalized on the estimate of β_9. After obtaining evidence for the presence of cointegration among variables, the optimal lag orders of each variable were chosen using the suitable AIC. According to the empirical literature,[1] the maximum lag order is usually between 2 and 4 for annual data in order not to lose more degrees of freedom, which is very important for the reliability of the results. Since in this study the data set is relatively large, the maximum lag of 3 was taken to find the cointegration among variables. Selected ARDL models in Table 4 below are revealed as optimal for the series of models used in this paper.

[1] See, for example, Pesaran and Shin, 1999; Pesaran et al. 2001.

Table 4: Selection of optimal models

	Selected Model
Model 1	ARDL(3, 3, 3, 3, 2, 3, 0, 3)
Model 2	ARDL(3, 3, 3, 3, 3, 3, 3, 3)
Model 3	ARDL(3, 3, 2, 3, 3, 3, 1, 2)
Model 4	ARDL(3, 3, 3, 3, 3, 3, 3, 3)
Model 5	ARDL(1, 1, 3, 2, 0, 2, 2, 2)
Model 6	ARDL(2, 0, 2, 2, 2, 2, 0, 2)
Model 7	ARDL(1, 0, 2, 2, 2, 0, 0, 1)
Model 8	ARDL(1, 0, 0, 2, 2, 0, 0, 0)
Model 9	ARDL(3, 3, 3, 3, 3, 3, 3, 0)
Model 11	ARDL(2, 0, 2, 2, 0, 0, 2, 1)
Model 12	ARDL(1, 0, 2, 1, 3, 3, 3, 3)

Table 5 summarizes the computed F-statistics of the models. These values are compared with the critical values of Pesaran et al. (2001). The results indicate that cointegration relationships exist between independent variables for all models.

Table 5: F-Bounds test results (Null hypothesis: No level relationship)

Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
Model 1			Asymptotic: n=1000	
F-statistic	**8.00**	1%	2.96	4.26
Model 2			Asymptotic: n=1000	
F-statistic	**6.16**	1%	2.96	4.26
Model 3			Asymptotic: n=1000	
F-statistic	**11.91**	1%	3.31	4.63
Model 4			Asymptotic: n=1000	
F-statistic	**3.49**	5%	2.32	3.5
Model 5			Asymptotic: n=1000	
F-statistic	**14.83**	1%	2.54	3.91

Model 6			Asymptotic: n=1000	
F-statistic	**6.68**	1%	2.54	3.91
Model 7			Asymptotic: n=1000	
F-statistic	**20.03**	1%	2.96	4.26
Model 8			Asymptotic: n=1000	
F-statistic	**25.75**	1%	3.31	4.63
Model 9			Asymptotic: n=1000	
F-statistic	**6.76**	1%	2.96	4.26
Model 10			Asymptotic: n=1000	
F-statistic	**23.73**	1%	2.54	3.91
Model 11			Asymptotic: n=1000	
F-statistic	**13.2470**	1%	2.54	3.91

Since all series are cointegrated, the long-run coefficients can be estimated. The estimated long-run coefficients of the variables are presented in Tables 6 and 7. Diagnostic tests were conducted. The autocorrelation problem was found in all models except 6, 8, and 10. To solve this problem, the Heteroscedasticity and Autocorrelation Consistent (HAC) estimator was applied. Other results provide no evidence of the diagnostic problem in the long-run estimation of all models. CUSUM and CUSUM-Q test results are given in Figure A1 in the Appendix.

Table 6: Long-run estimate results for government expenditure.

