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The Effectiveness of Quantitative Models in Estimating Military Expenditure under Nuclear Threats: A Comparative Analysis of Quantitative Forecasting Methods

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Abstract:

In the context of escalating nuclear threats and shifting security environments, this study assesses the effectiveness of four quantitative models in forecasting military expenditure: simple linear regression, multiple regression, fixed effects panel data, and time series analysis. Using empirical data from 2015 to 2025 across a sample of geopolitically exposed countries, the models were applied to generate projections for 2026 under three scenario-based assumptions (optimistic, likely, and pessimistic). Results indicate substantial variation in model performance. The panel data model outperformed others by offering greater contextual sensitivity and robustness, particularly in unstable or conflict-prone environments. In contrast, the simple regression model showed a tendency to overestimate expenditure in high-threat contexts, while the multiple regression model failed to capture the influence of strategic volatility. The study concludes by recommending the panel model for defense forecasting and advocates the integration of AI-powered analytical tools to improve accuracy, scalability, and adaptability in future military expenditure modeling.

key words: Military Expenditure ; Nuclear Escalation ; Quantitative Forecasting ; Expenditure Forecasting.

Introduction:

Between 2024 and 2025, the world witnessed an unprecedented escalation in the intensity of regional conflicts, many of which took a deeply alarming turn through overt references to nuclear weapons, reaching, in some cases, the level

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of practical threats and raised alert levels. On the European front, the Russian–Ukrainian war entered its fourth year, with an intensified use of long-range missile systems and the formal integration of nuclear threats into both sides' political and military rhetoric, amid repeated Western warnings against crossing nuclear "red lines." In South Asia, tensions flared once again between India & Pakistan, as renewed military confrontations in Kashmir were accompanied by mutual warnings about the possible use of limited nuclear weapons, raising regional and international concerns. Meanwhile, in the Middle East, the Iranian–Israeli conflict escalated dramatically following direct strikes on each other's territories. A brief but intense war lasting 12 days erupted between the two states, marked by high density operations targeting nuclear infrastructure and strategic defense sites. These developments reignited the global debate over the limits of "mutual deterrence" in the region.

These accelerating dynamics raise fundamental questions about the future of regional and international stability in light of the growing normalization of nuclear threats and the transformation of nuclear weapons from deterrent tools into instruments of coercive diplomacy. In this environment, many states, particularly those in Eastern Europe such as Poland and the Baltic countries, have raised their military spending to levels unseen since the Cold War. In parallel, other regional powers like Algeria have begun reassessing their defense strategies amid a shifting balance shaped by indirect nuclear risks.

In light of the rise in nuclear-related armed conflicts, there is a growing need to revisit approaches to analyzing military expenditure, particularly in regions undergoing profound security and geopolitical shifts. The evolving nature of nuclear threats whether direct or potential not only alters the dynamics of conflict but also reshapes states' economic priorities, driving increased militarization of national budgets.

Within this context, forecasting military expenditure has emerged as a vital analytical tool in strategic studies both as an indicator of national security posture and as a mirror reflecting transformations in the geopolitical environment and the surrounding threat landscape. The relevance of this tool has grown alongside the diversification of quantitative forecasting models, which include: the simple linear regression model based on threat indices, the multiple linear regression model anchored in economic variables, the fixed effects panel data model combining temporal and cross-sectional analysis, and the time series model that extrapolates from internal historical trends within each country.

Given this methodological evolution, and in light of the current global landscape marked by growing nuclear-influenced conflicts and heightened geopolitical tensions, the need for accurate quantitative tools to assess and forecast military expenditure has become increasingly urgent. While political and security variables remain crucial to understanding defense behavior, the absence of robust forecasting models limits the ability of researchers and policymakers to anticipate future defense budget trends especially in unstable or high risk environments. Accordingly, this research raises the following core question :

- To what extent are the four selected quantitative models effective and accurate in estimating and forecasting military expenditure under escalating nuclear threats ? Which of these models offers the most realistic and practically applicable estimates ?

Hypothesis :

The study hypothesizes that nuclear escalation does not only influence national defense decisions but also leads to significant variation in how military expenditure is calculated and projected. Relying on a single forecasting model without considering each country's geopolitical and economic structure may result in misleading conclusions. Accordingly, the accuracy of the four models in interpreting military spending differs across countries, depending on threat levels, growth dynamics, and financial vulnerability. It is anticipated that models combining both security and economic dimensions within a temporal and spatial framework are more capable of reflecting real-world defense behavior.

Objectives of the Study :

This study focuses on assessing the methodological effectiveness of different approaches to calculating military expenditure by applying four distinct quantitative models.

The research seeks to :

- Conduct a systematic analysis of military expenditure forecasting methodologies, through the application of four statistical models integrating security and economic variables.
- Compare the predictive outcomes of the four models to determine which one yields the most realistic estimates of military spending.

- Propose a flexible analytical framework that enables researchers to replicate or adapt these models based on country-specific characteristics.

Significance of the Study :

The significance of this study lies in the turbulent geopolitical environment that has characterized the 2024–2025 period, during which nuclear deterrence evolved into a direct instrument of political pressure. Threats of nuclear use have driven several states to restructure their defense priorities. In such a context, traditional analytical approaches are no longer sufficient to understand military spending dynamics, necessitating more flexible and responsive quantitative models.Constructing a comparative framework for evaluating the performance of predictivemodels in unconventionalthreatenvironments.

This study offers added value by :

- Systematically linking security analysis with economic forecasting.
- Providing a practical forecasting tool for military expenditure under nuclear escalation scenarios, enabling more informed decision-making by governments and research institutions.
- Addressing a knowledge gap in the literature on defense economics by integrating nuclear deterrence, evolving security environments, and quantitative effects on military budgets particularly in fragile or conflict-prone states.

Research Methodology :

This study adopts a comparative quantitative analytical method, aiming to evaluate the effectiveness of four statistical models in explaining and forecasting military expenditure under the increasing pressure of nuclear threats. The methodology combines theoretical analysis of the models and their underlying assumptions with practical application to a selected sample of countries that have experienced significant shifts in their security environments during the period 2015–2025.

First section : Military Expenditure and Nuclear Escalation

Understanding the concept of military spending is essential to grasp the broader dynamics of international security. Military expenditure reflects not only a state's defense priorities but also its strategic posture in response to perceived threats. In recent decades, shifts in global power balances, emerging

security risks, and the resurgence of nuclear rhetoric have all contributed to changing patterns of military investment. This section introduces the conceptual foundations of military spending, explores the nature and levels of nuclear escalation, and outlines the evolving trends that shape defense budgets in the 21st century.

