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The Effect of Defense Expenditures on Public Investment: An Econometric Application for Türkiye

Savunma Harcamalarının Kamu Yatırımları Üzerindeki Etkisi: Türkiye İçin Ekonometrik Bir Uygulama

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ÖZ

Bu çalışma, 1976-2024 dönemine ait yıllık veriler kullanılarak Türkiye'de askeri harcamaların kamu yatırımları üzerindeki etkisini Autoregressive Distributed Lag (ARDL) sınır testi yaklaşımı çerçevesinde incelemektedir. Gayri safi sabit sermaye oluşumu bağımlı değişken olarak tanımlanmış; savunma harcamaları, ekonomik büyüme, enflasyon ve işsizlik oranı ise bağımsız değişkenler olarak modele dahil edilmiştir. Ekonometrik analiz kapsamında değişkenler arasındaki uzun dönemli ilişki ARDL sınır testi ile incelenmiş ve değişkenler arasında eşbütünleşme ilişkisinin varlığı tespit edilmiştir. Uzun dönem tahmin sonuçları, ekonomik büyüme, enflasyon ve işsizlik oranının kamu yatırımları üzerinde pozitif etkiye sahip olduğunu göstermektedir. Kısa dönem dinamiklerini yansıtan hata düzeltme modeli (ECM) sonuçlarına göre, hata düzeltme terimi negatif ve %1 düzeyinde istatistiksel olarak anlamlıdır. Bu durum, kısa dönem sapmaların zaman içinde düzeltilerek sistemin uzun dönem dengeye geri döndüğünü göstermektedir. Bulgular Türkiye'de savunma harcamaları ile kamu yatırımları arasındaki ilişkinin çok boyutlu bir yapıya sahip olduğunu ve bu ilişkinin makroekonomik çerçevede dikkatli bir şekilde değerlendirilmesi gerektiğini ortaya koymaktadır.

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ABSTRACT

Using annual datasets from the 1976-2024 period, this study examines the impact of military expenditures on public investments in Türkiye through Autoregressive Distributed Lag (ARDL) bounds testing framework. Gross fixed capital formation serves as the dependent variable, and defense expenditures, economic growth, inflation, and unemployment are included as independent variables. The long-run relationship among cost variables used for econometric analysis has been examined using ARDL Bounds test. The long-run estimates indicate that economic growth, inflation rate, and unemployment positively influence the optimal level of public investments. The Error Correction Model (ECM) is able to predict short-run dynamics from the underlying database; therefore, in this case, it presents a negative and significant (at 1%) error correction term, meaning that deviations in the short-run will converge back towards the long-run. The findings demonstrate that defense spending and public investments in Türkiye have a multidimensional relationship; hence, their correlation should be analyzed precisely at a macroeconomic level.

1. Introduction

Public expenditures are important determinants of economic growth and development processes, which depend fundamentally on the quality of their composition (Barro, 1990). Because financial resources are necessarily low in developing economies and fiscal constraints more binding, public finance management (the allocation of public funds) is critical to sustainable and inclusive growth of the economy (International Monetary Fund (IMF), 2015; World Bank, 1993). Well-targeted public expenditure improves productivity and contributes to achieve long-term

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development objectives, increases the credibility of institutions and macroeconomic stability (OECD, 2019).

Defense spending is one of the main fields of public expenditure, and hence, defense expenditure has been increasingly regarded as a topic for both policy and academic debate within this larger background. In the backdrop of rising defense spending, critical questions pertaining to opportunity costs and resource allocation vis-à-vis still colossal issues in education, healthcare, and infrastructure (Collier and Hoeffler, 2007) have become paramount in ensuring national security, political stability, and territorial integrity. Therefore, its impact can go beyond security concerns to include broader economic dimensions.

The economic literature has extensively examined the relationship between defense expenditures and key macroeconomic variables, including growth, investment, and resource allocation. In other words, while this relationship exists, there is little consensus on its precise direction or strength. Some researchers claim that defense spending might boost economic growth via technological innovation, investment in infrastructure (Smith, 1995), and by increasing aggregate demand, while others focus on its possible crowding-out effects of productive investments. Thus, within the theoretical perspectives and empirical findings, there is contradictory evidence that this relationship may hold a complex or context-dependent nature (Benoit, 1973; Deger and Sen, 1995).