Dependent Variable: Annual Real GDP Growth Rate

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
INF	−0.03***	−0.05***	−0.01*	−0.05***	−0.04***	−0.04**	−0.00	−0.02
	(−3.16)	(−4.67)	(−2.6)	(−4.16)	(−4.17)	(−2.67)	(−0.21)	(−1.23)
DCPS	−0.05***	0.08	0.36*** (5.84)	0.04	0.01	0.00	−0.01	0.40***
	(−4.30)	(1.66)		(1.24)	(0.90)	(0.04)	(−0.89)	(4.23)
FDI	−4.62***	−4.76***	−4.03***	−3.91***	−2.87***	−3.02***	−3.59***	−3.96***
	(−6.08)	(−6.75)	(−5.96)	(−7.01)	(−7.54)	(−3.42)	(−3.71)	(−3.63)
EMP	−0.34***	−0.46***	−1.80***	−0.42***	−0.22***	−0.27***	−0.22	−1.97***
	(−5.47)	(−7.12)	(−6.66)	(−7.08)	(−5.00)	(−3.52)	(−1.00)	(−4.56)
CD	−11.52***	−15.280***	−7.040***	−14.11***	−7.61***	−7.91***	−6.06***	−6.33***
	(−7.72)	(−13.299)	(−4.962)	(−13.16)	(−7.29)	(−3.63)	(−4.28)	(−4.49)
ECenGov	0.66***							
	(3.13)							
ECenGov^2	−0.01**							
	(−2.81)							
EE		11.48**						
		(2.79)						
EE^2		−2.06**						
		(−2.38)						
HE			24.43*** (5.97)					
HE^2			−10.27***					
			(−4.65)					
EHE				7.45***				
				(4.03)				
EHE^2				−1.06***				
				(−3.46)				
DE					20.75***			
					(10.01)			
DE^2					−5.00***			
					(−10.79)			
CE						5.06***		
						(4.65)		
CE^2						−0.24***		
						(−4.29)		
IE							5.48**	
							(2.06)	
IE^2							−1.06*	
							(−1.72)	
CIE								5.90**
								(2.29)
CIE^2								−0.19*
								(−2.02)

Trend			−2.96***					−1.25***
			(−4.52)					(−4.32)
Constant	58.21***	50.06***	289.74***	48.87***			14.73	99.07***
	(4.76)	(3.53)	(5.23)	(4.04)			(1.38)	(3.35)
Opt. Gov. Size	23.85	2.78	1.18	3.50	2.07	10.29	2.57	15.07
R^2	0.95	0.97	0.97	0.97	0.93	0.86	0.84	0.82
Adjusted R^2	0.84	0.88	0.92	0.87	0.86	0.74	0.74	0.74
Observations	40	40	40	40	40	41	41	41

Note: Values in parentheses are t-statistics. Asterisks (*), (**), (***) denote statistical significance at 10%, 5%, and 1%, respectively.

Table 7: Long run estimate results for government revenues
Dependent Variable: Annual Real GDP Growth Rate

Variable	**(9)**	**(10)**	**(11)**
INF	−0.06***	−0.04***	−0.00
	(−3.67)	(−3.38)	(−0.42)
DCPS	−0.07***	−0.03	0.12**
	(−4.44)	(−1.61)	(2.13)
FDI	−5.16***	−3.21***	−1.13
	(−8.14)	(−5.69)	(−1.68)
EMP	−0.50***	−0.18***	−0.09
	(−6.22)	(−3.70)	(−1.08)
CD	−11.17***	−4.49***	−25.96***
	(−7.14)	(−3.15)	(−6.28)
RCenGov	1.84**		
	(3.00)		
$RCenGov^2$	−0.05**		
	(−2.81)		
RDirT		8.77***	
		(7.83)	
$RDirT^2$		−0.93***	
		(−8.61)	
RIndT			3.31*
			(2.00)
$RIndT^2$			−0.26*
			(−2.03)
Constant	56.69***		
	(5.35)		
Opt. Gov. Size	17.10	4.68	6.34
R^2	0.95	0.86	0.93
Adjusted R^2	0.85	0.78	0.84

Note: Values in parentheses are t-statistics. Asterisks (*), (**), (***) denote statistical significance at 10%, 5%, and 1%, respectively.

