VRIJE UNIVERSITEIT BRUSSEL

Bachelor Paper for Business Economics

Economic Impact of Military Spending on GDP Growth in Morocco

2023-2024

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Social Sciences & Solvay Business School
Vrije Universiteit Brussel, May 3rd, 2024

Amount of words (excluding reference list and appendices): 5328

Table of Contents

Introduction

Western Sahara has long been the stage of complex geopolitical dynamics, shaped by its unique history and struggles for independence. The region is inhabited by tribes categorised as either "*bilad al-makhzan*" (land of the government), fully under the Moroccan sultan's control, or "*bilad al-siba*" (land of dissidence), defined by Weiner (1979) as tribes acknowledging the religious authority of the sultan but not his political authority. This distinction has rendered the question of Western Sahara's independence intricate, considering that despite the tribes' religious affiliation to Morocco, some may have not always been politically aligned with the nation's government. Western Sahara was officially annexed as a protectorate by Spain in 1884 who saw in the region opportunities to develop fishing activities, as well as a more convenient pathway to control the Canary Islands. Phosphate deposits, which eventually proved to be of great economic interest, were only discovered in the late 1940s (Besenyö, 2010).

In March 1956, Marks (1976) indicated the emergence of a significant challenge to Spanish rule in Africa when Morocco gained independence from France. Resistance from Sahrawi tribes with the support of Moroccan authorities led to multiple armed conflicts (Besenyö, 2010). Spain, who had no intention to relinquish the now known phosphate deposits, along with France, who was also faced with threats in the area, created a joint coalition and started eliminating the resistance of local Western Sahrawi tribes (Besenyö, 2010). Spain gradually disengaged from its Western Saharan colony following pressures from neighbouring countries and the advisory opinion from the International Court of Justice in 1975 (Marks, 1976), which acknowledged Morocco and Mauritania's historical ties to the region, but not their sovereignty over it. On November 6th, 1975, 350,000 Moroccan citizens walked in a peaceful march towards the then Spanish-occupied Western Sahara to claim the desert from the Spaniards. This procession, now known as the Green March, was led by King Hassan II, and was conducive to an agreement between Mauritania, Morocco and Spain that compelled the latter to relinquish its claim on Western Sahara (Weiner, 1979).

The agreement did not however satisfy the Polisario Front, a political and military organisation seeking independence of the Western Sahara from Morocco (Encyclopaedia Britannica, 2024). The Polisario Front, based in and backed by Algeria, first emerged in 1973 as an armed resistance against Spanish occupation before declaring war against Morocco and Mauritania in 1976 (Bésenyő, 2017). Mauritania signed a peace treaty three years into the conflicts due to political and economic pressures following countless attacks by the Polisario Front. Mauritanian-occupied territories were then annexed by Morocco, which asserted a steadfast claim on the territory (Bésenyő, 2017). Despite the economic allure of vast phosphate deposits, the Moroccan leadership consistently emphasized territorial integrity and national unity over economic motivations (Marks, 1976).

After Mauritania's surrender of its Western Saharan territories, the Polisario Front shifted their antagonism towards Moroccan forces. Multiple attacks were orchestrated on the region's main cities such as Laayoune and Smara. Infrastructure, namely bridges and conveyer belts, were targeted to hamper economic exploitation and transportation, thereby inducing economic pressures on Morocco (Bésenyő, 2017). In 1991, the UN's Secretary General initiated talks for a ceasefire which went into effect on September 6th (MINURSO, 2017). The ceasefire was broken after the Polisario Front brought an end to its commitments and launched attacks on November 13th, 2020 (Zunes & Mundy, 2022).

This conflict has had a significant impact on Morocco's economy. The country was able to start exploiting new phosphate mines in the desert region. These total to approximately 50 billion metric tons, accounting for about 70% of global reserves (Jasinski, 2023), thus underscoring the high stakes involved in the conflict.

In terms of government expenditure, during the peak of the conflict in 1977, the country's military spending reached a record 6.6% of the national GDP compared to seven years prior predating the conflict where it only reached 2.3% (Stockholm International Peace Research Institute, 2023).

