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RESEARCH ARTICLE

The Causality between Public Expenditures and Economic Growth in Recent Times; Evidence from Turkey

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Abstract

Provided the results of the political elections in the economy of turkey together with the decision made by the government to foster growth and minimize spending, this research primary looks at the causality trend between total government expenses and growth of national income. Using World bank data from the period 2000 to 2021. The granger causality fails to confirm causality between government expenditure and national income the Toda Yamamoto concretely confirms bi-directional or two-way cause effect relationship between government income and total government expenses. Also, findings from the ARDL estimation, show that an increase in national income will reduce government expenditure, and as inflation continue to increase a large portion of government income will be spent.

Key Words: *Government; Expenditure; Toda yamamoto; Inflation; Income*

1. Introduction

Both emerging and wealthy nations have seen a marked increase in public spending. This was published a very long time ago, namely following the Second World War and the Industrial Revolution. This made a lot of economists wonder what the connection was between government spending and economic expansion. What must be the direction of flow and causality, and these elements brought two opposing points of view from two different schools of thought—Wagner's law and the Keynes hypothesis—regarding the rise in public spending and the role played by government in the expansion of the economy. The Wegner's Law, sometimes referred to as the law of growing state activities, states that public spending rises as income rises, which is a commonality between the two hypotheses. Adolph Wagner, a German economist, was the first to notice this theory in his own nation and afterwards in others. He was the one who gave it its name. Wegner [1] argues that government spending is an endogenous variable that follows or results from growth because he believes that the rise in public spending was caused by industrialization.

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Early on in the industrialization process, the private sector is reluctant to supply the government with services like telephony, infrastructure, sewage systems, and education. Urbanization, among other reasons, helps to an increase in the percentage of public expenditure, population growth, and good governance. Industrialization also reduces monopolies from the private sector, allowing for greater social development and economic efficiency. The demand for income-elastic public goods like energy, health care, and education increased as per capita income increased. On the basis of this supposition, the income elasticity of demand for public goods must be higher than one. Government also plays a crucial role in an economy by bridging the gap and resolving conflicts between private and social interests, which leads to an increase in socially beneficial investment. According to the Keynesian perspective, increased government spending spurs economic expansion. Therefore, government spending is viewed as an exogenous factor that boosts national output and acts as an economic engine for the economy. Contrary to Keynes [2] assertion, government spending is the best economic tool or policy during economic downturns. These two viewpoints are supported by additional hypotheses. A model was created to explain the correlation between government spending and economic growth by Rostove [3]. The Wagnerian model, which this method adheres to, outlined the stages of economic growth. Charumbira et al. [4] aligned the spending stages and types with the amounts of government expenditures. In the first phase, while the economy is still in its infancy, the government is the dominant force, investing heavily in the construction of roads and other forms of infrastructure. The private sector is the dominant participant in this economic boom that is characterized by rapid growth and little government, with the government typically playing a role in preserving law and order and controlling harmful externalities. Finally, there is the upper income and upper middle-class society, where the government is the main actor and has high levels of spending. Since this society has a strong demand for private goods and services, government spending is influenced by economic growth. The Rahn's hypothesis is commonly linked to Keynesian economics, as it suggests that there exists a specific level of government expenditure that stimulates economic progress. In simple terms, it proposes that government spending has the potential to drive economic growth, but only up to a certain point or optimum level. Beyond this level, the GDP is believed to decrease, thereby reinforcing the Keynesian principle that government spending plays a crucial role in boosting economic development.

The pre-1980 and post-1980 segments of the Turkish economy are separated into two categories. Post 1980 is regarded as the economic recovery road map for Turkey. This plan is referred to as the "Decisions of January 24, 1980." Prior to 1980, during this time the Democratic Party dictatorship, societal needs were taken into account in decision-making through the dynamics of political elections. According to Yay [5], populist developments were used, such as the insufficient tax collection, particularly from the main economic activity of agriculture, which caused a share of public expenditure to stand at an average of 17% with an expected ten-year government deficit. The Economic Stabilization Package, which targeted at the products and financial markets as well as economic liberalization, was brought about by the "January 24 1980 Decision" as the breaking point for Turkey. There was a period in the 1980s when the Gross Domestic Product was high, but following general elections in 1984 and the inauguration of a new administration, there was macroeconomic instability caused by variables such as inflation and budget deficits.