Table 8. Basic statistics related to government size

Alternative Proxy Measures for Government Size	Mean	Maximum	2016 Realization Rate	Optimal Rate*	Observations
ECenGov	19.11	33.54	22.55	23.85	40
CIE	14.40	18.91	18.34	15.07	41
CE	11.80	15.77	14.84	10.29	41
IE	2.59	4.40	3.50	2.57	41
EHE	3.54	5.80	5.8	3.50	40
EE	2.75	4.60	4.60	2.78	40
HE	0.78	1.60	1.20	1.18	40
DE	1.99	3.01	1.20	2.07	40
RCenGov	16.19	24.28	20.58	17.10	40
RDirT	5.39	7.22	5.29	4.68	41
RIndT	7.68	12.77	12.08	6.34	40

* It covers 1974–2016.

Table 8 presents basic statistics related to proxy measures for government size. Because the means of the proxy measures used for government size and the 2016 realization rates are significantly different, the optimal rates obtained from the econometric analysis are compared with the 2016 realizations in order to reach more realistic inferences and enable future rational policy proposals. Figure 2 presents the BARS curve for Turkey by alternative proxy measures for government size. The realized central government budget expenditure in 2016 is 22.55% of GDP and the optimum estimated for this expenditure indicator is 23.85%, so the government size indicator is below the optimal ratio.

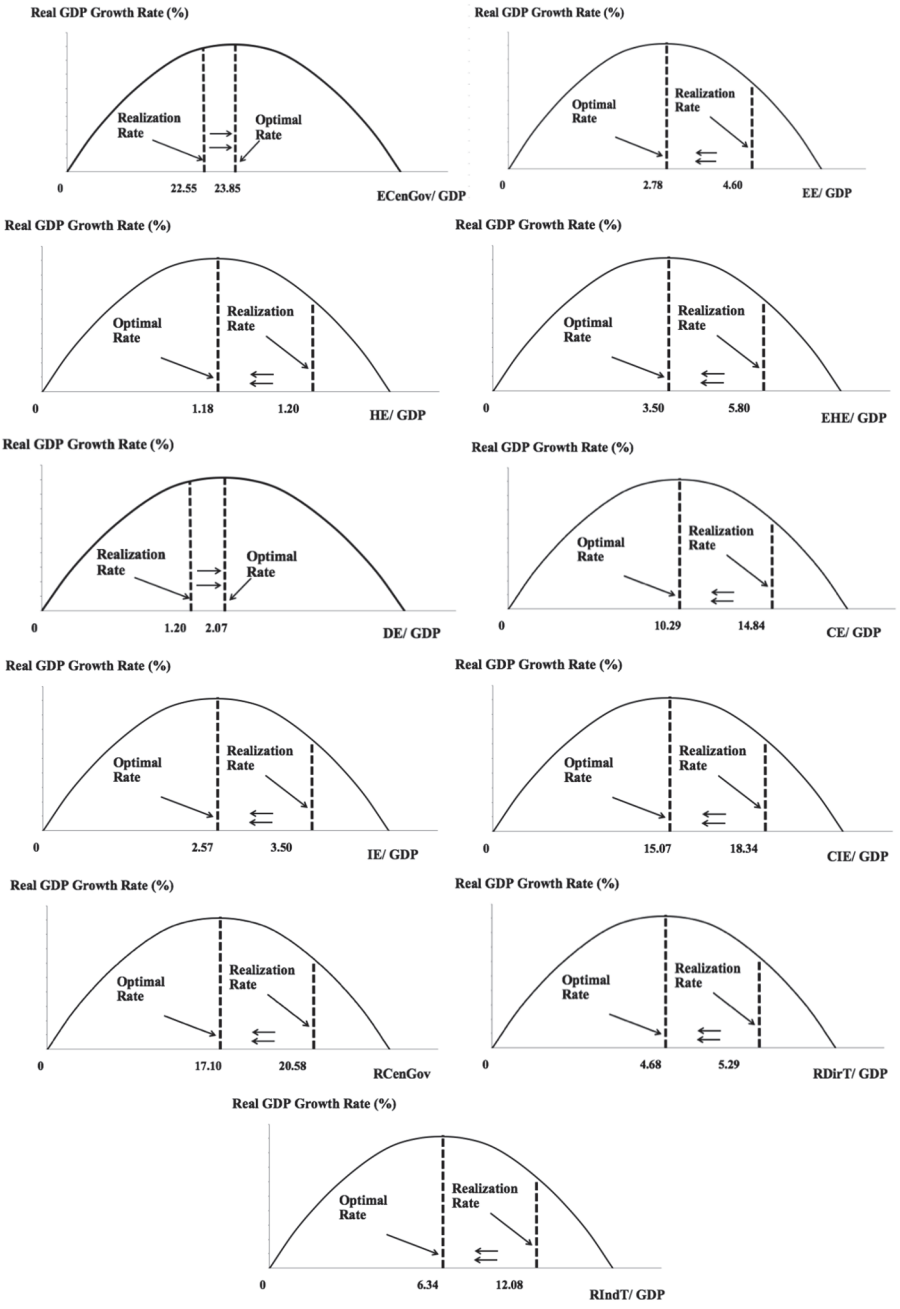
Central government real expenditure consists of the sum of central government investment and consumption expenditure. The results suggest that the central government's real expenditure should be reduced. Which component or components of this expenditure should be decreased is important, so central government investment and consumption expenditure are estimated separately. The 2016 realization rate of central government consumption expenditure for the