Literature analyses the effect of defense expenditures on public investments mainly by employing "crowding-out" and "crowding-in" hypotheses. The crowding-out paradigm postulates that defense outlays may crowd out productive public investments, for instance, infrastructure, education, and health, resulting in adverse long-term consequences for economic growth (Deger, 1986). By contrast, according to the crowding-in hypothesis, defense spending might itself even have strong positive effects on economic activity via technological progress (Alexander, 1990), a rise in industrial production and job creation (Dunne et al., 2005). Thus, the economic impacts of defense spending can vary based on national economic structures, institutional capacities, and macroeconomic contexts.

Not only for Türkiye but also for the regions in which it is located the geopolitical position of Türkiye backed by security dynamics has brought defense expenditures to a significant level. Over the past decades, defense policies have considered military spending not only as a national security expenditure but also as an enabler of domestic production capacity in the national defense industry and economic activity generally. Nevertheless, the question of how to interpret the rise of defense expenditures on public investments remains crucial for policy-makers in terms of its direction as well as magnitude. This situation lends itself to a salient research question for the Turkish economy: Does defense spending promote or crowd out public investments?

Both the national level of defense spending and more general macroeconomic conditions can affect public investments. Economic growth can increase public revenues, on the one hand creating more fiscal space for investment. In contrast, indicators like inflation and unemployment have an immediate impact on the investment climate. High inflation increases economic uncertainty and reduces investment decisions, whilst high unemployment can indicate recession and constraints on investment activity. This is why we must take these macroeconomic variables into account when analyzing the bivariate relationship between defense expenditures and public investments.

Much literature has studied the link between defense spending to economic growth or investment. Nevertheless, the nature or direction of this relationship is still not a foregone conclusion. Though Benoit (1973) found a positive association between military expenditure and economic growth, he pointed to the variance of this relationship by country. More recent research, such as Dunne and Uye (2009) indicate the effects are very country-specific. Empirical results for Türkiye are also mixed, indicating that the effect of defense expenditures on public investments may be affected by structural characteristics and time periods.

The primary goal of this research is to analyze the effects of defense expenditures on public investments in Türkiye with an econometric approach. To this end, time series data spanning the 1976-2024 period is used annually. The model employs gross fixed capital formation as dependent variable also defense expenditures, economic growth, inflation, and unemployment rate are treated as independent variables. The ARDL bounds test approach, as suggested by Pesaran et al. (2001), is utilized to assess the short-run and long-run relationship among these variables simultaneously. This method is particularly adapted for small samples and will allow the order of integration of the series to vary.

Furthermore, this study aims to make an empirical contribution to the relevant literature by offering a detailed assessment of the interplay between defense expenditures and public investments in various economic scenarios in Türkiye. The results are anticipated to provide useful insights for policymakers, especially public policies that can enhance resource allocation efficiency. The study is intended to benefit both the academic literature and the policy-making process in this regard.

2. Literature Review

One of the key issues discussed in economic literature is the relationship between military spending and macroeconomic

performance. Various theoretical paradigms and empirical evidence provide support for the analysis of the impact of such expenditures on economic growth, investment finance, employment, and price stability. Shifting perceptions of security, particularly in a post-Cold War world, have increased the need to evaluate opportunity costs and economic dividends from defense spending.

The earlier literature dealt with the promotion or crowding out of economic activity by defense spending. Defense spending in some developed countries and the resulting increase in aggregate demand for products has led to developing nations experiencing increased economic growth, a view maintained by Benoit (1973) as becoming one of the foundations of the military Keynesianism argument. Similarly, expenditures could contribute to long-term growth if directed toward productive sectors (Barro, 1990). Subsequent studies offer mixed empirical support.

Alexander (1990) analyzed the impact of defense expenditures on economic growth in advanced economies, and employed a four-sector production function model. The results showed that the defense spending had neither a significant positive nor a significant negative effect on economic growth. The study nevertheless found that, overall, the defense sector is not as productive in general.

Using U.S. data for 1951-2000, Heo and Eger (2005) estimated both direct and indirect impacts of military spending on economic growth. The aggregated estimation based on investment, employment and export channels indicates that defense expenditures have an indirect but negative impact on economic growth. Moreover, the direct impact of defense spending on growth was limited.

Khan et al. (2015) analyzed cases of five Asian countries covering the years from 1992 to 2013 and found no relationship between defense expenditures and unemployment, concluding that defense expenditure is not an effective tool for decreasing employment. Their education-backed approach found that redistributing military budgets into more productive sectors would increase welfare, while both investment and population control would be essential to curb wage unemployment.

Azam et al. (2016) used Panel DOLS analysis of SAARC countries, concluding that military expenditures reduced unemployment, followed by energy usage, per capita GDP, and foreign direct investment, which also exhibited the same trend.