In light of these developments, this paper seeks to explore the relationship between military expenditure and economic growth in Morocco. An econometric model shall serve as a means to assess the impact of military spending on the growth rate of the Moroccan economy. The study will focus on a timeframe between 1976 and 2015, a period that corresponds with the earliest available data and extends up to just before the breach of the 1991 UN ceasefire by the Polisario Front in 2020 (Zunes & Mundy, 2022). It is important to note, however, that the results of this study should be interpreted with caution and not generalized to other countries or regions without considering the specific externalities, historical context, and timeframes involved.

The structure of the paper is divided into three main sections: the literature review, the research design and results. Initially, the literature review will analyse earlier studies, such as those by Benoit (1978), and more recent analyses like those by Lanrui et al (2022), providing a comprehensive understanding of the topic. Following this, insights from the literature review will be used to define the research problem clearly and outline the research design, discussing the foundational elements of our model, which include the Augmented Dickey Fuller test, Granger causality, and the Ordinary Least Squares method. The final section provides the results of our tests. Through this approach, the paper aims to address a significant gap in the research regarding Morocco's government expenditure, specifically focusing on military spending.

Literature Review

This section explores several key studies investigating the impact of military spending on economic growth. By synthesizing these contributions from the relevant literature, it aims to offer a comprehensive overview of this critical issue.

The paper titled *'Defense spending and economic growth in developing countries*' by Benoit (1978) ignited a significant debate in the field of defence economics due to its

controversial findings. Benoit (1978) analysed data from 44 different developing countries and discovered a positive correlation between military spending and economic growth. His findings suggested that military expenditures could stimulate economic development by providing employment and training opportunities, developing infrastructure, and promoting technological innovation. Benoit's conclusions sparked interest and discussion, particularly due to the intriguing nature of his results, which can be attributed to differences in the economic contexts of the countries studied, the periods analysed, and the methodological approaches taken. This highlights the importance of considering various factors when assessing the relationship between military spending and economic growth.

In a later article by Grobar et Porter (1989) Benoit's arguments were revisited with newer research taken into account. Grobar et Porter (1989) attempted, for instance, to recalculate the correlation coefficients originally found by Benoit, using a different set of data, but their attempt proved unsuccessful. Furthermore, they pointed out that some reviewed studies did suggest a slight positive relationship between military spending and economic growth. However, when analysing how military expenditure affected economic growth through multiple channels, the slight positive effects in some were cancelled out by the negative effects in others resulting in a net negative result (Deger, 1986; Deger & Smith, 1983; Faini et al., 1984). In their conclusion, Grobar et Porter (1989) stated that the estimates of the correlation coefficients from Benoit's paper were not robust. The reason for the differing results found by Benoit (1978) and those observed by Grobar et Porter (1989) can be explained by the nuances in how military expenditure influences various economic sectors. While Benoit's analysis may have captured the initial boosts to employment and infrastructure, Grobar et Porter's broader approach highlighted how these short-term gains could be offset by long-term drags on the economy, such as increased government debt, higher taxes to support military spending, and the potential crowding out of more productive non-military investments.

Abu-Bader et Abu-Qarn (2003) conducted a study examining the relationship between military expenditure and economic growth in Egypt, Israel, and Syria over a period of three decades. Utilizing multivariate cointegration and variance decomposition techniques, the study aimed to elucidate the causal links between military spending, overall government expenditure, and economic growth in the three countries. The findings of the study revealed a bi-directional causality, meaning that not only does overall government spending influence economic growth, but economic growth also affects the levels of government spending, with a negative long-run relationship observed in the cases of Israel and Syria. The authors hypothesised that the burden of military expenditures, as indicated by the ratio of military spending to GDP, could be the cause of this negative relationship. To test this hypothesis, the authors split overall government expenditures into civilian and military expenditures. The results of the analysis demonstrated a consistent negative relationship between military expenditure and economic growth across all three countries. However, a positive relationship between civilian expenditures and economic growth was observed only in Israel and Egypt. The methodology employed allowed the researchers to disentangle the effects of military and civilian expenditures on economic growth. This approach clarified how military spending might crowd out other forms of productive government expenditure or economic activity, leading to overall negative effects on economic growth, despite any positive effects from civilian government spending.