year 2016 is 14.84% of GDP, and the optimal size of government is estimated at 10.29%. The realization rate of central government investment expenditure in 2016 is 3.50% of GDP and the optimal rate is estimated to be 2.57%. These findings suggest that both central government consumption and investment expenditure should be reduced to avoid a negative effect on economic growth.

Additionally, the 2016 realization rates of central government education and health expenditure are 4.60% and 1.20% of GDP respectively, above the estimated optimal rates of 2.78% and 1.18%. Although the realization rate for central government education and health expenditure to GDP is well above the optimal rate, the inability to obtain the desired efficiency from the expenditure shows that it was not used efficiently and effectively. On the other hand, central government defence expenditure in 2016 is 1.20% of GDP, whereas the estimated optimal rate for this indicator is 2.07% of GDP, indicating that defence expenditure should be increased.

The examination of central government budget revenue as an indicator of government size shows that the central government budget revenue for the year 2016 is 20.58% of GDP. The estimated optimal percentage for this proxy measure is 17.10%, so the current rate is above the optimal rate. In this study the central government's direct and indirect tax revenues are estimated separately. The realization rate of the central government's direct tax revenue in 2016 is 5.29% of GDP, while the estimated optimal rate is 4.68% of GDP. The realization rate of the central government's indirect tax revenue in 2016 is 12.08% of GDP and the estimated optimal rate is 6.34% of GDP. These findings show that the central government budget revenue is well above the estimated optimal percentage of GDP for central government direct and indirect tax revenue in Turkey.

Figure 2: Bars curves for Turkey by proxy measure of government size



6. ROBUSTNESS CHECK

When performing empirical analysis, strict assumptions may be made that can affect the results. It is necessary to test whether the results of the empirical analysis are robust with different methods or variables. Therefore, a robustness test is performed to verify long-run analysis results. Central government budget revenues lagged by one year are added to the first eight and the last three models in which central government budget expenditure and its sub-components are used as proxies for government size. The variables are lagged by one year to eliminate the endogeneity problem (Wooldridge, 2012) between the central government budget expenditure and revenue. Tables 9 and 10 show that the long-run estimations confirm the inverted U-shaped relationship between government size and economic growth for Turkey.[2]