2. Literature Review

Wegner's work gained significant attention among academic researchers when it was translated into English. These researchers conducted various studies to verify the hypothesis, and the results have been mixed across different countries. In one such study, Singh et al. [6] analyzed time series data from 1950 to 1981 in India to establish a causal connection between government spending and national GDP. No Wagnerian or Keynesian causality evidence was discovered, according to the study's findings. Demirbas [7] investigated the long-term link between public spending and the GDP from 1950 to 1990. Wagner's theory received no support from cointegration or Granger causality tests, which were used. Islam [8] reexamined Wagner's law in the United States of America during the years 1929 to 1996 and discovered support. Al-Faris [9] undertook research on the Gulf Cooperation Council states to explore the relationship between public spending and economic growth. The study showed that a causal link exists between national revenue and government expenditure, thus supporting Wegner's hypothesis. However, the findings contradicted the Keynesian economic law that claims public spending results in national income growth as there was no evidence to support this idea. According to research done by Ram [10] on 115 nations between 1950 and 1980, 60% of the nation's embrace Wagner's law, whereas 40% do not. Turan [11] conducted research on the rise in public spending in Turkey between 1950 and 2004. Government spending and GDP were found to be individually cointegrated at I (1), supporting their long-term relationship. The causality test results demonstrated that the direction of causality was bidirectional, thereby confirming both the Wagnerian and Keynesian perspectives. Dogan et al. [12] employed the Granger causality test to investigate the causal direction between government expenditure and economic growth in five Asian nations: Singapore, the Philippines, Thailand, Malaysia, and Indonesia. Time series data were employed for a period of four decades, and evidence for the theory that government spending causes national income was only discovered in the case of the Philippines and not for other nations. On the other hand, there are also several research that contradict Wagner's law. Ansari et al. [13] also examined three nations and found little support for the law. Afxentiou et al. [14] did cross-country research looking at six countries. Singh et al. [6] performed research in India for the years 1950 to 1981; neither Wegnerian nor Keynesian causation evidence was discovered. Magazzino et al. [15] conducted a panel data study to investigate Wagner's law [16] and Peacock et al. [17] displacement effect in European Union nations. The research aimed to assess these theories and their potential effects on the EU countries. The research focused on the displacement effect, which refers to the increase in tax rates during times of conflict to finance defense expenses. Additionally, the study analyzed the correlation between government spending and national income in the European Union from 1980 to 2013. The findings showed that the Granger causality produced inconsistent results, but that the link between public spending and GDP tended to be more Wagnerian than Keynesian. In 155 developing and developed nations from 1970 to 2010, Jalles [18] employed panel data analysis to evaluate the relationship between government expenditure and economic growth. The results were more supportive of the Wagnerian paradigm. Meanwhile, Narayan et al. [19] assessed Wagner's law using panel data from the Central and Western regions of China. However, no substantial evidence was found to support this theory. Oteng-Abaiye [20] used the co integration test between government spending and per capita income to evaluate five ECOWAS nations, including Nigeria, Ghana, Sierra Leone, Guinea, and Gambia. Studies by Thabane et al. [21] in Lesotho using annual data from 1980 to 2012, and Ekpenyong and Ogbuagu in Nigeria using annual data from 1970 to 2014, both of which used the ARDL, bound test for co integration created by Pearson et al. 2001, gave support to Wagner's law. In Zimbabwe from 1960 to 2014, research by Kunofiwa [22] examined the Wagner's law utilizing military spending and economic development. Military spending does not directly cause economic growth, and neither does economic growth directly cause military spending, according to the ARDL method and co integration and granger causation. Santiago [23] also looked at the application of Wagner's legislation from 1980 to 2011 in Chile, Honduras, Panama, Colombia, and Paraguay. In all countries, the analysis discovered co integration evidence between GDP and government spending. Wagner's support was discovered in every country that was investigated, and Granger Pair Wise causality, which links GDP to government expenditure, found no evidence for either version.

Four groups may be made of Wagner's hypothesis studies:

The one that offers proof and backing for Wagner's theory and the unidirectional causality that runs from income to overall government spending.

(a) The Keynesian perspective, which asserts that government spending generates revenue in both directions.
(c) Studies that show a causal connection between income and government spending under both the Keynesian and Wagner hypotheses.
(d) No inferences, which are conclusions that have not been drawn based on evidence, support, or the ability to reason about the causal relationships between government spending and income and may result in a connection that is neutral between our variable of interest, which is government spending, and income.

2.1. Theoretical framework

The literature provides differing levels of evidence regarding Wagner's law and the association between government expenditure and the Gross Domestic Product (GDP). Wagner did not offer his works in mathematical form, as Dutt et al. [24] noted, hence many models were put out to study Wagner's law. To avoid the issues of omitting significant variables and model misspecification, this research uses contemporary econometric techniques and a multivariate model with the inclusion of a third variable while maintaining the traditional and standard Peacock et al. [17] approach. The empirical model adopts the next approach:

$$GE_t = f(Y_t, P_t)$$

In accordance with Wagner, public spending is seen to be a result of, among other things, population growth and economic expansion. Government spending was used in the study as an endogenous variable to examine both the Wagner's law and the Keynesian hypotheses. Economic growth, which is income, is used interchangeably in the research in place of the multivariate variable used by Peacock et al. [17]. In a multivariate model, the log linear equation is described as follows:

Model 1 in line with Wagner's law

$$\text{In}\ (GE_t) = \beta_0 + \beta_1\ \text{In}\ (Y_t + \beta_2)\ \text{In}\ (P) + \varepsilon_t$$

Model 2 in line with Keynesian
Peacock et al. [17] model in line with Keynesian theory.

$$\text{In}\ (Y_t) = \beta_0 + \beta_1\ \text{In}\ (G_t + \beta_2)\ \text{In}\ (P) + \varepsilon_t$$

3. Data and Methods

3.1. Data

The study primarily employs time series data in recent times. That is from 2000 to 2021, The variables include gross domestic product, total government expense expressed as a percent of GDP, inflation the growth of urban population and national debt of the economy. are in log form because the log transformed technique has many benefits, including greater linearity between the relevant variables and the ability to make skewed data more normal.

ln TGE_t is the Total government expenditure of Turkey in the study and they are many ways of measuring it such as measuring it as a percentage of GDP. In this study, Government Final Consumption Expenditure was used and Pryor [25] was the first one to employ it. The Global Economy Website postulates that Government Final Consumption Expenditure considers all the expenditures such as defense and all types of government expenditures are included. As literature suggested, government expenditures are stimulated by economic growth and according to Keynes [2] economic growth is stimulated by the expenditures of government. The gross domestic product refers to the total worth of all goods and services produced by a country's economy.