Using data from 161 countries, Heo and Ye (2016) found that military expenditures crowd out private investment significantly in most parts of the world, despite their direct impact on growth remaining limited. Similarly, Faini et al. (1984) proved that military spending slows economic growth by suppressing savings and increasing tax burdens. Military expenditures have a weak and rarely statistically significant positive effect on growth, as shown by Mintz and Stevenson (1995) who analyzed 103 countries.

Lee et al. (2016) analyzed that the impact of military spending on economic growth through multiple channels, resource substitution, spillover effects, resource mobilization, and portfolio effects, but the net effect is unclear.

Similarly, Guo and Alotaish (2017) found that in the case of Saudi Arabia, defense expenditures positively affect both total GDP and non-oil GDP in the long run.

Sinha et al. (2018) conducted a comparative analysis on the relationship between defense expenditures and economic growth for developed and developing nations during 1960-2015. The results showed that for developed countries, as supported by panel cointegration and panel VAR analyses, defense expenditures stimulate economic growth, and the relationship is bidirectional. On the other hand, spending on defense has shown a detrimental effect on growth in developing states.

GMM estimation is used by Rahman and Siddiqui (2019) for 85 country cases, and they concluded that military expenditures negatively matter to produce economic growth in all cases except when military expenditures are combined with arms advertisement.

Within a neoclassical growth framework, the investigation of defense expenditures and economic growth was carried out by Mueller and Atesoglu (2019). The economy was modelled as split between defense and civilian sectors, and it alluded to the idea that technological progress may boost economic growth, but increased defense spending could inhibit this.

Saba and Ngepah (2022) assessed the link between military spending and economic growth and development in three regions; Sub-Saharan Africa, the Middle East and North Africa region, and Latin America during 1990-2018. The evidence suggested a long-run and bi-directional relationship between our research variables. In addition, the study indicated that a reduction in military outlays could spur economic growth and welfare.

Based on Keynesian and monetary models, Emmanouilidis and Karpetis (2021) then offered a general model based upon evidence from the Turkish national economy, stating that while defense expenditures lead to short-run income, this indirectly correlates with potentially heightened inflationary pressure over the longer-term. But empirical results for Türkiye do not fully conform to theory.

Ahmad et al. (2024) using ARDL model, investigated the determinants and persistence of unemployment in Pakistan during 1972-2021. They found that most macroeconomic

factors are statistically significant in determining unemployment in the long run but inflation is statistically significant only when we estimate regression for short period. They also reported bidirectional causality in the relationship between military expenditure and unemployment, whilst no causal link between inflation and unemployment was found.

Arya et al. (2024) investigated the role of economic growth, gross fixed capital formation, education, defense expenditures and innovation in peaceful and conflict-afflicted nations for 2007-2022. The results revealed that defense expenditure has a limited impact on economic growth in peaceful nations while it adversely affects growth in conflict-ridden countries. In addition, their analysis found that innovation is a driver of GDP growth across all countries and that gross fixed capital formation contributes importantly to long-run economic growth.

Solanki et al. (2025) analyzed the impact of defense expenditure on economic growth and unemployment in India for 1991-2017. The Johansen cointegration test shows that there is a long-run relationship among defense expenditures, unemployment and economic growth. The results also reveal that a rise in the unemployment rate increases military spending, while an increase in economic growth reduces military expenditure. Additionally, they found that military spending has a strong impact on GDP growth in the short run as well as in the long term.

Using ARDL and various nonlinear techniques, Akume and Akadiri (2025) find that military expenditures have an asymmetric impact on economic growth in Nigeria using data covering the period from 1980-2021 similar to evidence reported above: while increase in expenditure has a positive but not significant impact on economic growth, decrease return negative consequences that are statistically significant. Their work suggests that sustainable growth relies on transparency and diversification of economic and human capital.

Applying a PSTR model to the data of 82 countries over the period 1995-2020, Raza and Ahmed (2025) show that the push for military spending and unemployment is conditional on income levels. Specifically, low-income countries have a positive relationship between inequality and growth; middle-income economies are regime dependent in that respect while high-income economies showed a negative relationship. With the exception of GDP(negatively related) and population and inflation (positive relationship), all the other relationships are statistically significant.

Tsitouras and Tsounis (2026) found that military spending boosts short-run economic growth but damages it over longer horizons in the case of Greece. For the USA, bidirectional linkages were reported by Raifu and Afolabi (2023), who detected relationships between military expenditure and macroeconomic variables in growth, investment, and unemployment.