Table 9: Robustness check results for government expenditure

Dependent Variable: Annual Real GDP Growth Rate

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
INF	−0.08**	−0.02	−0.00	−0.00	−0.04**	−0.04	0.01	0.00
	(−2.58)	(−0.69)	(−0.48)	(−0.27)	(−2.68)	(−1.50)	(0.41)	(0.27)
DCPS	−0.09**	0.11	0.49***	0.42***	−0.00	0.01	0.01	0.74***
	(−2.59)	(1.47)	(8.02)	(4.10)	(−0.28)	(0.44)	(0.74)	(6.92)
FDI	−3.65***	−4.52***	−3.94***	−4.68***	−3.13***	−3.34**	−3.83***	−8.82***
	(−3.88)	(−3.21)	(−8.78)	(−6.58)	(−5.65)	(−2.53)	(−4.48)	(−6.58)
EMP	−0.13**	−0.23**	−2.37***	−1.95***	−0.14***	−0.29**	−0.03	−3.68***
	(−2.86)	(−2.35)	(−8.33)	(−5.31)	(−3.02)	(−2.22)	(−0.39)	(−7.64)
CD	−	−7.89***	−5.91***	−7.21***	−8.19***	−8.07***	−7.29***	−4.96***
	17.39***	(−4.88)	(−3.73)	(−4.64)	(−9.10)	(−3.20)	(−4.32)	(−4.93)
	(−6.51)							
ECenGov	3.18***							
	(5.57)							
ECenGov^2	−0.04***							
	(−4.78)							
EE		12.93**						
		(2.52)						
EE^2		−2.33**						
		(−2.30)						

[2] Diagnostic tests for autocorrelation, heteroscedasticity, normality, and stability (Cusum and Cusum-Q) were conducted. Results from the authors upon request.

HE			35.93***					
			(4.51)					
HE²			−15.61***					
			(−3.98)					
EHE				9.89**				
				(2.80)				
EHE²				−1.16**				
				(−2.28)				
DE					16.83***			
					(5.54)			
DE²					−4.31***			
					(−8.25)			
CE						5.59**		
						(2.78)		
CE²						−0.27***		
						(−3.09)		
IE							4.84*	
							(1.82)	
IE²							−1.30***	
							(−3.19)	
CIE								6.70***
								(3.46)
CIE²								−0.22**
								(−3.14)
RCenGov(−1)	−1.27**	0.20	0.00	0.16**	0.11	−0.05	0.35***	0.74***
	(−3.26)	(1.11)	(0.05)	(2.31)	(0.88)	(−0.25)	(4.13)	(5.45)
Trend			−2.80***	−2.09***				−2.77***
			(−5.22)	(−3.97)				(−6.99)
Constant			255.05***	193.29***				232.51***
			(5.95)	(4.76)				(6.97)
Opt. Gov. Size	33.17	2.76	1.15	4.23	1.94	10.06	1.86	15.16
R^2	0.97	0.78	0.96	0.94	0.90	0.89	0.94	0.99
Adjusted R^2	0.84	0.68	0.88	0.84	0.83	0.77	0.82	0.96
Observations	39	40	40	40	41	41	40	40

Note: Values in parentheses are t-statistics. Asterisks (*), (**), (***) denote statistical significance at 10%, 5%, and 1%, respectively.

Table 10: Robustness check results for government revenue

Dependent Variable: Annual Real GDP Growth Rate

Variable	(9)	(10)	(111)
INF	–0.02	–0.01	–0.07***
	(–0.93)	(–0.85)	(–5.50)
DCPS	–0.05**	–0.02	0.07
	(–2.78)	(–0.91)	(1.04)
FDI	–2.79***	–2.10**	–4.96***
	(–3.89)	(–2.63)	(–8.12)
EMP	–0.14	0.04	–0.57***
	(–1.58)	(0.33)	(–4.92)
CD	–13.34***	–4.31***	–16.50***
	(–12.58)	(–3.98)	(–5.33)
RCenGov	1.57*		
	(1.88)		
RCenGov^2	–0.06*		
	(–2.00)		
RDirT		19.55***	
		(3.06)	
RDirT^2		–1.95***	
		(–3.36)	
RIndT			7.46***
			(6.54)
RIndT^2			–0.47***
			(–4.34)
ECenGov(–1)	0.52**	0.09	–0.21
	(2.32)	(0.89)	(–0.71)
Constant		–61.74**	61.82
		(–2.32)	(1.74)
Opt. Gov. Size	12.51	5.00	7.90
R^2	0.81	0.89	0.98
Adjusted R^2	0.68	0.80	0.92
Observations	41	41	39

Note: Values in parentheses are t-statistics. Asterisks (*), (**), (***) denote statistical significance at 10%, 5%, and 1%, respectively.