1. The Concept of Military Expenditure :

Military expenditure is defined as the financial cost of building military power as one of the essential pillars of the state. Definitions vary between a narrow conceptwhich is limited to officially declared defense budgets, as adopted by the International Institute for Strategic Studies and a broader concept that encompasses all expenses related to military activities, such as troop recruitment, training, defense research, and military aid, according to the Human Development Report and the Stockholm International Peace Research Institute (SIPRI). It is worth noting that arms procurement budgets are often excluded from official data under the pretext of confidentiality and national security, making actual spending significantly higher than the declared figuresespecially in arms importing countries.(Khazin & Jidur , 2023, p. 579)

2. The Concept of Nuclear Escalation :

The concept of nuclear escalation is a central notion in security and strategic studies, as it reflects the evolving nature of contemporary threats related to the use or threat of nuclear force in conflicts. Nuclear escalation generally refers to the gradual or sudden increase in the level of tension or violence within a regional or international conflict, accompanied by the introduction of nuclear weapons into the equation whether as a threat or a potential means of use. Nuclear escalation does not necessarily imply the actual launch of a nuclear attack; it may also include verbal threats, raising the alert status of nuclear forces, the mobilization of launch platforms, or the conduction of demonstrative nuclear tests. Thomas Schelling defined nuclear escalation as “a competition in risk-taking, a diplomatic military maneuver whose outcome is determined more by the manipulation of risk than by actual force deployment.” (Bogdanov, 2023, p. 30)

3. Levels of Nuclear Escalation :

Nuclear escalation can be categorized into several levels, each differing in terms of severity and impact. These include:

1) **Political Symbolic Escalation:**

This level involves the use of nuclear rhetoric as a tool for deterrence or political signaling without engaging in actual military action. It is commonly employed to send deterrent messages to adversaries or the international community. The risk associated with such signaling depends on the channel through which the nuclear message is conveyed. Nuclear signaling can occur through three channels :(Rizwan, 2023, p. 25)

- *Direct signals* : official communication between governments or representatives.
- *Implicit signals* : physical displays of capabilities such as nuclear or missile tests, or official political statements.
- *Indirect signals* : media statements or press coverage directed at broader, multi-layered audiences.

2) **Operational Escalation :**

This level involves the physical demonstration of military capabilities or the actual movement of nuclear assets, such as repositioning tactical or strategic warheads, or altering the readiness level of nuclear deterrent forces. For example, under Xi Jinping, China has increasingly used its military including nuclear components of the People's Liberation Army (PLA) to influence the strategic decisions of other states, especially during rising tensions in the South China Sea. These displays are part of a broader strategy to align other countries' interests with those of the People's Republic of China.(Gill, 2022, p. 108)

3) **Test-BasedE scalation :**

This involves conducting nuclear tests as a show of force or a political pressure tactic. Since 2006, North Korea has carried out six nuclear device tests, all underground detonations that have progressively increased in strength.(Nikitin, 2025, p. 01) These tests are designed to send political messages and project power. They reflect North Korea's efforts to affirm its functional nuclear capability despite facing international sanctions, demonstrating its use of nuclear weapons more as a tool of coercion than as conventional battlefield weapons.

4) **Military or Actual Escalation :**

This is the most dangerous level, involving the actual use of nuclear weapons, whether through limited (tactical) or large-scale (strategic) strikes. The world witnessed the first and only wartime use of nuclear weapons in August 1945, when the United States dropped atomic bombs on Hiroshima and Nagasaki, causing massive destruction and loss of life. A few years later, the Soviet Union conducted its own nuclear test, marking the beginning of the nuclear age. This led many American strategic theorists to realize that nuclear weapons, due to their revolutionary impact on military strategy, were not viable tools for conventional warfare.(Stein, 2023, p. 33)

4. Rising Military Expenditure in the 21st Century

Geopolitical threats and military conflicts in the first quarter of the 21st century have significantly contributed to reshaping public spending priorities across states. There has been a marked shift toward increasing defense expenditures, not only in areas of arms production and military procurement but also in financial support for humanitarian, economic, and military needs in conflict-engaged nations. The Russian-Ukrainian war, the Israeli-Iranian conflict, and the India-Pakistan war stand out as key drivers of this upward trend in military spending. The escalation of such threats has pushed many countries to expand their defense budgets, exacerbating the challenges of funding social initiatives and public services.(Olena & Anastasia, 2023, p. 11)

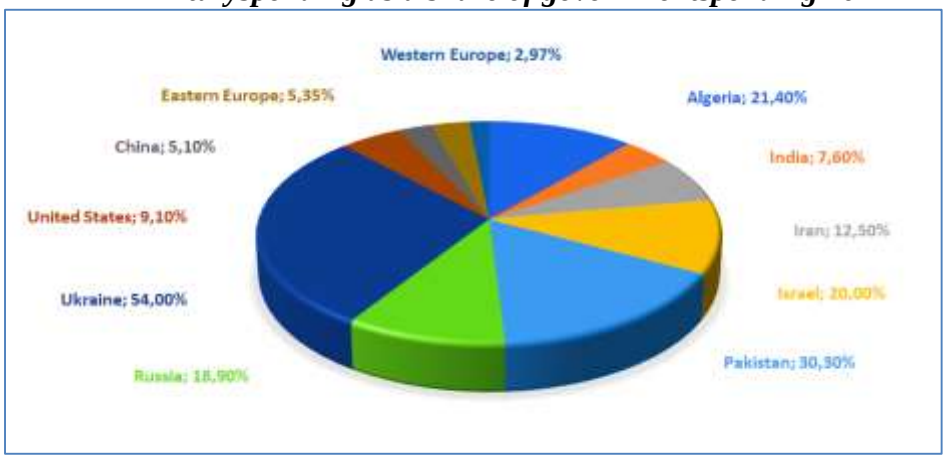
Recent data reveal a recurrent pattern : global military expenditure tends to surge following each nuclear-related crisis, a trend that was clearly evident in 2023. That year marked the ninth consecutive annual increase in global military spending, reaching $2.72 trillion the highest level ever recorded by the Stockholm International Peace Research Institute (SIPRI). This increase, amounting to 11.34% over the previous year, represents the largest annual jump since 2009.(tian & Other, 2024, p. 03) This surge reflects the international community’s growing response to heightened geopolitical risks, particularly the war in Ukraine and the escalation of conflicts in Asia and the Middle East.

This trend reinforces the notion that international crises serve as direct catalysts for reallocating resources toward the military sector—either as an immediate response to threats or as preparation for potential future conflicts. Moreover, the data point to an additional dimension of growth in global defense spending: investments aimed at border protection, strategic defense, preventive conflict response, and humanitarian and military assistance to allied or war-affected nations. The following chart presents a sample of countries that have been directly or indirectly impacted by ongoing military conflicts.

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Militaryspending as a share of governmentspending 2024



Source : (World in Data, 2025)

The disparities in military spending ratios across countries and regions in 2024 reflect the degree to which states are exposed to direct conflict, regional instability, or geopolitical rivalry. Ukraine's exceptionally high figure (54%) is emblematic of a fully mobilized wartime economy, where military needs override most civilian priorities. This extreme case contrasts sharply with Western European countries (2.97%), where defense is largely outsourced to multilateral security alliances like NATO, enabling them to allocate greater resources to welfare and development.