The Gross Domestic Product (GDP) is frequently used as a metric to assess the health and performance of the economy. Other researchers have used the Gross Domestic Product, which has gained wide acceptance in literature because it directly illustrates the relationship noted by Peacock et al. [17], Pryor [25], and Mann [26].

Wikipedia defines population as the complete count of individuals residing in a particular place, such as a city, town, country, region, or even the entire world. The population has a significant role in influencing the amounts of government spending as the country progresses toward a high-progressive society (industrialization), according to Wagner's theories [27,28]. According to Velenchick, when population grows and cities become more populated, there is a greater need for public services like schools, hospitals, and the building of road networks, among other things, which results in more public spending.

ε_t is the serially uncorrelated error term.
t is the time index of series

3.1.1. Stationary test or Unit root test

A dataset is considered stationary if both the mean and variance of the data remain constant over time, and the covariance between two distinct time periods relies solely on the time interval separating the two periods, rather than the specific time when the covariance is calculated. To avoid spurious regression results it is very vital to test on the stationarity of the series. To test for the unit root, we use the augmented dickey fuller tabulated by Dickey et al. [29] with specification as follows.

$$\mathrm{Yt} = \beta \mathrm{Yt} - 1 + \mu\mathrm{t} \tag{1}$$

If β =1 it means, there is unit root problem, or the series is not stationary but if β<1we can conclude the series is stationary. In the above equation we cannot directly test the hypothesis that β =1with the use of T- test because this will be biased. So, we subtract Yt-1 from both side of the equation

$$Yt - Yt - 1 = \beta Yt - 1 - Yt - 1 + \mu t = (\beta - 1)\, Yt - 1 + \mu t \tag{2}$$

$$\Delta Y = \theta Y_t - 1 + \mu t \tag{3}$$

Where θ is the same as $(\beta - 1)$ so for each time series the hypothesis is
H0: $\theta = 0$ (that is there is unit root, or the time series is not stationary or have stochastic trend)
H1: $\theta < 0$ (that is there is NO unit root, or the time series is stationary or have NO stochastic trend)

The ADF is also efficient because it allows for serially correlated error term μt.

$$\Delta Y = \beta 1 + \beta 2t + \theta Yt - 1 + \sum \alpha i\, \Delta Yt - 1 + \mu t \tag{4}$$

Several unit root tests were created by Phillips et al. [30], and they have since gained popularity in the study of financial time series. The primary areas where the Phillips-Perron (PP) unit root tests and ADF tests diverge are in their approaches to serial correlation and heteroskedasticity in the errors. The PP tests specifically ignore any serial correlation in the test regression while the ADF tests use a parametric autoregression to approximate the ARMA structure of the errors in the test regression. The PP tests' test regression is.

$$\Delta Y_t = \beta o Xt + \pi Yt - 1 + Ut \tag{5}$$

Where μt. is heteroskedastic and I (0). Any serial correlation and heteroskedasticity in the test regression's errors are considered by the PP tests.

3.1.2. Co integration test and lag length

When two or more series are non-stationary, but their linear combination is stationary, co integration takes place. Testing for co integration is necessary to ascertain whether one is modelling an empirically significant relationship. In this analysis, the long-term associations between the variables are examined. First, using the Akaike criteria (AIC), Schwarz Bayesian criterion (BIC), Hannah-Quinn criterion (HQC), and Akaike's Final Prediction Error (FPE) criterion, the appropriate number of lag lengths must be determined. From Liew [31] While the AIC and FPE operate best with smaller datasets (under 60 observations) and are the least likely to result in an underestimate, the HQC frequently performs better with larger datasets (over 120 observations). We can choose the lag length depending on which criterion result appears most frequently, and if there are ties, we can choose the lag length that is most suited for our model, presuming that too few or too many lags may not effectively depict the extent of the link between variables.

After ensuring the present and absent of unit root in the time series analysis, it is vital to ensure that variables have long run or short run relationship or equilibrium relationship.

$$Y_t = \beta 1 + \beta 2Xt + \mu t \tag{6}$$

Where Y and X are integrated at order 1, suppose we now subject the error term to unit root testing.

$$\mu_t = Yt - \beta 1 - \beta 2Xt \tag{7}$$

And discover that the error term is integrated that order (0) then it can be said there is co integration within variable. $\beta 2$ is the co-integration parameter and it is said that if variables are set to be co integrated, then they can be use and interpreted for long run analysis. In establishing causality, we must make sure that the underlining variables are stationary. It is important to note that.