Other studies have more nuanced findings. The case of two-way causality was not different in the study by Wanjun and Xiaohe (2011) whereby a threshold effect is evident, as China with high levels of defense spending experience adverse effects on growth; conversely, once it passes this threshold limit defense expenditure can add positively to the economic growth. Huang et al. (2017) found that the relationship between defense spending and growth, depends on the Human Development Index (HDI), with negative effects diminishing as HDI increases. Emmanouilidis (2024) states that the economic effects of military expenditure depends on its composition (wages vs R&D vs) arms purchases. Miklif (2025) focusing on Iraq, concluded that military spending has only short-term effects and fails to generate sustainable growth in the absence of a strong domestic defense industry.

Overall, the literature does not seem to have a consensus about defense spending impacts on economic growth and investments. The results differ depending on countries' economic structure, security logic and policy framework. Distinctive in comparison to prior empirical approaches, this paper conceptualizes defense expenditures as a national security policy variable, and it investigates their impact on investment behavior from a macroeconomic perspective. In this respect, the study aims to add something not only to the literature about security policies but also that of macroeconomic performance in broader sense.

3. Data Set and Methodology

Through a macroeconomic perspective with time series analysis data, this study examines the influence of defense expenditures on investment dynamics in Türkiye. Within this model, defense expenditure represents the independent variable reflecting the economic effects of national security policies, whereas gross fixed capital formation serves as the dependent variable. The impact of this variable on gross fixed capital formation will be analyzed.

In this study, Gross Fixed Capital Formation (GFCF) was used as an endogenous variable (dependent variable) from a theoretical standpoint; it is the main/leading macroeconomic indicator that measures the level of investment/capital accumulation in an economy. To explore investment determination variables, Economic Growth (GDP), Inflation (INF), Defense Expenditure (DEF), and Unemployment rate (UNEMP) were added. GDP indicates the impact of economic growth on investment capacity, as investment tendencies tend to rise in phases when the economy is booming. INF component observes the price level fluctuations that affect macroeconomic stability and influence investment choices. The DEF variable was

included to investigate the potential indirect effects of defense spending on public investment. Specifically, the study explores whether defense expenditures, driven by geopolitical threats and conflicts, interact with technology transfer. According to the Military Keynesianism approach, defense expenditures are considered to increase economic activity and support capital formation. Lastly, UNEMP variable was a significant macroeconomic driver used to explain investment dynamics based on the close correlations with economic slowdowns, production capacity, and government interventions. Thus, since the aim of this study is to supply a detailed explanation of investment behavior, variables are carefully selected driven by both theoretical literature and structural aspects of Turkish economy.

Data Set and Variables

It uses data of the Turkish economy of annual series: 1976-2024. The variables and data sources are shown in Table 1 and descriptive statistics of the variables used in the study are shown in Table 2.

Table 1: Variables and data sources

Variable	Acronym	Source
Gross Fixed Capital Formation (% of GDP)	GFCF	World Development Indicators
GDP Growth (annual %)	GDP	World Development Indicators
Inflation, Consumer Prices (annual %)	INF	World Development Indicators
Military Expenditure by Country; in constant (2024) US $	DEF	Stockholm International Peace Research Institute
Unemployment Rate	UNEMP	Turkish Statistical Institute

Note: Prepared by the author

Table 2: Descriptive statistics

Variables	GFCF	GDP	DEF	INF	UNEMP
Mean	23.75520	4.542645	9425.242	40.31006	9.374898
Median	24.64289	5.035635	9233.969	37.61478	9.000000
Maximum	32.87403	11.81109	21884.41	105.2150	14.02600
Minimum	14.39553	-5.459408	4200.285	6.250977	6.495000
Std. Dev.	5.227919	4.168411	4111.809	29.12175	1.780914
Skewness	-0.322684	-0.629132	1.073772	0.377131	0.611888
Kurtosis	1.974179	2.942527	3.901808	1.892308	3.082196
Jarque- Bera	2.998820	3.239165	11.07645	3.666618	3.071447
Probability	0.223262	0.197981	0.003933	0.159884	0.215300

Note: Prepared by the author

Table 2 provides summary statistics indicating that the average trends for our variables appear to differ. On the contrary, for GFCF and DEF variables, their distribution is more symmetric where value of mean is close to its median; moreover on GDP variable has high standard deviation with positive skewness indicating some duration had huge surge in the period. The INF variable is highly volatile and changes widely. In contrast the UNEMP variable has higher variation but we also see overall stability at a lower interval.