Examining the econometric literature on the effects of military expenditure on economic growth, Dunne et al. (2005) reviewed existing models in their paper '*Models of Military Expenditure and Growth: A Critical Review.*' They focused on three main models—the Feder-Ram model, the Augmented Solow model, and the Barro model—to assess their suitability for analysing the relationship between military spending and economic growth. The study concluded that the Feder-Ram model should be avoided in defence economics studies due to its potential for misinterpretation and its narrow scope of possible influences on growth. While the Augmented Solow model was found to have fewer theoretical weaknesses, its range of

significant determinants of economic growth was deemed too narrow. In contrast, the Barro model showed promise, as it allows for the inclusion of the effects of threat level on output. This indicates a nonlinear effect of military expenditure that leads to positive effects on output when threat is high and negative effects when threat is low. Dunne et al.'s findings (2005) highlight the significant impact of model selection in defence economics, as it can fundamentally alter the observed relationship between military spending and economic growth. Such an evaluation reveals how the choice of model in defence economics can fundamentally alter the observed impact of military spending on economic growth, emphasizing the importance of model selection in capturing the complex dynamics between military expenditures and economic outcomes.

The journal article *'Military Spending and Economic Growth: The Case of Iran'* by Farzanegan (2014) analysed how the Iranian economy responded to shocks stemming from military expenditure during the period from 1959 to 2007. Employing Granger causality, variance decomposition tools, and impulse response functions, the author delved into the complex relationship between military spending and economic growth. The study's findings reveal a statistically significant unidirectional causality between growth in military spending and economic growth, indicating that increases in military expenditure may have stimulated economic activity in Iran. Specifically, the Impulse Response Functions (IRF) results suggest that that positive shock in military expenditure led to statistically significant economic growth in the short and medium run. Increases in military spending may have led to an immediate stimulation of economic activity, possibly through increased government spending in military-related areas, which in turn boosts employment and stimulates related industries. This economic impact appears to persist into the medium term, highlighting the significant role that military expenditure plays in shaping economic trajectories in countries with substantial defence spending like Iran.

The research conducted by Das et al. (2015) investigated the causal relationship between military expenditure and GDP across countries. Employing unit root tests, Johansen cointegration tests, error correction modelling and Granger causality tests, the study revealed mixed results for the direction of causality, with some showing GDP to cause a rise in military expenditure and others exhibiting the converse effect. On the other hand, Shahbaz et al. (2013) confirmed cointegration between economic growth, military spending, government spending and interest rate. Their results indicating a negative effect of military spending on economic growth for Pakistan. The variance in findings by Das et al. (2015) across different countries can be attributed to diverse economic structures and political contexts that influence how military expenditures are financed and their subsequent impact on the economy. In countries where GDP growth leads to increased military spending, defence policies may be responsive to economic capacity, while in others, higher military spending could be driving GDP changes due to the economic activities associated with defence sectors. These findings underscore the complexity of the relationship between military expenditure and GDP while highlighting the importance of considering contextual factors in understanding their dynamics.

The article '*Analysis of the Effects of Defense Expenditures on Income Distribution and Economic Development with Panel Asymmetric Causality Test: Brics Countries and Turkey Case'* by Gül et Torusdağ (2019) explores the relationship between defence spending, income distribution, and economic development in BRICS countries and Türkiye from 1995 to 2015. Employing a panel asymmetric causality test, the authors analysed the causal relationships between these variables. The study revealed a one-way causality from economic growth to defence expenditures during the period of 1995 to 2010, suggesting that economic growth likely enabled these countries to spend more on defence without necessitating cuts in other areas of expenditure. This finding implies that defence spending was more likely a consequence of economic growth rather than a cause of it. Conversely, the lack of causality from defence expenditures to economic growth suggests that increases in defence spending did not lead to

economic stimulation. This could be attributed to the complex interactions between government spending patterns and other economic activities, potentially including high opportunity costs or inefficient allocation of resources. These findings highlight the nuanced dynamics of defence expenditures and their impact on economic development in BRICS countries and Türkiye, underscoring the importance of considering causal relationships in economic analysis.