3.1.3. Auto Regressive Distribution Lag (ARDL)

This model contains lagged values of the dependent variable as explanatory variable together with the current and lagged values of the regressors. Unlike VAR model, which is mainly design for endogenous variables, the ARDL model is design for both exogenous and endogenous variables. This model is best and should use in the case when variables are integrated and order 0 and 1 only. Supposed variables are integrated at seconds, using this model will portray spurious results. From the results of the bound test, we can make decision whether specify for the long and short run regression. If variables are co integration, then it approved to run the long run ARDL which the same as the error correction model. One of the advantages of the ARDL model is that results obtained are said to be unbiased. The model is generally specifying as

$$Y_t = Y_{o\iota} + \sum_{\iota=1}^{P} \delta Yt - 1 + \sum_{\iota=0}^{q} \beta\iota Xt - 1 + E\iota t \quad (8)$$

Y and X are dependent and explanatory variables respectively integrated at I (0) or I (1), and β are the coefficients, p, q, is the optimal lag order and Eit is the error term which is serially uncorrelated. With respect to the variables, we specify for the bound test as

$$\Delta TGE_\tau = \alpha o\iota + b1TGE\tau - b2GDPG\tau - \iota + b3TND\tau - \iota + b4URBAN\tau - \iota + b5INFL\tau - \iota + \sum_{\iota=1}^{P} \alpha 1\,\iota\,\Delta TGE\tau - 1 + \sum_{\iota=1}^{q} \alpha 2\iota \Delta GDPG\tau - 1 + \sum_{\iota=1}^{q} \alpha 3\iota \Delta TND\tau - 1 + \sum_{\iota=1}^{q} \alpha 4\iota \Delta URBAN\tau - 1 + \sum_{\iota=1}^{q} \alpha 5\iota \Delta INFL\tau - 1 \quad (9)$$

If no Co integration the short run model can be specified as

$$\Delta TGE_\tau = \sum_{\iota=1}^{P} \alpha 1\,\iota\,\Delta TGE\tau - \sum_{\iota=1}^{q} \alpha 2\iota \Delta GDPG\tau - 1 + \sum_{\iota=1}^{q} \alpha 3\iota \Delta TND\tau - 1 + \sum_{\iota=1}^{q} \alpha 4\iota \Delta URBAN\tau - 1 + \sum_{\iota=1}^{q} \alpha 5\iota \Delta INFL\tau - 1 + E\iota t \quad (10)$$

If there is Co integration, we can specify as follow adding the error correction model in it.

$$\Delta TGE_\tau = \sum_{\iota=1}^{P} \alpha 1\,\iota\,\Delta TGE\tau - 1 + \sum_{\iota=1}^{q} \alpha 2\iota \Delta GDPG\tau - 1 + \sum_{\iota=1}^{q} \alpha 3\iota \Delta TND\tau - 1 + \sum_{\iota=1}^{q} \alpha 4\iota \Delta URBAN\tau - 1 + \sum_{\iota=1}^{q} \alpha 5\iota \Delta INFL\tau - 1 + E\iota t \quad (11)$$

3.1.4. Models

$$TGE = GPDPG + TND + URBAN + INFL$$
$$TGE = \alpha o + \beta 1GPDPG + \beta 2TND + \beta 3URBAN + \beta 4INFL$$

Equations first and second represent the economic model and econometric model, respectively. The difference between these two models is that the econometric has the constant and trend parameters. The trend is also called the coefficient; in equation later, we have 4 coefficients (from β1to β4), each of these coefficients explains how much the dependent variable will change if the explanatory variable increases by 1 unit or a percentage. While the other four variables are regressors, the log value of the log of coal consumption remains constant.

4. Results and Discussion

Table 1: *Descriptive statistics.*

Variables	TGE	TND	URBN	EG	INF
Mean	35.28250	36.27273	2.135271	5.089682	16.44682
Median	34.17100	31.83200	2.225001	5.923500	9.244500
Maximum	44.03700	72.15500	2.735903	11.35300	55.03500
Minimum	31.20600	22.11500	1.365605	-5.75	6.251000
Std. dev.	3.091659	14.23535	0.380504	4.486766	15.05791
Skewness	1.366872	1.189776	-0.789951	-0.92135	1.828498
Kurtosis	4.305662	3.443990	2.901724	3.476430	4.859465

Table 1 above describes the variable dataset in greater detail. All variables have positive percentage means and medians when it comes to the measure of central tendency. URBN has the lowest mean and median, whereas TND and TGE have the highest mean and median respectively.

A dispersion measure, such as range and standard deviation, was also implemented. The highest and minimum values indicated the data's range. The variable with the highest range is TND with a maximum of 72.155 and a minimum of 22.115. Followed by INF with a range of 55.035–6.251. The variables with the lowest range are URBN and EG. The widest range indicates that the values are distant from each other. Standard deviation is another measure of dispersion that demonstrate how the data deviated from the mean. Variables with lower standard deviation estimates imply that the data are well segregated around the mean and high standard deviation means the data is far from the mean. Looking at the variables, URBN, TGE, and EG are nicely distributed around the mean; however, TND and INF have large standard deviations, indicating that their data is far from the mean.

Normality tests, such as skewness and kurtosis, demonstrate the standard distribution of values. Skewness is a distribution metric that measures asymmetry. In contrast a negative skewness distribution has a tail that extends to the left while positive skew extends to the right. UBRN and EG are negatively skewed i.e. slanted to the left, while TGE, TND, and INF are slanted to the right. Kurtosis is a measure of how much the tails of a probability distribution diverge from a normal distribution. TND, URBN, and EG are mesokurtic i.e. they have normal shapes while TGE and INF have a Leptokurtic form, which implies they have peak shape. Jarque Berra explains how the data is normally distributed or not. When the p-value of the Jarque Berra is greater than 5%, implies that the data is normally distributed. The p-value from the table is greater than 5%, indicating that the data is normally distributed.

Table 2: *Augmented Dickey Fuller's (ADF) Unit root test.*

Variables	Level	Probability	1st. difference	Probability
TGE	-3.900997	0.0082***		
TND	-5.613436	0.0002***		
URBN	-2.526368	0.1245	-2.556918	0.0136**
EG	-4.024635	0.0060*		
INF	-3.251315	0.0310**		

Note: *, ** and** specify the significance of variables at 10%, 5% and 1% respectively.