Model Specification

In this study, the following functional model is established to analyze the impact of defense expenditures on investments:

$$GFCF_t = f(DEF_t, GDP_t, INF_t, UNEMP_t)$$

This model can be expressed in its econometric form as follows:

$$GFCF_t = \beta_0 + \beta_1 DEF_t + \beta_2 GDP_t + \beta_3 INF_t + \beta_4 UNEMP_t + \varepsilon_t$$

In the above model;
ε_t represents the error term, while β_i coefficients indicate the relationships among the variables.
The general ARDL form is expressed as follows:

$$GFCF_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \, GFCF_{t-i} + \sum_{i=0}^{q1} \beta_i \, DEF_{t-i} + \sum_{i=0}^{q2} \gamma_i \, GDP_{t-i} + \sum_{i=0}^{q3} \delta_i \, INF_{t-i} + \sum_{i=0}^{q4} \theta_i UNEMP_{t-i} + \varepsilon_t$$

The Error Correction Model (ECM) form of the ARDL model is expressed as follows:

$$\Delta GFCF_t = \alpha_0 + \sum_{i=1}^{p-1} \alpha_i \Delta GFCF_{t-i} + \sum_{i=0}^{q1-1} \beta_i \Delta DEF_{t-i} + \sum_{i=0}^{q2-1} \gamma_i \Delta GDP_{t-i} + \sum_{i=0}^{q3-1} \delta_i \Delta INF_{t-i} + \sum_{i=0}^{q4-1} \theta_i \Delta UNEMP_{t-i} + \varphi ECM_{t-1}$$

ECM_{t-1} represents the deviation from the long-run equilibrium, while φ denotes the speed of adjustment coefficient.

The long-run equilibrium of the ECM term is expressed as follows:

$$ECM_{t-1} = GFCF_{t-1} - \lambda_1 DEF_{t-1} - \lambda_2 GDP_{t-1} - \lambda_3 INF_{t-1} - \lambda_4 UNEMP_{t-1}$$

Econometric Method

The ARDL bounds testing approach was utilized to examine the short-run and long-run relationships among the variables. Additionally, ARDL approach has also advantages for the combination of integrated variables of different orders and to estimate both short and long-run coefficients while is reliable continue in small sample size (Pesaran et al., 2001; Narayan, 2005). Moreover, it has a significant advantage over all these cointegration methods in allowing variables of different cointegrating orders (level I(0) and first difference stationary I(1)) could be used simultaneously.

This empirical analysis is carried out sequentially: univariate unit root tests, bounds test for ARDL cointegrating relation existence, long run and short-run coefficients estimation, and diagnostic checks to verify the model fitness. This multi-step process enables to assess both theoretical soundness and statistical adequacy of both formats (Pesaran et al., 2001).

For these reasons, the ARDL technique presents additional and strong rules for testing their relationship regarding defense expenditures and investment dynamics. In particular, it is able to characterize short-run dynamics as well as long-run equilibrium relations with relative ease, thus making this a suitable study for such a model.

Unit Root Tests

Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests for checking the stationarity properties of the series are then applied. It is necessary to perform such tests in order to identify the integration (order of differencing) of the variables and decide on an appropriate econometric strategy (Dickey & Fuller, 1981; Phillips & Perron, 1988).

While ADF test eliminates autocorrelation by including the lagged difference terms into the model, PP test provides an even more flexible structure since it corrects for possible autocorrelation and heteroskedasticity of error term. The simultaneous application of both tests enhances the reliability and robustness of empirical findings (Enders, 2015).

Table 3: Unit root tests results

Variables	**ADF** Level *T-statistics*	**ADF** First different *T-statistics*	**PP** Level *T-statistics*	**PP** First different *T-statistics*	**Order of integration**
GFCF	-1.305748 (0.6196)	-6.403947 (0.0000)	-1.337233 (0.6048)	-6.403947 (0.0000)	I(1)
GDP	-7.056183 (0.0000)	-	-7.067229 (0.0000)	-	I(0)
DEF	1.921223 (0.9998)	-4.602315 (0.0005)	2.260396 (0.9999)	-4.328775 (0.0012)	I(1)
INF	-2.077781 (0.2542)	-7.575490 (0.0000)	-2.077781 (0.2542)	-7.645865 (0.0000)	I(1)
UNEMP	-2.047350 (0.2664)	-5.753648 (0.0000)	-2.185500 (0.2140)	-5.702012 (0.0000)	I(1)

Note: Prepared by the author

If p > 0.05, we can conclude that the variable is non-stationary, and if this value is less than or equal to 0.05, we will accept that the variable is stationary. All the variables GFCF, DEF, INF and UNEMP are found non-stationarity test at level I(0) in both ADF and PP tests but stationary tests at their first differences. Thus, these variables can be said to be I(1). In contrast, the GDP variable has high statistical significance and stationary at level across both tests which class it as I(0). The ARDL approach was found appropriate for the analysis because the variables have different order of integration. Thus, the appropriate model specification, in accordance with the Akaike Information Criterion (AIC), was selected ARDL(1,4,4,0,3).