The mid to high spending levels in countries like Pakistan (30.3%), Algeria (21.4%), Israel (20%), and Russia (18.9%) suggest a persistent perception of threat and a deliberate choice to channel public resources toward defense readiness and modernization. These ratios also indicate sustained regional tensions : Indo-Pakistani hostility, Algerian engagement with Sahelian instability, Israeli security concerns, and Russia’s prolonged military campaigns. On the other hand, moderate ratios observed in Iran (12.5%), India (7.6%), and the United States (9.1%) imply a more balanced fiscal strategy, where defense is important but not dominant. China's relatively low share (5.1%), despite being a global military power, reflects a long-term strategic approach focused on incremental modernization, prioritizing economic and technological growth over rapid military expansion.

These variations suggest that while some states adopt reactive militarization in response to immediate threats, others follow strategic restraint, balancing military spending with domestic development goals. The regional comparison between Eastern and Western Europe illustrates this dichotomy: the

East remains threat-oriented, while the West is more development-focused, relying on collective deterrence.

Ultimately, military spending as a share of government expenditure is not merely a budgetary figure ; it encapsulates national threat perception, economic resilience, and political will—making it a critical indicator for assessing strategic behavior in an evolving global security landscape.

5. Structural Shifts in Military Spending Patterns (2020–2025)

The data presented in the table below show the percentages of military expenditure as a share of total government spending during the period from 2020 to 2025. This indicator serves as a key tool for measuring the priority given to defense within national fiscal policies and reflects strategic orientations related to national security and regional stability. The table provides a foundation for analyzing developments and structural changes in the allocation of public resources toward the military sector in recent years.

Table (1) : Military spending as a share of government spending (2020–2025)

Country	*2020*	*2021*	*2022*	*2023*	*2024*	*2025 (estimated)*
Algeria	*15,70%*	*15,00%*	*12,40%*	*20,00%*	*21,40%*	*~22,72%*
India	*8,80%*	*8,00%*	*8,00%*	*7,90%*	*7,60%*	*~7,79%*
Iran	*14,40%*	*14,10%*	*13,90%*	*15,00%*	*12,50%*	*~13,06%*
Israel	*11,80%*	*12,40%*	*12,10%*	*13,80%*	*20,00%*	*~21,30%*
Pakistan	*17,20%*	*18,40%*	*15,90%*	*15,00%*	*30,30%*	*~31,55%*
Russia	*10,60%*	*10,30%*	*13,00%*	*14,80%*	*18,90%*	*~20,24%*
Ukraine	*9,60%*	*8,50%*	*39,20%*	*49,10%*	*54,00%*	*~57,85%*
United States	*8,20%*	*8,00%*	*9,10%*	*9,10%*	*9,10%*	*~ 9,45%*
China	*4,90%*	*4,90%*	*4,90%*	*5,00%*	*5,10%*	*~ 5,16%*
Eastern Europe	*3,94%*	*4,04%*	*4,32%*	*4,79%*	*5,35%*	*~ 5,52%*
Western Europe	*2,41%*	*2,45%*	*2,56%*	*2,70%*	*2,97%*	*~3,04%*

***Source** : (World in Data, 2025)*

An examination of the table data shows that military spending rates between 2020 and 2025 reflect a structural shift in the patterns of national resource allocation, occurring within a wave of gradual nuclear escalation that peaked in 2025. The first phase (2020–2022) witnessed relative stability or even a noticeable decline in spending levels, reflecting a less tense geopolitical environment in which priority was given to development and domestic

economic reform. This trend is evident in countries such as Algeria (from 15.70% to 12.40%) and India (from 8.80% to 8%).

However, the outbreak of successive waves of escalation particularly the Russian–Ukrainian war and confrontations in the Middle East led to sharp increases in spending rates during 2023 and 2024, reaching unprecedented levels at the beginning of 2025, exceeding 14.80% and 18.90% in Russia, and 13.80% and 20% in Israel, and reaching about 49.10% and 54% in Ukraine, reflecting a purely wartime economy.

Ukraine and Russia are the most prominent models of financial and military escalation. The former has become almost entirely dependent on external aid to finance its defense efforts, while Russia is moving toward comprehensive militarization of its resources despite inflationary pressures and mounting sanctions. In the Middle East, the "12-day war" between Iran and Israel accelerated armament programs and expanded spending, with rates expected to rise to (~13.06% and ~21.30%) respectively, which increased insurance and maritime shipping costs in the Gulf and placed additional pressure on the budgets of these countries.

In South Asia, disparities in responses emerged: India adopted a "cold containment" strategy with disciplined spending (~7.79%), while Pakistan raised its spending to (~31.55%), reflecting a strategic imbalance that could translate into risks of using unconventional weapons in the event of escalation.

In unique cases such as Algeria and the United States, high spending stems from different motives : Algeria maintained a high spending rate (~22.72%) even before the global nuclear escalation, reflecting a firm security doctrine, though it may lead to the erosion of social investments in the medium term. Meanwhile, the United States adopted a "calculated deterrence" approach, raising its spending to (~9.45%) in support of its allies while maintaining a domestic balance between security and welfare.

Military spending data in Europe point to a clear divergence between the eastern and western paths in terms of armament pace and motivations. Military spending in Eastern European countries rose from 3.94% of GDP in 2020 to about 5.35% in 2024. This rise can be directly attributed to the Russian–Ukrainian war, as heightened security concerns drove countries in the region (Poland, Romania, and the Baltic states) to adopt a preventive military doctrine based on deterrence and rapid readiness, in response to what they see as an

increasing existential threat from Moscow. NATO's involvement in supporting these countries has also enabled greater opportunities to finance and accelerate their defense programs.

In contrast, Western Europe demonstrated a more cautious behavior, with military spending rising from 2.41% in 2020 to about 2.97% in 2024. Although the growth remained gradual, it reflects a slow shift in Western defense doctrine after decades of reduced military budgets in the post Cold War era. This increase is attributed to two main factors: first, Western European countries' commitment to NATO pledges to raise spending to 2% or more ; and second, the geopolitical changes after 2022 especially Germany's announcement of a €100 billion additional defense budget and France's move toward modernizing its nuclear arsenal. Nonetheless, Western Europe's ability to absorb military spending without disrupting its financial balance remains significantly higher than that of its Eastern counterparts, thanks to its strong economic structure and the flexibility of its public finance tools.

As for China, military spending ranged between 4.90% and 5.16% of GDP during the 2020–2025 period. This level of spending reflects China's clear commitment to expanding its military capabilities over the long term particularly in smart weapons, missile defense, and naval modernization amid rising tensions in the South China Sea and Taiwan. Chinese defense investments are primarily funded by state surpluses and sovereign wealth funds, which temporarily protect them from deficit effects. The lack of full transparency regarding the exact details of the defense budget makes precise evaluation difficult, but it suggests the possibility of concealing actual costs higher than the declared figures, leading to misperceptions about the true burden of military spending on the Chinese economy, especially as tensions with the United States and Taiwan increase.