Table 3: *Phillip Peron's (PP) Unit Root Test.*

Variables	Level	Probability	1st. difference	Probability
TGE	-1.492175	0.5178	-4.626238	0.0017***
TND	-1.229396	0.6414	-5.890389	0.0001***
URBN	-0.790108	0.8013	-2.199297	0.0301***
EG	-4.009932	0.0062***		
INF	-3.14104	0.0387**		

Note: *, ** and** specify the significance of variables at 10%, 5% and 1% respectively.

In terms of stationarity, time series data are untrustworthy. It is necessary to determine the level of stationarity of the variables before utilizing the model to make predictions. The unit root test can be used to detect and stabilize non-stationary trends. Two-unit root tests Augmented Dickey-Fuller (ADF) and Philip Perron (PP) were employed in the study. Using the test results in Tables 2 and 3, there is inconsistency in the results from the two tests conducted. The ADF Tests demonstrated that all the variables are stationary at the level except URBN. Whereas the PP showed that, only EG and INF are stationary at a level while TGE, TND, and URBN became stationary at the first difference after destabilizing the trends. As a result, a mixture of I(0) levels and I(1) first difference resulted from the unit root tests. When I (0) and I (1) are combined, except for I (2), it is critical to select a model that will produce the correct results. The mode that can give accurate results from this unit root test is the ARDL. Omission bias and serial correlation in residuals are no longer issues with the ARDL technique, which also works well with small sample sizes [32].

Table 4: *VAR choice of lag order.*

LAG	LogL	LR	FPE	AIC	SIC	HQ
0	-255.7242	NA	41850.03	24.83087	25.07957	24.88485
1	-181.9574	105.3812*	436.5137*	20.18641*	21.67859*	20.51025*

The Schwarz Information Criteria were applied to the VAR model to determine the best lags for understanding the econometric framework (SIC), it may be helpful to look at some of the lags that may be particularly important. SIC always provides the length of the lag effects and gives accurate findings. Table 4 above showed an ideal lag interval of one.

Table 5: *ARDL Bound test.*

Test Statistics	Value	Significance	I(0)	I(1)
F-statistic	19.76726	10%	2.2	3.09
K	4	5%	2.56	3.49
		2.50%	2.88	3.87
		1%	3.29	4.37

After completing the stationarity tests for both ADF and PP tests in Tables 2 and 3, the model was selected based on previous findings. The ARDL bound test, rather than the cointegration test, was employed to verify the variables' long-term relationship [33]. Table 5 shows the ARDL bound test for the cointegration of the variables. The f-statistic values for both models are 6.686280 and 6.993874, respectively. The decision rule specifies that if the F statistic is less than 5% of the upper and lower bounds, there is no meaningful link between variables; nevertheless, it is confirmed that the F-statistics is greater than the 5% threshold for both the upper and lower bounds. This illustrates that there is a lengthy connection between the reliant variable and the regressors at 10%, 5%, and 1% significance levels. We discovered a long-term link between the variables after rejecting the null hypothesis.

Table 6: *Short-run ARDL.*

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
TGE (-1)	0.452673	0.12828	3.52879	0.0030***
INF	0.062264	0.029869	2.084594	0.0546*
EG	-0.339044	0.051282	-6.611367	0.0000***
URBN	1.127913	0.542285	2.079926	0.0551*
TND	0.014441	0.029795	0.484689	0.6349
C	16.89134	3.887525	4.345012	0.0006***
CointEq (-1)*	-0.547327	0.043524	-12.5753	0.0000***

Note: *, ** and** specify the significance of variables at 10%, 5% and 1% respectively.

The short-run association of the variables is shown in Table 6. The ARDL short-run model is made up of lagged values of the dependent variable and explanatory variables. The coefficients of the lag variables represent the short-run dynamics. The coefficients row indicates the betas of the variables. All the coefficients are significant except TND. Only URBN is elastic while the others are inelastic. The coefficient of the constant (C) is 16.89134. This value represents the value of the dependent variable (TGE) when all the independent variables are held constant with a significant p-value of 0.0006 (1%). The first lag of the dependent variable (TGE) has a positive connection with (TGE) at a 1 % p-value. TGE will increase by 0.062264 and 1.127913 percent respectively, if each of INF and URBN increases with p-values of 0.0546 and 0.0551 with the assumption that all other variables are constant. A percentage change in EG accounted for a 0.339044 percent decrease in TGE with ceteris paribus assumption. This implies that EG reduces TGE while INF and URBN increased it in the short run. TND also increases it but it has no significant impact. The Error Correction Model (ECM) combines short-run dynamics and long-run equilibrium in a time series analysis. It includes the concept of cointegration, which implies that variables have a long-run relationship. The appropriate specification is a (-1) ECM result. It met the a priori expectation, and it is statistically significant at the 1% level. The results show that INF, URBN, EG, and TND are cointegrated with the dependent variable (TGE) at a rate of 0.547327 (54.73%) and a p-value of 0.0000 (1%). The shift from short-term shocks to long-term adjustments will happen quickly.

Table 7: *Long-run Estimations ARDL.*

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
INF	0.11376	0.053041	2.144763	0.0488**
EG	-0.619454	0.200455	-3.090241	0.0075***
URBN	2.060767	1.100045	1.873348	0.0806*
TND	0.026385	0.051147	0.51586	0.6135
C	30.86154	2.194656	14.06213	0.0000***

Note: *, ** and** specify the significance of variables at 10%, 5% and 1% respectively.