Diagnostic Tests

Tests mentioned below verify the reliability of model. The autocorrelation test, the heteroskedasticity (variance instability) test, the normality test, and tests for the stability of the model (CUSUM and CUSUMSQ). The Ramsey RESET test is also performed to check if the correct

functional form of the model.

Conclusions the results of the diagnostic tests performed validate and confirm the reliability of the model. The p-value of Normality (Jarque-Bera) test is 0.7687, implying that error terms satisfy normal distribution assumption. And since this value is high enough, the normality assumption of the model does not seem to be a problem.

Table 4: Results of diagnostic tests

Test	Decision Statistics (p-value)
Serial correlation LM	0.695870 (0.5077)
Normality JB	0.526011 (0.768738)
Heteroscedasticity	1.243923 (0.2975)
Ramsey Reset	2.473593 (0.1274)
R^2	0.9648

Note: Prepared by the author

Also the p-value for Serial Correlation LM is 0.5077 confirming that no autocorrelation issue among the error terms exist. The p-value of the heteroskedasticity test is 0.2975 that also shows no desire for heteroskedasticity error terms have constant variance.

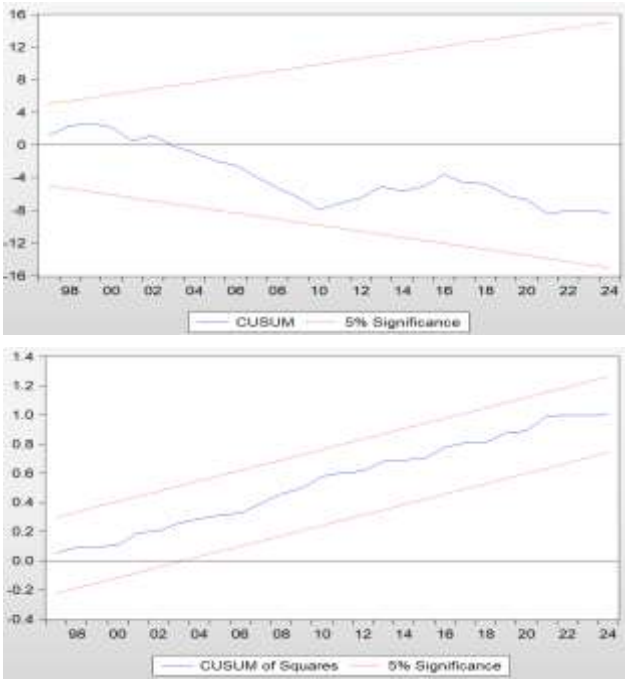
It is bolstered by the Ramsey Reset test results, which confirm that the model has been specified correctly. The p-value of 0.1274 indicates that there is no functional form misspecification, which suggests the model has been appropriately specified.

And lastly, the goodness of-fit, given how well the model explains the variance in this response variable, is pretty high (R^2=0.9648). This suggests a high percentage of the explained variance about the dependent variable is attributed to the independent variables in the model and shows that overall, model outcomes are very good.

The Cumulative Sum of Recursive Residuals (CUSUM) and CUSUM of Squares (CUSUMSQ) tests are two standard stability analysis methodology to determine if model parameters change over time. The coefficient CUSUM test checks the stability of estimated coefficients which is based on cumulative sum of recursive residuals, and CUSUMSQ test tests the variance stability of error terms, a CUSUMSQ stress-testing method that is especially sensitive to structural breaks sudden can be observed.

The graphical results of the CUSUM and CUSUMSQ tests show that the cumulative sums do not cross the 5% significance bounds over the entire sample period. The results indicate stability of estimated coefficients which provides statistical evidence for absence of structural breaks in the model. This means that the model keeps parameters constant and variance does not change through time.

Figure 1: CUSUM Tests



Note: Prepared by the author

A small deviation can be seen in some of the intervals, especially from the initial phase to close to the end of sample period (the gradual increase trend on each plot in CUSUMSQ) but these do not cross the critical bounds. These mild fluctuations can be interpreted as the build-up of tiny shocks or gradual changes in growth trends from a data-generating perspective. These variations fall within the confidence limits therefore do not compromise the overall model stability, reliability or robustness.

ARDL Bounds Test

To test the long-run relationships between variables, bounds test has been used. This meta-statistic is then compared with its critical values for testing the existence of a cointegration relation.