These shifts lead to highly dangerous economic consequences. The decline in health and education spending has become noticeable, particularly in financially fragile countries or those dependent on a single resource. Fiscal deficits have become a structural phenomenon in some countries, with changes in the structure of international trade due to the redirection of industries toward military production. This disrupts supply chains and undermines the development of civilian sectors. In this context, military spending cannot be separated from broader economic and political dynamics. It is no longer merely a tool of deterrence, but has become a governing structure within the macroeconomy of states placing policymakers before the urgent need to

reconsider the balance between defense and fiscal policy to ensure a minimum level of stability and sustainability.

Second section: Quantitative Modeling Approaches for Forecasting Military Expenditure

1. The Concept of Simple and Multiple Linear Regression Models

The simple and multiple linear regression models are among the most widely used statistical methods for prediction and analyzing relationships between variables.

1) Simple Linear Regression Model

Simple linear regression is used when there is one dependent variable and one independent variable. It is expressed by the following equation:

$$Y = \beta_0 + \beta_1 x + \varepsilon$$

- Y: the dependent variable
- x: the independent variable
- β_0: the intercept
- β_1: the regression coefficient (slope)
- ε: the random error

2) The Multiple Linear Regression Model

Multiple linear regression is a statistical method used to examine the relationship between one dependent variable and two or more independent variables. It extends the principles of simple linear regression, which considers only one independent variable, to accommodate the complexity of real-world data and uncover significant relationships among variables. This allows researchers to study the combined effect of multiple predictors on the outcome of interest.(Ruan, 2024, p. 02)The multiple regression model is used when we want to analyze the impact of several independent variables on a single dependent variable. Its general equation is: (Hayes, 2025)

$$Y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_P x_{iP} + \varepsilon$$

- Y_i: the dependent variable
- x_i: the explanatory (independent) variables
- β_0: the intercept (constant termwhere the line crosses the y-axis)
- β_p: the slope coefficients for each explanatory variable
- ε: the errorterm of the model (also known as the residual)

Multiple regression analysis is an effective tool for examining complex relationships and making predictions based on multiple factors. It enables researchers to explore how multiple predictors collectively influence the outcome variable.

2. The Concept of Time Series

Time series modeling for general forecasting plays a significant role across various scientific fields. Both linear and nonlinear statistical approaches have been widely applied, most notably exponential smoothing, Autoregressive Integrated Moving Average (ARIMA), state-space and structural models, the Kalman filter, nonlinear models, and Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models . (CHRISTOS et Other 2024, 776) A time series is a collection of observations generated sequentially over time. We can distinguish between continuous time series, where observations are recorded continuously over time, and discrete time series, where observations are recorded at specific, separate intervals, typically using historical data for forecasting purposes. Time series models are fundamental tools in econometrics and statistics, designed to analyze and predict data points collected or recorded at specific time intervals.(Camps, 2022, p. 03)

The General Equation:

$$Y_t = c + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \cdots + \phi_n Y_{t-P} + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + .. + \theta_q \varepsilon_{t-q} + \varepsilon_t$$

- Y_t : The value of the variable (e.g., military expenditure) at time *t*
- C : The constant (intercept)
- ϕ ،....،ϕ_{P1} ، ϕ_{P2}: Coefficients of the autoregressive part.
- θ ،....، θ_{q2}،θ_{q1}: Coefficients of the movingaverage part.
- ε_t : The random error (white noise) at time *t.*
- p : Order of the autoregressive component.
- q : Order of the movingaverage component.
- d: The number of differencing operations needed to make the series stationary.

3. The Concept ofPanel Data Models

The term**"panel data"**refers to observations collected over a time period for a specific unit, gathered across multiple time points. (Pavić, 2019, p. 01) It involves statistical methods that analyze data collected over time across multiple subjects and refers to a dataset that combines both cross-sectional and time-series dimensions. This structure allows researchers to monitor changes and dynamic relationships over time. Panel data models integrate cross-sectional and time-series data, enabling the examination of both individual-specific and temporal effects. The choice between fixed effects and random effects models is crucial, as it significantly influences the interpretation of results and the appropriateness of the model for the data structure. (Ghosh & Samanta, 2021, p. 196)

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The General Equation:

$$Y_{1t} = \alpha + \beta X_{it} + \varepsilon_{it}$$

- Y_{it}: The dependent variable for unit *i* at time *t* (e.g., military expenditure of a specific country in a given year).
- X_{it}: The independent variable(s) for unit *i* at time *t.*
- α: The overall intercept (constant).
- β: The slope coefficient (effect size of the independent variable).
- u_i: The unit-specific effect (e.g., a country effect) represent sun observed differences between units.
- ε_{it}: The idiosyncratic (remaining) random error term.

Table (2) : Summary of the Previous Equations and Their Application to Military Expenditure Forecasting

Model Name	Mathematical Equation	Application to Military Expenditure Forecasting
1. Simple Linear Regression	$Y = \beta_0 + \beta_1 x + \varepsilon$	Y: Military expenditure (as % of GDP or absolute value) x: Gross Domestic Product (GDP) or a security threat index β_0: Projected Expenditure Why x=0 β_1: Impact of xx on yy ε: Unexplained factors (e.g., sovereign decisions)
2. Multiple Linear Regression	$Y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_P x_{iP} + \varepsilon$	y_i: Military expenditure for country i x_{i1}: GDP x_{i2}: Border threat index or number of conflicts x_{i3}: Inflation rate x_{i4}: Alliance member ship (e.g., NATO) ε: Effects of unaccounted variables (e.g., political choices)
3. ARIMA (Time Series Model)	$Y_t = c + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \cdots + \phi_n Y_{t-P} + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + .. + \theta_q \varepsilon_{t-q} + \varepsilon_t$	Y_t: Military expenditure in year t Y_{t-1}, Yt_{-2}, ..., Yt_{-p}: Past values of military expenditure c : Constant trend level ϕ_p: Autoregressive effects θ_q: Effects of pastshocks ε: Random error in year t
4. Panel Data Model	$Y_{1t} = \alpha + \beta X_{it} + \varepsilon_{it}$	Y_{it}: Military expenditure for country ii at year tt X_{it}: Explanatory variables (GDP, threats, inflation, alliances...) α: Common constant acrossunits β: Effect size ui: Unobserved country-specific effect ε_{it}: Randomerror

Source : Researcher's elaboration based on the preceding analysis

Section Three : The Applied Part Forecasting Military Expenditurein 2026 Using the Four Statistical Models

This section focuses on forecasting military expenditure using four statistical models: simple linear regression, multiple linear regression, time

series analysis, and panel data models. By applying these methods to real-world data, the aim is to evaluate the accuracy and relevance of each model in predicting future military spending. The analysis provides insights into how different statistical approaches can capture trends, assess influencing factors, and support strategic decision-making in defense planning.