Finally, Lanrui et al. (2022) investigated the nexus between military expenditure and economic growth in Pakistan by implementing the NARDL (Nonlinear Autoregressive Distributed Lag) model on data from 1972 to 2018. The NARDL model revealed an asymmetric relationship between military spending and economic growth in Pakistan. Specifically, the results indicated that a negative shock or decrease in military spending had a positive effect on economic growth, while an increase in military expenditure in the long term had an insignificant effect on economic growth. This outcome is attributed to the NARDL model's ability to capture both positive and negative shocks in military spending, providing a more nuanced analysis than traditional linear models. The positive effect of reduced military spending suggests that lower defence costs may free up resources for more productive economic activities, thereby supporting growth. In contrast, the insignificance of increased military spending on long-term growth implies that such expenditures do not yield proportionate economic benefits, possibly due to the crowding out of private sector investment or inefficiencies in military spending.

In synthesizing the findings from various studies on the relationship between military expenditure and GDP growth, it becomes evident that the dynamics are multifaceted and complex. While Benoit (1978) proposes a positive correlation, highlighting the potential for military spending to drive economic growth through employment, infrastructure, and technological innovation, other studies, such as those by Abu-Bader et Abu-Qarn (2003) and Shahbaz et al. (2013), suggest a negative long-run relationship. These findings underscore the challenges of resource allocation and the potential diversion of funds from productive uses.

Farzanegan (2014) offers a different perspective, pointing towards a significant unidirectional causality from military spending to economic growth, implying potential short-to-medium-term benefits. However, Das et al. (2015) and Gül et Torusdağ (2019) present mixed results, highlighting the country-dependent nature of the relationship and emphasizing the need for context-specific analyses. Lanrui et al.'s (2022) findings further complicate the landscape by revealing that a negative shock in military spending unexpectedly affects economic growth in a positive way, while an increase shows insignificant long-term effects. This highlights the nuanced and asymmetric impacts military expenditures can exert on a nation's economic growth.

Externalities

To better estimate the economic significance of the military expenditure, it is imperative to delve into the significant economic events that have shaped Morocco's economic identity in recent times. Understanding these events provides crucial context for evaluating the impact of independent variables on GDP. Additionally, the geopolitical challenges Morocco faced in the late 20th century, including conflicts with the Polisario Front over the Western Sahara territory, not only reshaped its territorial dynamics but also left lasting impacts on its economic policies.

As the nation grappled with complexities arising from the Western Sahara conflict, a series of economic reforms were set in motion to address internal financial issues which played a significant role in defining its economy. The territorial disputes regarding the annexation of the Western Sahara in 1975 led to a spike in military expenditures. This annexation prompted a four-decade-long conflict, with the Polisario Front demanding independence for the Western Sahara from Morocco and Mauritania. The ensuing conflict resulted in increased military spending, accounting for 3.5% of GDP between 1974 and 1977 (Stockholm International Peace Research Institute, 2023). Subsequently, to address economic challenges such as high inflation rates and budget deficits, King Hassan II initiated a reform program in collaboration with

international institutions like the IMF and the World Bank (El-Said & Harrigan, 2014). These reforms aimed to mitigate the country's budget deficit and promote private sector activities through trade liberalization and privatization initiatives. Consequently, the government attempted to promote activities in the private sector by carrying through the liberalization of trade and the privatization of previously state-owned companies such as Maroc Telecom and Attijariwafa Bank in order to reduce government interventions (El-Said & Harrigan, 2014). Furthermore, international agreements like the Free Trade Agreement signed with the United States in 2004 reduced trade barriers between both countries, increasing exports contributing to economic growth (U.S. Trade Representative, n.d.).

Beginning in late 2010, the Arab Spring had a profound impact on the political and economic landscape of Morocco. While under the leadership of King Mohammed VI, the Moroccan government responded to the calls for change of its population by implementing a series of constitutional reforms in 2011. These reforms aimed to strengthen political pluralism and to delegate some powers to elected officials. Despite these measures, Morocco did face economic challenges during the Arab Spring, including a slowdown in tourism and foreign direct investment. However, Morocco is an exception of the Arab springs as the monarchy survived the protests and the country's diversified economy and proactive government policies helped mitigate the adverse economic impacts (Sadiki, 2014).