The results of the ARDL investigation of the long-term regressors are shown in Table 7. Based on the results, the intercept coefficient is 30.86154 representing the value of TGE when the dependent variables are held constant. The elasticities are consistent with those in the short run. INF, EG, and TND are inelastic while URBN is elastic. TND also fails to show a significant impact on TGE in the long run. INF and URBN increase TGE by 0.113760 and 2.060767 percent respectively with a change in each of them with respect to the ceteris paribus assumption, whereas EG decreases TGE by 0.619454 with the same assumption with all significant p-values. Just like in the short run results, EG decreases TGE while INF and URBN increase TGE in the long run.

Table 8: *Residual Diagnostic Test.*

Test name	F-statistic	Probability	Results
Serial correlation	0.927472	0.2695	No serial correlation
Heteroscedasticity	0.52269	0.6821	Homoscedasticity
Normality	0.63334	0.728571	Normally distributed

Regression analysis requires residual diagnostics to evaluate a model's quality and suitability. It involves analyzing residuals and the differences between observed and predicted values. The residuals must have normality (a bell-shaped distribution), homoscedasticity (constant variance or no heteroscedasticity), and independence (no serial or autocorrelation correlation or patterns) to be valid. Table 8 shows residual diagnostic tests for the variables. The nulls in the residual diagnostic test are rejected if the p-value of each test surpasses the 5% threshold. The null hypothesis for the serial correlation test is no serial correlation. The p-value of the serial association test exceeds the 5% level threshold significance. In that regard, the null hypothesis failed to be rejected and confirmed that the residuals are free from auto or serial correlation. Similarly to the heteroscedasticity test, the p-value of the test is greater than 0.05. This shows that the residuals are Homoscedasticity or free from heteroscedasticity after the rejection of the null. The graph below demonstrates the distribution of data. It shows a normal bell-shaped distribution. The Jarque Berra has a significant p-value of less than 0.05. The null of the Jarque Berra statistic is Normal Distribution. The null failed to be rejected assured a normal distribution.

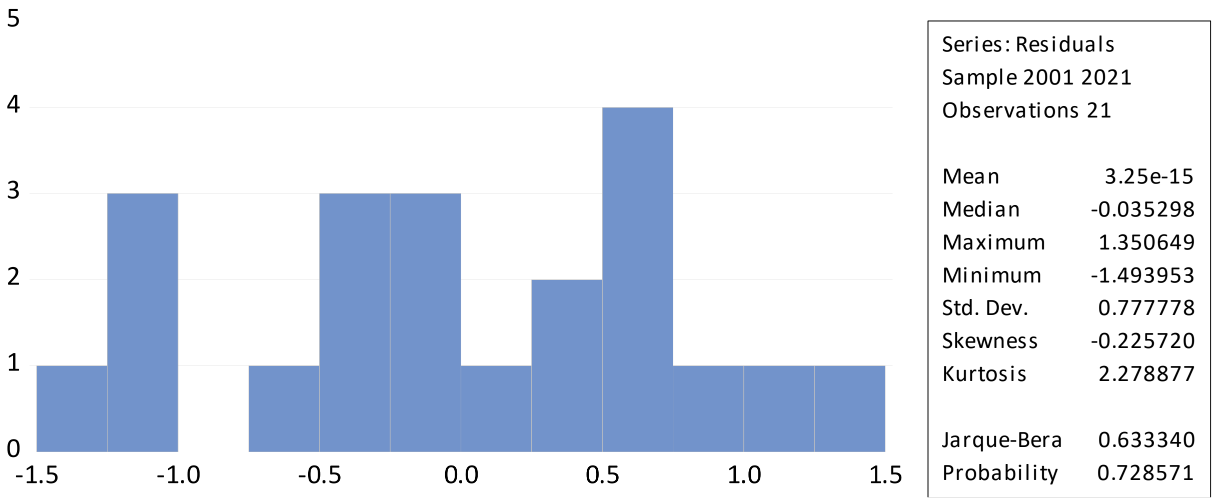

Figure 1: *Normality test.*

Table 9: *Granger Causality Test.*

Null hypothesis	F-Statistic	Probability
TND does not Granger Cause TGE	0.32282	0.5769
TGE does not Granger Cause TND	3.78619	0.0675
INF does not Granger Cause TGE	13.6598	0.0017
TGE does not Granger Cause INF	3.09069	0.0957
INF does not Granger Cause TND	27.189	6.00E-05
TND does not Granger Cause INF	6.6425	0.019

Note: *, ** and** specify the significance of variables at 10%, 5% and 1% respectively.

The Granger causality test results for the variables are shown in Table 9. It determines if the historical values of one variable may predict the future values of another. It establishes that one variable Granger causes the other by examining the p-values of the test. This suggests a predictive link between the two variables. The analysis found two pieces of evidence of the bi-directional relationship between the variables. The test found that there is a bi-directional causality between TND and INF at a significant value of 5%. INF and TGE also exhibit a bi-directional granger cause relationship between them. TGE also granger causes TND at 10% significance.