The Bounds test results (Table 5) show that the computed F-statistic (6.663420) exceeds upper bound I(1) critical values at the conventional significance levels of 10%, 5%, 2.5% and 1%. As evident from the relationship with the ARDL bounds testing framework, this result gives confidence against the null hypothesis of no cointegration. Hence it could be concluded that the variables have a statistically significant long-run equilibrium relationship.

Table 5: Bounds test results

Test	F-statistic	I(0)	I(1)
Bounds test	6.663420	2.2 (%10) 2.56 (%5) 2.88 (%2.5) 3.29 (%1)	3.09 (%10) 3.49 (%5) 3.87 (%2.5) 4.37 (%1)

Note: Prepared by the author

The results indicate that, although the variables may fluctuate in the short run without exhibiting explosive behavior, they tend to move together over time and ultimately converge to a stable long-run equilibrium relationship. In simpler terms, this indicates that the series are long-run co-movers or in other words that a cointegrating relationship exists among them. In addition, it also indicates that any short-term disequilibrium is more likely to be curtailed with time and the estimated model will be stronger and stable.

Long-Run and Short-Run Coefficients Estimation

In case a cointegration relation is found, long-run coefficients are estimated and an ECM is generated to see the short-run interaction patterns.

Table 6: ARDL long- term coefficients

Variable	Coefficient	Std. Err.	t-Stat.	p-value
GDP	3.109880	0.683978	4.546757	0.0001
DEF	0.000553	0.000281	1.965568	0.0593
INF	0.086251	0.39971	2.157831	0.0397
UNEMP	1.786931	0.743936	2.401997	0.0232

Note: Prepared by the author

As per the ARDL long-run coefficient (Table 6), ex-imposed model shows positive impact over dependent variable from all explanatory variables but varies in terms of magnitude and statistical significance. More specifically, the impact of GDP turns our to be positive and statistically significant ($p < 0.01$) in the long-run; affirming that economic growth is indeed a primary driver of our dependent variable, as expected within the model setting. The result underscores the larger role of macroeconomic expansion in determining long-term effects.

Likewise, the terms INF and UNEMP coefficients are positive and statistically significant at the 5%. These results suggest that both inflationary pressures and labor market conditions are consistently and systematically related to increases in the dependent variable over the long run, pointing to a significant, stable long-term association between these variables.

On the other hand, while the defense expenditure (DEF) variable also has a positive sign stating that level of DEF matters, it is statistically significant at the level 0.1 (p-value = 0.0593). This suggests a positive directional association, but the evidence is not sufficiently strong to affirm a significant long-run effect as traditionally defined.

Long-run estimation results reveal that all variables are positively contributing to the dependent variable in terms of direction, however their explanatory power varies. The findings together advocate for a structural coherent long-run relationship in which macroeconomic variables jointly determine the dependent variable although a structure of economic relevance may still suffer from statistical independence.

Table 7: ARDL short-term coefficients

Variable	Coefficient	t-Statistic	p-value
D(GDP)	0.450397	6.632084	0.0000
D(GDP(-1))	-0.257019	-2.369716	0.0181
D(GDP(-2))	-0.238285	-2.813806	0.0055
D(GDP(-3))	-0.176980	-3.215091	0.0020
D(DEF)	0.000059	0.224541	0.7737
D(DEF(-1))	-0.000399	-1.461380	0.0922
D(DEF(-2))	0.000324	1.175796	0.1669
D(DEF(-3))	-0.000869	-3.127912	0.0010
D(INF)	0.029832	2.164604	0.0391
D(UNEMP)	0.306673	1.314538	0.1993
D(UNEMP(-1))	0.348556	1.505893	0.1433
D(UNEMP(-2))	-0.406681	-1.702884	0.0997
ECM(-1)	-0.302822	-6.224004	0.0000

Note: Prepared by the author

The effects of the variables in ARDL long-run and short-run results differ both with respect to magnitudes and the statistical significance. Indeed the effect of the current value of GDP is positively highly significant in the short run, even though the lags have a negative and statistically significant coefficients which indicate that it does have an oscillating effect on the short term.

The INF variable is significant and positively correlate suggest a short-run enhancing effect. The UNEMP variable itself is not generally statistically significant, though it possesses weak significance at the second lag.