Drawing from recent key studies on the relationship between military expenditure and economic growth, as well as an exploration of events shaping Morocco’s economic landscape, it is evident that the relationship between military spending and economic growth is complex. Overall, the literature suggests that military expenditure often has a negative effect on economic growth. Building on these insights, this study will conduct an empirical analysis to further elucidate this relationship within the Moroccan context.

Research Design

Theoretical Framework

As mentioned at the onset of this paper, the academic literature shows a lack of congruence in its findings with respect to the question of how military expenditure impacts economic productivity. While some, such as Abu-Bader et Abu-Qarn (2003), assert that military expenses divert public resources from other avenues of investment that are critical to an economy's improvement, others such as Benoit (1978) argue for the positive externalities and stimulating effects of military expenditure on the aggregate demand side of the economy (this latter view is known in the academic literature as Military Keynesianism).

To fathom the relationship between military expenditure and GDP, it is important to establish some conceptual underpinnings. Military expenditure is thus defined as all current and capital expenditures on armed forces, including peacekeeping forces in an economy (Stockholm International Peace Research Institute, 2023). Following, economic growth is measured by proxy of the GDP, defined as the sum of gross value added by all resident producers in an economy plus taxes and minus subsidies not included in the value of the products (World Bank, 2024). As an investigative goal, this paper therefore proposes as a null hypothesis that variations in military expenditure do not cause variations in GDP.

Data and Methodology

Firstly, Morocco's demographic composition, characterised by a young population, plays a pivotal role in shaping its economic trajectory (Becker et al., 1999). As highlighted by Alfani et al. (2020), the country faces considerable challenges regarding unemployment and social discontent, particularly among the youth and NEETs (Not in Education, Employment or Training). Understanding demographic trends and their implications is crucial for comprehensively assessing Morocco's economic performance. While population is generally presumed to yield a driving effect upon an economy's productivity, it must be understood by accounting for characteristics of its constituent labour force (Aizenman & Glick, 2006).

However, due to the lack of data, labour force characteristics (unemployment rate, age structure, etc.) were omitted as control variables and the model shall strictly account for population figures.

Second, trade balance on goods and services, defined by the World Bank (2023) as the exports minus the imports of goods and services in current U.S. dollars, is a growingly important indicator of Morocco's economic condition and its integration into the global market. The reforms undertaken by the government, as analysed by Harrigan et El-Said (2010), aimed at enhancing trade liberalization measures to improve Morocco's trade balance. Despite efforts to bolster exports and reduce imports, Morocco continues to grapple with a persistently negative trade balance, reflecting the complexities of its economic policies and global trade dynamics (World Bank, 2023).

Lastly, foreign direct investment, defined by the World Bank (2024) as the net direct investment of foreign equity flows for lasting stakes in private sector company management, serves as a key driver of Morocco's economic growth and development. As noted by Aggarwal et Lyttle (2022), Morocco has demonstrated an exceptional ability to attract foreign direct investment (FDI) with respect to other African economies, underscored by its remarkable performance in the 2022 Inward FDI Performance Index. The influx of foreign investment, particularly from countries like the United States, France, and the United Arab Emirates, highlights Morocco's appeal to investors and its significant economic prospects. Notwithstanding this observation, data on net foreign direct investment still displays conspicuous variations and has been constantly negative throughout the timespan chosen by this study.

The incorporation of population, trade balance, and foreign investment as control variables in the last step of the regression model shall ultimately provide a comprehensive

analysis of the economic significance of Morocco's military expenditure on the country's GDP, corrected for the influence of exogenous factors that affect the variation of the latter.

A less stringent version of the Gauss – Markov assumptions was used instead of the classical linear model assumptions as they might not have satisfied certain time series problems. The model provided us with the results of an *F-test* which ensured that the model effectively added value alongside the coefficients for the model using the OLS method.

The data needed for this study was garnered from two sources, namely the World Bank's World Development Indicators dataset for the following variables: GDP levels, foreign direct investment, population and trade balance. and the *SIPRI Yearbook 2023: Armaments, Disarmament and International Security* for the share of military expenditure. The data utilized in this study meets quality standards outlined by Batini et al. (2009), such as process model and improvement management, ensuring its reliability and relevance.