1. Data Related to Military Expenditure for a Selected Group of Countries

This applied part presents data on military expenditure for a selected group of countries, with the aim of supporting comparative analysis and forecasting within different geopolitical and economic contexts. The countries included Algeria, China, India, Iran, Israel, Pakistan, Russia, Ukraine, and the United States were chosen based on their strategic significance, regional influence, and diverse military spending patterns. The three tables included cover :

- GDP growth rates
- Military expenditure as a percentage of government spending. (10 yearsago)
- The Security Threat Index.

These datasets provide the empirical foundation for applying the four statistical models discussed earlier to evaluate and predict future military expenditure trends.

Table (3) : GDP growth (Annual %)

	2015	***2016***	***2017***	***2018***	***2019***	***2020***	***2021***	***2022***	***2023***	***2024***
Algeria	*3,20*	*3,90*	*1,50*	*1,40*	*0,90*	*-5,00*	*3,80*	*3,60*	*4,10*	*3,30*
China	*6,98*	*6,78*	*6,89*	*6,76*	*6,07*	*2,34*	*8,57*	*3,13*	*5,41*	*4,98*
India	*8,00*	*8,26*	*6,80*	*6,45*	*3,87*	*-5,78*	*9,69*	*7,61*	*9,19*	*6,48*
Iran	*-1,42*	*8,82*	*2,76*	*-1,84*	*-3,07*	*3,33*	*4,72*	*3,78*	*5,04*	*3,04*
Israel	*2,24*	*4,46*	*4,35*	*4,00*	*3,71*	*-2,02*	*9,39*	*6,26*	*1,83*	*0,87*
Pakistan	*4,22*	*6,57*	*4,43*	*6,15*	*2,50*	*-1,27*	*6,51*	*4,78*	*-0,04*	*3,23*
Russia	*-1,97*	*0,19*	*1,83*	*2,81*	*2,20*	*-2,65*	*5,87*	*-1,44*	*4,08*	*4,34*
Ukraine	*-9,77*	*2,44*	*2,36*	*3,49*	*3,20*	*-3,75*	*3,45*	*-28,8*	*5,53*	*2,91*
United States	*2,95*	*1,82*	*2,46*	*2,97*	*2,58*	*-2,16*	*6,06*	*2,51*	*2,89*	*2,80*

***Source : Researcher's elaboration based on data from** (The World Bank 2025)*

Table (4) : Military spending as a share of government spending(%)

	2015	***2016***	***2017***	***2018***	***2019***	***2020***	***2021***	***2022***	***2023***	***2024***
Algeria	*5,60*	*5,50*	*5,30*	*5,00*	*4,90*	*4,90*	*4,90*	*4,90*	*5,00*	*5,10*
China	*13,60*	*15,20*	*14,60*	*13,60*	*14,40*	*15,70*	*15,00*	*12,40*	*20,00*	*21,40*
India	*8,80*	*9,10*	*9,40*	*9,10*	*9,30*	*8,80*	*8,00*	*8,00*	*7,90*	*7,60*
Iran	*15,50*	*15,40*	*16,00*	*14,60*	*14,60*	*14,40*	*14,10*	*13,90*	*15,00*	*12,50*

Israel	*14,50*	*14,30*	*14,20*	*18,80*	*13,20*	*11,80*	*12,40*	*12,10*	*13,80*	*20,00*
Pakistan	*18,00*	*18,10*	*17,60*	*13,50*	*18,40*	*17,20*	*18,40*	*15,90*	*15,00*	*30,30*
Russia	*13,80*	*14,80*	*12,20*	*11,40*	*11,40*	*10,60*	*10,30*	*13,00*	*14,80*	*18,90*
Ukraine	*8,90*	*9,00*	*7,80*	*8,70*	*9,80*	*9,60*	*8,50*	*39,20*	*49,10*	*54,00*
United States	*9,90*	*9,60*	*9,40*	*9,30*	*9,50*	*8,20*	*8,00*	*9,10*	*9,10*	*9,10*

Source : Researcher's elaboration based on data from *(World in Data 2025)*

Table (5) : Security Threat Index Scenarios 2026 [1 to 10]

	Geographic Region	***Security Threat Index***		
		Optimistic scenario	***Most likely scenario***	***Pessimistic scenario***
Algeria	*North Africa*	*1*	*3*	*8*
China	*East Asia*	*0*	*3*	*7*
India	*South Asia*	*1*	*4*	*8*
Iran	*Middle East*	*5*	*6*	*10*
Israel	*Middle East*	*4*	*4*	*9*
Pakistan	*South Asia*	*4*	*4*	*10*
Russia	*Eurasia*	*4*	*3*	*9*
Ukraine	*Eastern Europe*	*0*	*7*	*10*
United States	*North America*	*1*	*3*	*6*

Source : Researcher's elaboration (see Appendix No. 01 : Security Threat Index Scenarios 2026 [1 to 10])

Note:

The Security Threat Index is one of the key analytical tools for explaining the variation in military expenditure levels among countries, as it reflects the magnitude of pressures and risks a state faces both internally and externally. While economic and political factors are undoubtedly important, decisions related to defense spending are largely influenced by the nature of the surrounding security environment and the state's perception of potential threats.

In this context, a composite index has been adopted, consisting of five main dimensions : the level of armed conflict, terrorist threats, border and regional tensions, nontraditional threats (cyber or nuclear attacks), and political-social fragility. The use of this composite index is scientifically justified, given the multiplicity and interconnection of threat sources, which necessitate a comprehensive assessment that reflects the actual security reality of each country. The index ranges from 0 to 10 and integrates each dimension individually using a standardized scale. This approach ensures a balance between quantitative precision and analytical realism, enhancing the

explanatory power of the quantitative models used to study the strategic determinants of military expenditure.

2. The Applied Part

In this part, military expenditure for the year 2026 will be calculated using each of the four statistical models separately. Algeria will be selected as a case study to illustrate and explain the step-by-step calculation process in detail. The results for the other countries will be presented in summary tables to allow for comparison and analysis across different contexts.

1) Simple linear regression equation :

- **Optimistic scenario:**

$$\beta = \frac{(y - y_i)^-(x - x_i)^-}{\sum(x - x_i)^2}$$
$$\alpha = \bar{y} - \beta\bar{x}$$

Step1 : Compute Means

$$\bar{x} = \frac{1 + 0 + 1 + 5 + 4 + 4 + 4 + 0 + 1}{9} = 2{,}22$$
$$\bar{Y} = \frac{5.1 + 21.4 + 7.6 + 12.5 + 20 + 30.3 + 18.9 + 54 + 9.1}{9} \approx 19{,}99$$

Step2 : Compute Slope (β)

$$\sum(X_i - \bar{X})(Y_i - \bar{Y}) \approx 112{,}62$$
$$\sum(X_i - \bar{X})^2 \approx 49{,}08$$
$$\beta = \frac{112{,}62}{49{,}08} \approx 2{,}29$$

Step 3 : Compute intercept (a)

$$\alpha = \bar{y} - \beta\bar{x} = 19{,}99 - (2{,}22 \times 2{,}29) \approx 14{,}78$$

Step 3 : Compute Military Spending

$$Y = \beta x + a$$
Military Spending=2,29×Threat Index+14,78
*Y=2,29×1+14,78=**17,07***