At first sight, the positive and significant influence of INF and UNEMP on GFCF are not fully in line with traditional macroeconomic expectations. Still, these findings can be meaningfully interpreted in light of the structural-economic dynamics of Turkish economy. When investment expenditures receive nominal increases during periods of high inflation, it can have a positive impact on GFCF. Moreover, expansionary fiscal policy can also be supported by governments in times of inflation and increase public investments that support the necessity of a new fixed capital formation. Rising unemployment rates are often regarded as a signal of economic slowdown. In response, governments may expand infrastructure spending and defense-related investments to stimulate economic activity, support employment, and promote economic growth. While an effect of DEF on investments is not expected to be particularly strong, such expenditures may however transversally bring indirect effects on GFCF through technology transfer, expansion in production capacity, build up of infrastructural developments and linking with supporting industries. This means the results should be placed in the context of country specific fiscal constraints, public investment strategies, and other macroeconomic conditions.

Except for a few lags of the DEF variable with little impact, its coefficients are found to be statistically insignificant. But the coefficient is only significant at the 10% level, so it suggests that defense expenditures indirectly affect investments instead of directly affecting them. Such expenditures targeting the defense sector are likely to lead to greater public and private investments through technology transfer, infrastructure development, R&D efforts, scale-up of production capacity and connections with supporting industries. Benoit (1973), and Deger and Smith (1995) provides descriptions of how defense may have a positive effect on the rate of growth and capital accumulation in developing countries with regard to national defense expenditures. However, in economies like Turkey where the defense industry has grown so quickly in recent years, these effects are expected to appear not directly but involve informal bounds mechanisms.

A negative statistically significant coefficient capturing the ECM(-1) indicates that only 30% of short-run deviations are corrected within the next period thus confirming convergence to the long-run equilibrium.

4. Conclusion and Recommendations

Findings of this research indicate not only a long-run relationship, its relationship between public investment and defense expenditures in Turkish economy. The bounds testing approach confirmed the existence of a long-run relationship between private investment and the macroeconomic variables, suggesting that the series are cointegrated and converge to a stable long-run equilibrium. In addition to fiscal policy instruments, public investments are also often related to factors of macroeconomic stability.

At long-run, coefficient estimates show that public investments primarily respond to economic growth. Investment in public sector is a just another way to promote infrastructure and productive investments which leads towards economic growth an open-ended system. Secondly, in terms of average absolute effects, the state macroeconomic variables with statistically largest impacts on public investments are inflation and unemployment; they highlight that for development it is macroeconomic stability that matters. In particular, low inflation and low unemployment are both seen as integral to maximizing the value of public investment.

Comparative analysis indicates that defense expenditures exert a relatively smaller influence on public investment than other determinants. This also means that spending for defense does not immediately translate into investment, but affects the economy indirectly. Defense spending might very well have a positive impact on the economy, both via technological advancement and through industrial stimulation and job creation, but its effects on public investments appear to operate more along tangled causal pathways.

The error correction model (ECM) results indicate that a disequilibrium or an imbalanced state in the short-run is adjusted towards and thus corrected by its long-run equilibrium over time. These results support the dynamic structure of our model and the economic plausibility of our results. Moreover, the results of diagnostic tests and CUSUM analyses confirm that there are no problems associated with structural breaks, autocorrelation or heteroskedasticity in addition, which strengthens the reliability of these results even further.

Thus, this study argues that defense spending, by itself, is not the sole determinants which governs public investments in Türkiye; macroeconomic variables such as general economic growth, inflation and unemployment need to be put under the same roof.

Based on the findings of this investigation, several potential policy recommendations are offered for policymakers. Public resources need to be allocated effectively and balanced that is priority number one. Such realistic defense spending increases must not crowd out other public investments needed for long-run economic growth (on infrastructure, education, health and technologies). This is the equilibrium that public investments must look to achieve even as defense spending increases.

Second, repeating one of the premisses of rationalizing economic growth as one of the main benefits is providing resources for public investment, we must adhere to pro-growth policies. The enabling growth and creating fiscal

space through public investment policies of expanding production capacity and preferential industries and technologies. At the same time, price stability through controlling inflation is very important to create a good environment for investment.

Thirdly, productively low unemployment rates should use active labor market policies. Stronger labor markets will support growth, and public investments will become more productive. Hence, quality of labour and employment-friendly policies play a very important role in this respect.

Defense expenditure must be aligned with domestic production, technology transfer, and innovation processes with a view to boosting the socioeconomic impact of military spending. For instance, multiplier effects might derive from investments in the defense industry, and will impact civilian sectors of the economy related to high-tech development underlying growth, and public investment indirectly.

Finally, future investigations should also be supplemented according to implementing the diverse econometric methods and intercountry analyses to make more significant additions. In particular, cross-structural break models and sectoral analyses could provide more insight into the economic impacts related to defensive spending.

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