7. CONCLUDING REMARKS

Studies examining the relationship between government size and economic growth yield quite different results. The main reason for these differences is the variable or variables used as indicators of government size. Other possible causes are the specific characteristics of the country studied, the period studied, and the different econometric methods used.

In this context, the purpose of this article is twofold. First, it examines whether the inverse U-shaped relationship between government size and economic growth is valid for Turkey in the period 1974–2016. Second, it estimates the optimal government size for this period, based on various indicators, in order to compare it with the current situation. Long-term coefficients were obtained using the ARDL bounds test, then the square of the variable used for government size was added to the model. Next, the optimal government size ratios were calculated by testing whether the relationship between economic growth and government size was linear.

Our findings show that there is a long-run relationship between government size and economic growth, and this relationship confirms the validity of the BARS curve. However, this validation depends on how government size is measured. As long as the 11 variables – ECenGov, EE, HE, EHE, DE, CE, IE, CIE, RCenGov, RIndT, RDirT – are taken as proxies for government size, the results support the existence of this relationship. Moreover, our results are in line with other studies (Peden 1991; Scully 1994; Karras 1996; Vedder and Gallaway 1998; Chao and Grubel 1998; Afonso et al. 2003; Chobanov and Mladenova 2009; Forte and Magazzino 2011; Christie 2014; Asimakopoulos and Karavias 2016; Forte and Magazzino 2016; Şen and Kaya 2019) that also found a non-linear relationship between government size and economic growth.

When the empirical findings of the study are evaluated in terms of expenditure, the estimation results for the optimal government size show that expenditures other than the central government budget and defence expenditure are above the estimated optimal rates and should be reduced. A decrease in these expenditures to the calculated optimal rates will lead to increased economic growth.

The government size that maximizes economic growth in terms of taxes shows that the realization rates of both indirect and direct tax revenues are above the optimal rates. Therefore, to maximize economic growth in Turkey, both indirect and direct taxes should be reduced until the calculated optimal rates are reached.

These results show that it is possible to achieve economic growth without additional financing by changing the composition of expenditures and using existing resources more effectively and efficiently. In particular, it is vital for developing countries to implement policies to avoid wasting resources and to achieve and even maintain economic growth without the need for borrowing. Fiscal policy instruments such as public expenditure and taxes should not fall below or exceed the calculated optimal ratios.

This study has some limitations. It focuses primarily on central government expenditure and revenue and their main sub-components. However, these sub-components also have other sub-components, which could be examined in more detail in future research. The data is limited to the period 1974–2016, as no longer-term data for the variables is available. Finally, the analysis used a linear econometric method; future studies could contribute to the literature by using non-linear methods.

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Received: March 14, 2021
Accepted: February 28, 2022