- **Most likely scenario :**

Step1 : Compute Means

$$\bar{x} = \frac{3 + 3 + 4 + 6 + 4 + 4 + 3 + 7 + 3}{9} = 4{,}11$$

$$\bar{Y} = \frac{5.1 + 21.4 + 7.6 + 12.5 + 20 + 30.3 + 18.9 + 54 + 9.1}{9} \approx 19{,}99$$

Step2 : ComputeSlope (β)

$$\sum(X_i - \bar{X})(Y_i - \bar{Y}) \approx 193{,}7$$
$$\sum(X_i - \bar{X})^2 \approx 24{,}55$$
$$\beta = \frac{163{,}7}{24{,}55} \approx 6{,}67$$

Step 3 : Compute intercept (a)

$$\alpha = \bar{y} - \beta\bar{x} = 19{,}99 - (6{,}67 \times 4{,}11) \approx -7{,}42$$

Step 4 : Compute Military Spending

$$y = \beta x + a$$
$$\textit{Military Spending} = 6{,}67 \times \textit{Threat Index} + (-7{,}42)$$
$$Y = 6{,}67 \times 3 + (-7{,}42) = 12{,}59$$

- **Pessimistic scenario :**

Step1 : Compute Means

$$\bar{x} = \frac{8 + 7 + 8 + 10 + 9 + 10 + 9 + 10 + 6}{9} = 8{,}56$$
$$\bar{y} = \frac{5.1 + 21.4 + 7.6 + 12.5 + 20 + 30.3 + 18.9 + 54 + 9.1}{9} \approx 19{,}99$$

Step2 : Compute Slope (β)

$$\sum(X_i - \bar{X})(Y_i - \bar{Y}) \approx 93{,}51$$
$$\sum(X_i - \bar{X})^2 \approx 16{,}22$$
$$\beta = \frac{93{,}51}{16.22} \approx 5{,}76$$

Step 3 : Compute intercept (a)

$$\alpha = \bar{y} - \beta\bar{x} = 19{,}99 - (8{,}56 \times 5{,}76) \approx -29{,}32$$

Step 4 : Compute Military Spending

$$y = \beta x + a$$
$$\textit{Military Spending} = 2{,}29 \times \textit{Threat Index} + (-29{,}32)$$
$$Y = 5{,}76 \times 8 + (-29{,}32) = \mathbf{16{,}76}$$

Table (6) : Forecast of military spending for 2026 based on a simple linear regression

	OPTIMISTIC SCENARIO	*MOST LIKELY SCENARIO*	*PESSIMISTIC SCENARIO*
ALGERIA	***17.07***	***12,59***	***16,76***
CHINA	*6,12*	*10,21*	*21,35*
INDIA	*6,67*	*11,31*	*23,43*
IRAN	*16,77*	*18,87*	*30,99*
ISRAEL	*13,67*	*13,67*	*27,79*
PAKISTAN	*13,67*	*13,67*	*30,99*
RUSSIA	*13,67*	*10,21*	*27,79*

UKRAINE	*6,12*	*16,77*	*30,99*
UNITED STATES	*6,67*	*10,21*	*20,45*

Source : Author'selaborationbased on final results

2) Time series model:

Step1 : Converting Yearsinto a Numerical Time Variable:

We Calculate the arithmetic mean for each of the following :

- ***t*** : the time variable (numerical representation of years)
- ***Y*** : military expenditure for each year

Each year is assigned a corresponding time value as follows :

YEAR	***2015***	***2016***	***2017***	***2018***	***2019***	***2020***	***2021***	***2022***	***2023***	***2024***
t (TEMPORAL)	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*

Step 2 : Calculating the Means

$$t = \frac{1+2+3+4+5+6+7+8+9+10}{10} = 5{,}5$$

$$Y = 5{,}6 + 5{,}5 + 5{,}3 + 5{,}0 + 4{,}9 + 4{,}9 + 4{,}9 + 4{,}9 + 5{,}0 + 5{,}1 = 51{,}1$$

$$\bar{\bar{Y}} = \frac{5{,}6 + 5{,}5 + 5{,}3 + 5{,}0 + 4{,}9 + 4{,}9 + 4{,}9 + 4{,}9 + 5{,}0 + 5{,}1}{10} = 5{,}11$$

Step 3 : Calculating the Slope (β_1) and Intercept (β_0)

- *Calculating the Slope (β_1)*

t	Y_t	$t_i - \bar{t}$	$Y_i - \bar{Y}$	$(t_i - \bar{t})(Y_i - \bar{Y})$	$(t_i - \bar{t})^2$
1	*5,60*	*-4,50*	*0,59*	*-2,66*	*20,25*
2	*5,50*	*-3,50*	*0,49*	*-1,72*	*12,25*
3	*5,30*	*-2,50*	*0,29*	*-0,73*	*6,25*
4	*5,00*	*-1,50*	*-0,01*	*0,02*	*2,25*
5	*4,90*	*-0,50*	*-0,11*	*0,06*	*0,25*
6	*4,90*	*0,50*	*-0,11*	*-0,06*	*0,25*
7	*4,90*	*1,50*	*-0,11*	*-0,17*	*2,25*
8	*4,90*	*2,50*	*-0,11*	*-0,28*	*6,25*
9	*5,00*	*3,50*	*-0,01*	*-0,04*	*12,25*
10	*5,10*	*4,50*	*0,09*	*0,41*	*20,25*
			TOTAL	*-5,15*	*82,5*

$$\beta_1 = \frac{\sum(t_i - \bar{t})(Y_i - \bar{Y})}{\sum(t_i - \bar{t})^2}$$

$$\beta_1 = \frac{-5{,}15}{82{,}5} = -0{,}0624$$

- Calculating the Intercept (β_0)

$$\beta_0 = \bar{Y} - \beta_1 \cdot \bar{t}$$

Substitution:

$$\beta_0 = 5{,}11 - (0{,}0624 * 5{,}5) = 4{,}794$$

Final Equation:

$$Y_t = 4.794 - (0{,}0624 * t)$$

t = 12 for the year 2026

$$Y_{2026} = 4{,}794 - (0{,}0624 * 12) = 4{,}045$$

Note :

The time series model applied to Algeria's military expenditure data for the period 2015–2024 is based solely on actual historical trends, without relying on external assumptions such as the level of security threats or geopolitical changes. This model is built on the premise that future military spending will follow the same historical pattern. Accordingly, it forecasts that Algeria's military expenditure in 2026 will be approximately 4.60% of total government spending.

In comparison with the three alternative scenarios based on the Security Threat Index, the time series model represents a likely internal scenario grounded in the continuation of current trends. Meanwhile, the scenario based on security threat projections estimates military spending at 12.59% (most likely), 46.72% (pessimistic), and 17.07% (optimistic). Therefore, the time series model offers a conservative estimate that does not account for security shocks or sudden strategic shifts, making it suitable in stable conditions, but potentially underestimating the risks of future escalations.