4.1. Causality (Toda Yamamoto)

In order to examine the causal relationship between various highlighted variables, the Toda-Yamamoto conditional Granger causality test is utilized. The reason for carrying out this analysis is to foster the development of strategies that promote coal consumption, trade policy, and environmental sustainability. This method employs a vector auto-regressive model with lag p that employs a modified Wald test statistic to effectively investigate the direction of causality between these variables. The Toda-Yamamoto causality technique outperforms the pairwise Granger causality method which requires that all explored variables be integrated I(0) or I(1). Fortunately, the Toda-Yamamoto causality test is straightforward to execute and provides accurate results if the examined variables are integrated I(0) or I(1). Moreover, while the Granger causality analysis failed to confirm any causal relationship between government expenditure and national income, Toda-Yamamoto causality confirmed a bidirectional or two-way causal relationship between government income and total government expenses.

Table 10: *Yamamoto Causality Test.*

Excluded	Chi-sq	df	Prob.
TND	0.939796	2	0.6251
URBN	0.878165	2	0.6446
EG	6.705811	2	0.035
INF	7.678929	2	0.0215
All	28.88047	8	0.0003
Dependent variable: TND			
TGE	6.773003	2	0.0338
URBN	0.591913	2	0.7438

EG	6.556641	2	0.0377
INF	3.871947	2	0.1443
All	17.46531	8	0.0256
Dependent variable: URBN			
TGE	4.915487	2	0.0856
TND	5.548196	2	0.0624
EG	2.727251	2	0.2557
INF	2.651329	2	0.2656
All	14.41204	8	0.0716
Dependent variable: URBN			
TGE	4.915487	2	0.0856
TND	5.548196	2	0.0624
EG	2.727251	2	0.2557
INF	2.651329	2	0.2656
All	14.41204	8	0.0716
Dependent variable: EG			
TGE	9.260368	2	0.0098
TND	0.841189	2	0.6567
URBN	2.324191	2	0.3128
INF	9.598683	2	0.0082
All	16.65225	8	0.0339
Dependent variable: INF			
TGE	0.367769	2	0.832
TND	3.444134	2	0.1787
URBN	8.8277	2	0.0121
EG	5.542095	2	0.0626
All	24.34018	8	0.002