APPENDIX

Table A1: Descriptive statistics

	RGdpG	CE	IE	CIE	DE	EE	HE	EHE	ECenGov	RCenGov	RDirT	RIndT	INF	FDI	DCPS	EMP
Mean	4.54	11.80	2.59	14.40	1.99	2.75	0.78	3.54	19.11	16.19	5.39	7.68	40.95	0.80	25.73	54.99
Maximum	11.11	15.77	4.40	18.91	3.01	4.60	1.60	5.80	33.54	24.28	7.22	12.77	105.21	3.65	69.85	67.50
Minimum	−5.96	7.52	0.98	9.70	1.20	1.39	0.31	1.72	11.88	9.65	3.86	3.34	6.25	0.01	13.58	46.20
Std. Dev.	4.30	2.07	0.78	2.38	0.52	0.88	0.38	1.23	5.65	4.44	0.76	3.45	29.48	0.89	15.64	6.42
Skewness	−0.88	−0.49	−0.14	−0.11	0.01	0.31	0.63	0.30	0.66	0.12	0.22	0.28	0.38	1.53	1.72	0.47
Kurtosis	3.10	2.67	2.30	2.33	1.84	2.14	2.10	1.90	2.79	1.61	2.52	1.37	1.92	4.72	4.62	2.13
Jarque-Bera	5.58	1.96	1.03	0.89	2.38	2.04	4.31	2.83	3.22	3.53	0.75	5.29	3.11	22.14	26.01	2.94
Probability	0.06	0.37	0.59	0.63	0.30	0.35	0.11	0.24	0.19	0.17	0.68	0.07	0.21	0.00	0.00	0.22

Source: Author's computation

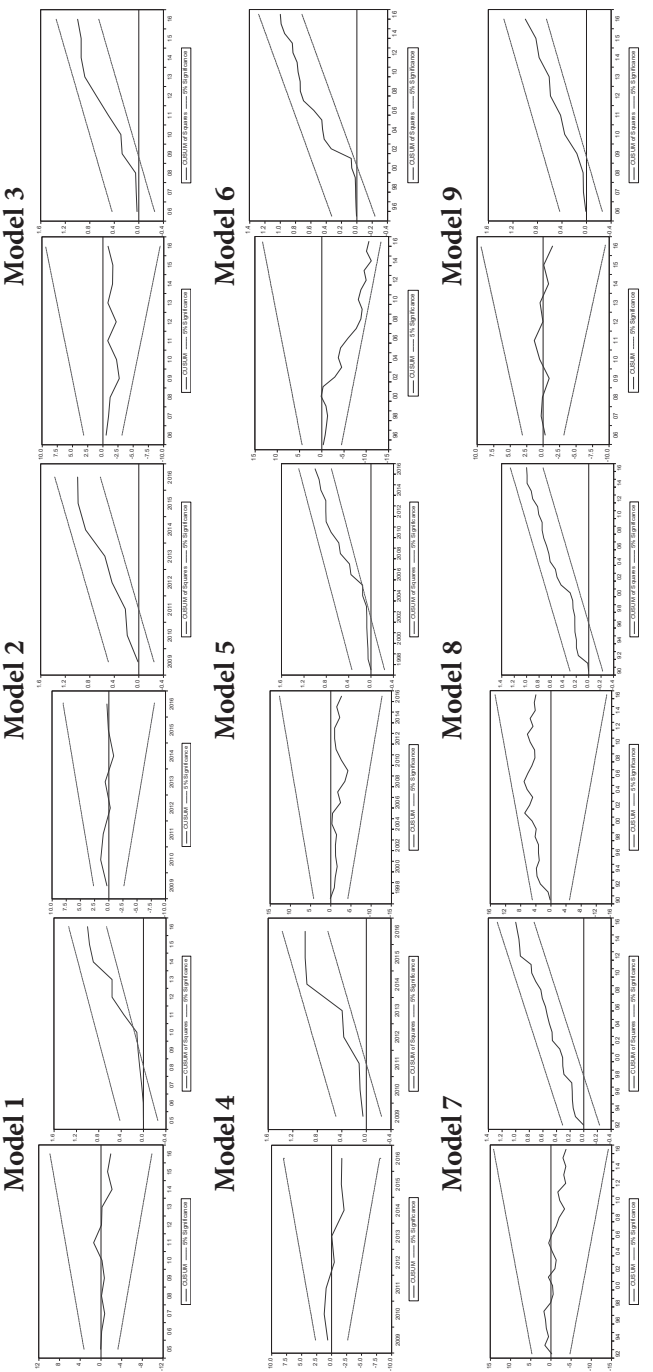

Figure A1: CUSUM and CUSUM-Q test results