3) Panel Data Model

Step 1: Calculating Within-Country Averages

The Fixed Effects Model ignores differences between countries by removing the fixed effects specific to each country.

We calculate:

$$\overline{\boldsymbol{Y_{ti}}} = \boldsymbol{Y_{ti}} - \bar{\boldsymbol{Y}}_{\boldsymbol{i}} \& \bar{\boldsymbol{X}}_{\boldsymbol{ti}} = \boldsymbol{X_{ti}} - \bar{\boldsymbol{X}}_{\boldsymbol{i}}$$

Calculating Averages Within Algeria (2015–2024):

$$\bar{X}_{algeria} = \frac{3{,}2 + 3{,}9 + 1{,}5 + 1{,}4 + 0{,}9 + (-5) + 3{,}8 + 3{,}6 + 4{,}1 + 3{,}3}{10} = 2{,}07$$

$$\bar{Y}_{algeria} = \frac{5{,}6 + 5{,}5 + 5{,}3 + 5{,}0 + 4{,}9 + 4{,}9 + 4{,}9 + 4{,}9 + 5{,}0 + 5{,}1}{10} = 5{,}11$$

Step 2: Calculating the Slope and Intercept

The adjusted regression equation is used :

$$\overline{Y_{ti}} = \beta_1 \cdot \bar{X}_{ti} + \varepsilon_{ti}$$

We calculate the slope β_1 using the same equation :

$$\beta_1 = \frac{\sum(\bar{X}_{ti} \cdot \overline{Y_{ti}})}{\sum \bar{X}_{ti}^2}$$

	X_t	Y_t	$\bar{X} = X - \bar{X}$	$\bar{Y} = Y - \bar{Y}$	$\bar{X}.\bar{Y}$	$(\bar{X})^2$
2015	3,2	5,6	1,13	0,59	0,6667	1,2769
2016	3,9	5,5	1,83	0,49	0,8967	3,3489
2017	1,5	5,3	-0,57	0,29	-0,1653	0,3249
2018	1,4	5	-0,67	-0,01	0,0067	0,4489
2019	0,9	4,9	-1,17	-0,11	0,1287	1,3689
2020	-5	4,9	-7,07	-0,11	0,7777	49,9849
2021	3,8	4,9	1,73	-0,11	-0,1903	2,9929
2022	3,6	4,9	1,53	-0,11	-0,1683	2,3409
2023	4,1	5	2,03	-0,01	-0,0203	4,1209
2024	3,3	5,1	1,23	0,09	0,1107	1,5129
				TOTAL	**2,043**	**67,721**

Calculating the Slope β_1:

$$\beta_1 = \frac{2,043}{67,721} = 0,0302$$

Calculating the Intercept (α) :

$$\boldsymbol{a = \bar{Y}_i - \beta \cdot \bar{X}_i}$$
$$a = 5,11 - (0,0302 \times 2,07)$$
$$a = 5,01 - 0,0625 = 4,9474$$

Final Equation for Algeria :

$$\bar{Y}_{i_{algeria}} = 4,9474 + (0,0302 * X_t)$$
$$\bar{Y}_{i_{algeria}} = 4,9474 + (0,0294 * 4)$$
$$Y_{2026} = 4,9474 + 0,1179 = 5,0653$$

Note **:**

Each 1% increase in Algeria's economic growth is associated with an approximate 0.03% increase in the share of military expenditure from total government spending. This result reflects a weak relationship between economic growth and military spending in Algeria, suggesting that defense expenditure is not significantly influenced by annual economic fluctuations. Instead, it is likely driven by more stable security and strategic factors, which supports the use of the Fixed Effects Model to isolate those country-specific characteristics.

Section Four : Discussion of Results and Evaluation of Predictive Models

The results derived from the four quantitative models used to forecast military spending for the year 2026 show significant variation across the countries studied. This divergence reflects not an inconsistency, but rather the methodological differences among the models specifically in terms of their theoretical underpinnings, the explanatory variables used, and the structure of each model. By comparing these models, a comprehensive evaluation can be made regarding their ability to accurately reflect and predict military spending behavior in dynamic geopolitical and security contexts.

Table (7) : Forecast of military spending for 2026 based on previous results

	SIMPLE LINEAR REGRESSION	*MULTIPLE REGRESSION MODEL*	*PANEL DATA*	*TIME SERIES*
ALGERIA	*12.59*	*≈ 5.11*	*≈5.06*	*≈4.60*
CHINA	*12.59*	*≈ 5.22*	*≈ 12.9*	*≈22.5*
INDIA	*19.26*	*≈ 5.24*	*≈ 8.5*	*≈7.9*
IRAN	*32.60*	*≈ 5.11*	*≈ 13.8*	*≈13.0*
ISRAEL	*19.26*	*≈ 5.15*	*≈ 12.1*	*≈20.0*
PAKISTAN	*19.26*	*≈ 5.15*	*≈ 18.0*	*≈30.3*
RUSSIA	*12.59*	*≈ 5.09*	*≈ 13.0*	*≈18.9*
UKRAINE	*39.27*	*≈ 5.03*	*≈ 48.0*	*≈54.0*
UNITED STATES	*12.59*	*≈ 5.12*	*≈ 9.1*	*≈9.1*

Source : Author's elaboration based on final results

1. Model Evaluation

In order to determine the most effective and reliable method for forecasting military expenditure, it is essential to critically evaluate the performance of the quantitative models employed in this study. Each model whether based on a simple or multivariate structure, temporal dynamics, or cross-sectional variation offers distinct insights and limitations. This section provides a comparative assessment of the four predictive models.

1) Simple Linear Regression Model

This model relies on a single independent variable namely, the nuclear or security threat index. While this simplicity allows for a focused interpretation of the relationship between perceived threat and defense spending, it exposes the model to the risk of oversimplification. The results clearly show a tendency to overestimate military spending in countries with elevated threat levels, such as Iran (32.60%) and Ukraine (39.27%). This is expected due to the model's sole dependence on a volatile security variable that does not always translate directly or linearly into defense budget increases. Therefore, while useful for

highlighting the impact of threat perception, the model lacks robustness in situations where economic and political constraints significantly mediate military responses.

2) Multiple Regression Model

This more sophisticated model integrates multiple economic variables such as GDP growth, fiscal deficit, and possibly financial dependency which allows for a more comprehensive view of the fiscal dynamics behind defense spending. However, the model's forecasts appear clustered within a narrow range (~5.1%) across almost all countries, including those experiencing severe conflict (e.g., Ukraine or Israel). This uniformity suggests a limited sensitivity to real-world security developments. Furthermore, its exclusion of political and strategic variables makes it more appropriate for peacetime economic analysis than for assessing military behavior in high-risk or wartime conditions.