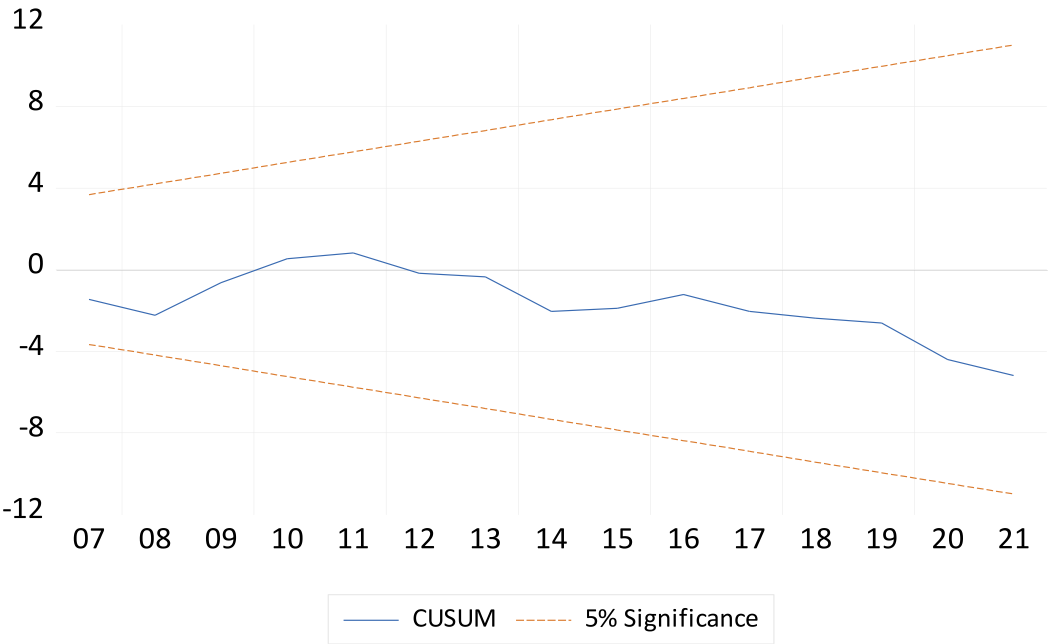

Figure 2: *Cusum test.*

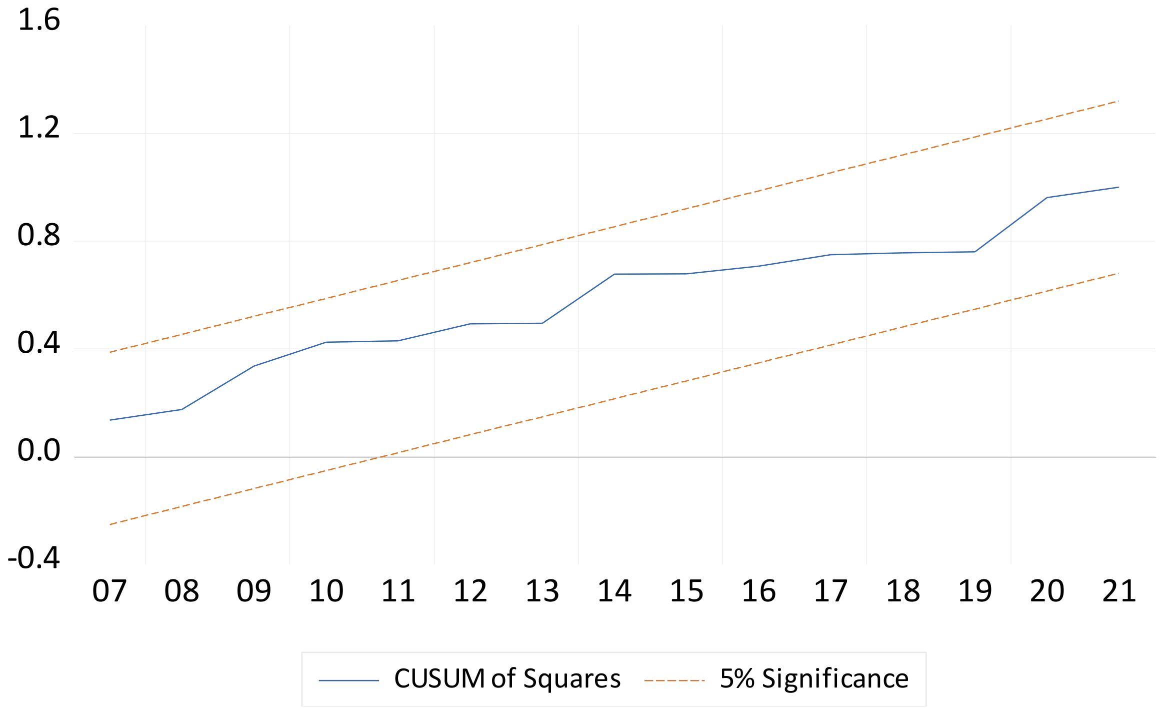

Figure 3: *Cusum of Square test.*

Cusum also known as cumulative sum, is a stability statistical approach for detecting data shifts or changes over time. It entails computing the total sum of deviations from a reference or goal value. Significant shifts in the data can be recognized by watching the cumulative amounts. Cusum of Square is an expansion of the Cusum technique that squares the deviations before summing them. This tweak makes it more sensitive to modest, long-term changes in the data. It is especially good for detecting slow changes or trends in data that standard Cusum may overlook. Cusum and Cusum Square are both frequently used in a variety of applications, including quality control, process monitoring, and time series analysis. They offer a systematic and efficient technique for identifying data changes, allowing for quick intervention and corrective actions. Figures 2 and 3 represent the Cusum and Cusum Square tests. It shows that the parameters are steady at 5% level.

5. Conclusion and Policy Implications

In the short run, lagged values of the dependent variable and explanatory factors make up the ARDL short-run model. The short-run dynamics are represented by the lag variables' coefficients. The betas of the variables are shown in the coefficients row. Except for TND, all of the coefficients are significant. The other is inelastic, but URBN is elastic. The constant's coefficient is 16.89134. With a significant p-value of 0.0006 (1%), this number shows the value of the dependent variable (TGE) when all the independent variables are held constant. At a 1% p-value, the initial lag of the dependent variable (TGE) is positively correlated with (TGE). 0.062264 and 1.127913 percent more TGE will be added, respectively, assuming all other variables are held constant then INF and URBN both rise with p-values of 0.0546 and 0.0551, respectively. With the ceteris paribus supposition, a percentage change in EG caused a 0.339044 percent decrease in TGE. This suggests that EG decreases TGE whereas INF and URBN temporarily boost it. TND also makes a bigger difference, but not significantly. In a time series study, the Error Correction Model (ECM) blends short-run dynamics and long-run equilibrium. It incorporates the idea of cointegration, which denotes a long-term link between the variables. The proper specification is an ECM result of (-1). It matched the predetermined expectation and is statistically significant at 1%.

The intercept coefficient, which represents the value of TGE when the dependent variables are held constant, based on the results, is 30.86154. The elasticities match those found in the short run. While URBN is elastic, INF, EG, and TND is inelastic. Additionally, TND fails to demonstrate any sustained influence on TGE. With respect to the ceteris paribus assumption, INF and URBN each raise TGE by 0.113760 and 2.060767 percent, whilst EG decreases TGE by 0.619454 with the same assumption and all significant p-values. In the long run, EG lowers TGE while INF and URBN raise it, much like in the short run results.

Using aggregate data for Turkey in recent times our major goal in this article was to test for Granger causality between GE and economic development (testing of Wagner's law and the Keynesian hypothesis). We used ADF to check for the presence of unit roots. We discovered that the GDP and public spending variables were not integrated in the same order, I (1), and that some of the variables were stationary in first differences. As a result, we were unable to use a co-integration test.

Despite some evidence suggesting that public spending and GDP are not co-integrated and stationary in this study, it is still possible to Examining the short-term links between variables is nevertheless interesting even when there is no co-integration between them. Utilizing the Musgrave model of Wagner's law, we examined the causality. However, there is no evidence to back up Keynes' theory or Wagner's law in this model. Because of people's ongoing need for more and better public goods and services—which can only be delivered by the public sector owing to market failure—GE rose during the course of the analysis period relative to national income.

Our research suggests that, contrary to Wagner's law, the rise of public spending in Turkey is not primarily influenced by and/or dictated by economic growth. Of fact, public spending is the result of several choices made in light of shifting economic and political conditions. It is influenced by decisions about the allocation of public funds among competing parties, whether they are geographically concentrated or consolidated into organized interests. The nature of Sudan's growth and other factors like political processes and the conduct of interest groups may thus be thought of as potential explanatory variables for the rise in the volume of public spending.

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