3) Panel Data Model

This model is arguably the most robust and context sensitive of the four. By incorporating both the temporal dimension (within country changes over time) and the cross sectional dimension (differences between countries), and by controlling for unobserved time invariant characteristics (such as institutional or doctrinal factors), the fixed effects panel model offers a nuanced interpretation of military spending. Its forecasts show logical variation : moderate estimates for relatively stable countries (Algeria : 5.06%, China : 12.9%) and much higher figures for states directly engaged in military conflict (Ukraine : 48.0%). This model demonstrates flexibility and realism, capable of reflecting structural economic variables alongside geopolitical and military pressures making it well suited for empirical applications in strategic and defense studies.

4) Time Series Model

The time series model extrapolates from a country's internal historical trend, without incorporating external variables. It performs well in states with stable institutions and gradual policy shifts such as India (7.9%) or the United States (9.1%) but is less effective in capturing abrupt shifts caused by conflict, foreign intervention, or military aid. This shortcoming is evident in the exaggerated predictions for conflict-ridden states such as Ukraine (54.0%) or Pakistan (30.3%), where external factors play a decisive role in shaping defense

budgets. As such, while the model may be reliable in normal conditions, its utility is limited in volatile or war-torn environments.

2. Recommendation

Based on the quantitative comparison and contextual interpretation of the results, the Fixed Effects Panel Data Model emerges as the most appropriate and reliable approach for forecasting military spending in a world increasingly shaped by nuclear and hybrid threats. This model :

- Captures both structural country specific characteristics and evolving temporal dynamics.
- Offers differentiated, realistic predictionsthat reflect the security realities of each state.
- Avoids the pitfalls of over reliance on a single explanatory variable or overly generalized economic assumptions.
- Provides a rigorous analytical framework that is both interpreted and policy relevant.

Accordingly, **the panel data model** not only stands out for its empirical accuracy but also for its theoretical strength, making it a valuable tool for strategic planners, defense economists, and security analysts. In the context of modern conflict environments marked by nuclear escalation, asymmetric threats, and fiscal constraints this model supports more informed, data-driven decision-making and contributes to the refinement of defense policy forecasting methodologies.

Conclusion

The ability to forecast military expenditure is a crucial strategic tool for understanding national priorities in the context of shifting security and economic dynamics. This study has aimed to provide a comparative analysis of four distinct quantitative models for estimating military spending: simple linear regression, multiple regression, fixed effects panel data, and time series models. The evaluation revealed that each model possesses specific methodological features that allow it to explain certain aspects of defense expenditure, yet their accuracy and applicability vary depending on the structural characteristics and geopolitical context of each country.

The results show that the fixed effects panel data model stands out as the most appropriate and realistic among the models tested. Its strength lies in its ability to integrate both the country-specific structural attributes and the internal temporal variations. This allows for a more nuanced and context-sensitive interpretation of military spending, especially in environments where security threats interact closely with economic constraints.

However, this study does not claim to have exhausted all analytical tools available in the field. Advanced forecasting frameworks such as Bayesian models, structural vector autoregression (SVAR), and dynamic panel data model sprovide broader analytical horizons for researchers seeking greater precision or working with more complex datasets. Moreover, the rapid evolution of artificial intelligence has opened unprecedented possibilities in defense analytics. AI powered systems can now process vast volumes of data in real time, detect hidden patterns, and produce highly adaptive forecasts far beyond the capabilities of traditional econometric models.

In this context, the study encourages researchers and professionals in the field of military expenditure to adopt a hybrid analytical approach that combines classical quantitative models with cutting-edge computational tools. It also highlights the importance of relying on validated, up-to-date datasets provided by reputable institutions such as:

- Stockholm International Peace Research Institute (SIPRI).
- International Institute for Strategic Studies (IISS).
- The World Bank, International Monetary Fund (IMF), and NATO defense databases.

By combining rigorous methodology with credible data sources, researchers can move beyond interpretation and into the realm of predictive model ling building robust tools that are not only theoretically grounded but also applicable to real world defense and security planning. In an increasingly uncertain world, marked by rising defense budgets and strategic volatility, such tools are no longer optional they are indispensable.

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Appendix No. 01

Table (8) : Security Threat Index Scenarios 2026 [1 to 10]

	Armedconflict									*Terroristthreats*								
	First scenario			*Second scenario*			*Third scenario*			*First scenario*			*Second scenario*			*Third scenario*		
	No conflict	*Limited conflict*	*Major conflict*	*No conflict*	*Limited conflict*	*Major conflict*	*No conflict*	*Limited conflict*	*Major conflict*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*
	0	*1*	*2*	*0*	*1*	*2*	*0*	*0*	*2*	*0*	*1*	*2*	*0*	*1*	*2*	*0*	*1*	*2*
Algeria	✓			✓					✓	✓			✓					✓
China	✓			✓				✓		✓				✓				✓
India	✓				✓				✓	✓				✓				✓
Iran		✓			✓				✓		✓			✓				✓
Israel		✓			✓				✓		✓			✓				✓
Pakistan		✓			✓				✓		✓			✓				✓
Russia		✓			✓				✓	✓			✓				✓	
Ukraine	✓					✓			✓	✓				✓				✓
United States	✓			✓				✓		✓				✓				✓

Border tensions or regionalthreats			*Non-conventionalthreats*		
First scenario	*Second scenario*	*Third scenario*	*First scenario*	*Second scenario*	*Third scenario*

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No tension	*Limited tension*	*Persistent tension*	*No tension*	*Limited tension*	*Persistent tension*	*No tension*	*Limited tension*	*Persistent tension*	*None*	*Potential*	*Actual*	*None*	*Potential*	*Actual*	*None*	*Potential*	*Actual*
0	*1*	*2*	*0*	*1*	*2*	*0*	*1*	*2*	*0*	*1*	*2*	*0*	*1*	*2*	*0*	*1*	*2*
	✓				✓			✓	✓				✓			✓	
✓				✓				✓	✓			✓				✓	
	✓				✓			✓	✓			✓				✓	
	✓				✓			✓		✓				✓			✓
	✓			✓				✓		✓			✓				✓
	✓			✓				✓	✓				✓				✓
	✓			✓				✓		✓			✓				✓
✓					✓			✓	✓			✓					✓
✓			✓				✓			✓				✓			✓

Political–social fragility									*Security Threat Index*		
First scenario			*Second scenario*			*Third scenario*					
Stable state	*Somefragility*	*High fragility*	*Stable state*	*Somefragility*	*High fragility*	*Stable state*	*Somefragility*	*High fragility*	*Optimistic scenario*	*Most likely scenario*	*Pessimistic scenario*
0	*1*	*2*	*0*	*1*	*2*	*0*	*1*	*2*			
✓			✓				✓		*1*	*3*	*8*
✓				✓				✓	*0*	*3*	*7*
✓			✓				✓	✓	*1*	*4*	*8*
	✓			✓				✓	*5*	*6*	*10*
✓			✓				✓		*4*	*4*	*9*
	✓			✓				✓	*4*	*4*	*10*
	✓			✓				✓	*4*	*3*	*9*
✓					✓			✓	*0*	*7*	*10*
✓			✓				✓		*1*	*3*	*6*

Source *: Developed by the author based on security threat scenario assumptions constructed for 2026.*