The sample of data upon which the research was carried out was chosen to encompass the political developments in Morocco's recent history, marked by the conflict between Moroccan national authorities and the Polisario Front over the disputed territory of the Western Sahara (Zunes & Mundy, 2022). Another concern that shaped the canvas of the sampled values regards data availability: all variables that are featured in the model elaborated in this study had to be retrieved from economic indicator datasets devoid of any omissions, to perform a viable regression analysis in later stages with relevant control variables. Taking all of this into account, a timeframe from 1976 through to 2015 was chosen. All the data consist of time series measured in the indicators' respective units: GDP, military expenditure, trade balance and foreign direct investment were all measured in current US dollars, whereas population merely corresponds to a census count of all residents regardless of legal status or citizenship (World Bank, 2024).

An econometric model was used to support the inquiry into the effects of military expenditure on Morocco's economic growth, making use of the first difference of the natural logarithm of the economy's yearly GDP over the chosen timespan. Likewise, the first difference

of the natural logarithm of military expenditure serves as a measure for variations in military expenditure. Additional data for the control variables used in the model stem from the World Bank Indicators: foreign direct investment, population and trade balance.

The following paragraphs shall provide an outline of the instruments selected for the quantitative analysis of this study. Comprehensively, the *Augmented Dickey-Fuller* (ADF) test, the *Granger causality* test and the *Ordinary Least Squares* (OLS) regression method make up the model upon which the data were tested.

The Augmented Dickey-Fuller statistical test was used to establish the stationarity in the time series data used in this study. Stationarity implies that the data values are stationary, which allows for the interpretation of unconditional moments (independent from specific time periods or conditions) from a sample such as its mean, variance, skewness and kurtosis (Dickey & Fuller, 1979). The ADF test for stationarity serves as a prerequisite for the Granger Causality statistical test, which establishes a proxy for causation between military expenditure and GDP time series (Granger, 1969).

The selection of these variables was warranted on one hand by their significant impact on Morocco's economic landscape, and on the other by the availability of their respective data. Moreover, the regression model was designed to include an independent term consisting of lagged values of GDP by one year. The choice of the lagged values of GDP by one year was based on a study using a similar model by Yıldırım et al. (2005), which allowed for the model to capture the effects of autocorrelation in time series values for the dependent variable.

Since the actual values for the chosen indicators showed important differences in magnitude from one another, all data were converted to a natural logarithmic form. This had the effect of linearizing exponential trends, enabling the use of the ADF and subsequently Granger Causality tests for which stationarity of data was a prerequisite. Furthermore, the time series data for the indicators were integrated (i.e. converted to a first difference of adjacent values), for the same purpose of establishing stationarity (Granger, 1969).

The OLS regression model ultimately uses differentiated logarithmic values for all variables. This formulates a log-log regression equation in which the coefficients associated with an independent variable represent the elasticity of GDP with respect to the said variable (Greene, 2012). Finally, since the values for foreign direct investment and trade balance were persistently negative throughout the timespan, this resulted in the impossibility of conversion to logarithmic values, applied to all other variables. To account for this, the signs of both foreign direct investment and trade balance datasets are directly inverted (entailing that their associated coefficients reported in the regression model tables should be inverted in sign to be read correctly).

Results and Discussion

Table 1

Descriptive statistics for the integrated logged variables used. S – Skewness , K - Kurtosis

	μ	σ^2	S	K
GDP	0.059	0.01	-0.324	-0.337
GDP Lagged	0.066	0.011	-0.123	0.042
ME	0.044	0.028	-0.268	2.047
POP	0.017	0	0.844	-0.907
TBAL	0.038	0.701	0.337	12.181
FDI	0.108	1.647	0.657	3.71

Table 1 provides the results of the descriptive statistics of the integrated variables that were used in the study. It is interesting to observe that the first difference of the POP (population) variable has essentially 0 variance, suggesting that the rate at which the population of Morocco grows is constant.

Figure 1

Nominal GDP and military expenditure (logarithmic scale) graph from 1976 to 2015

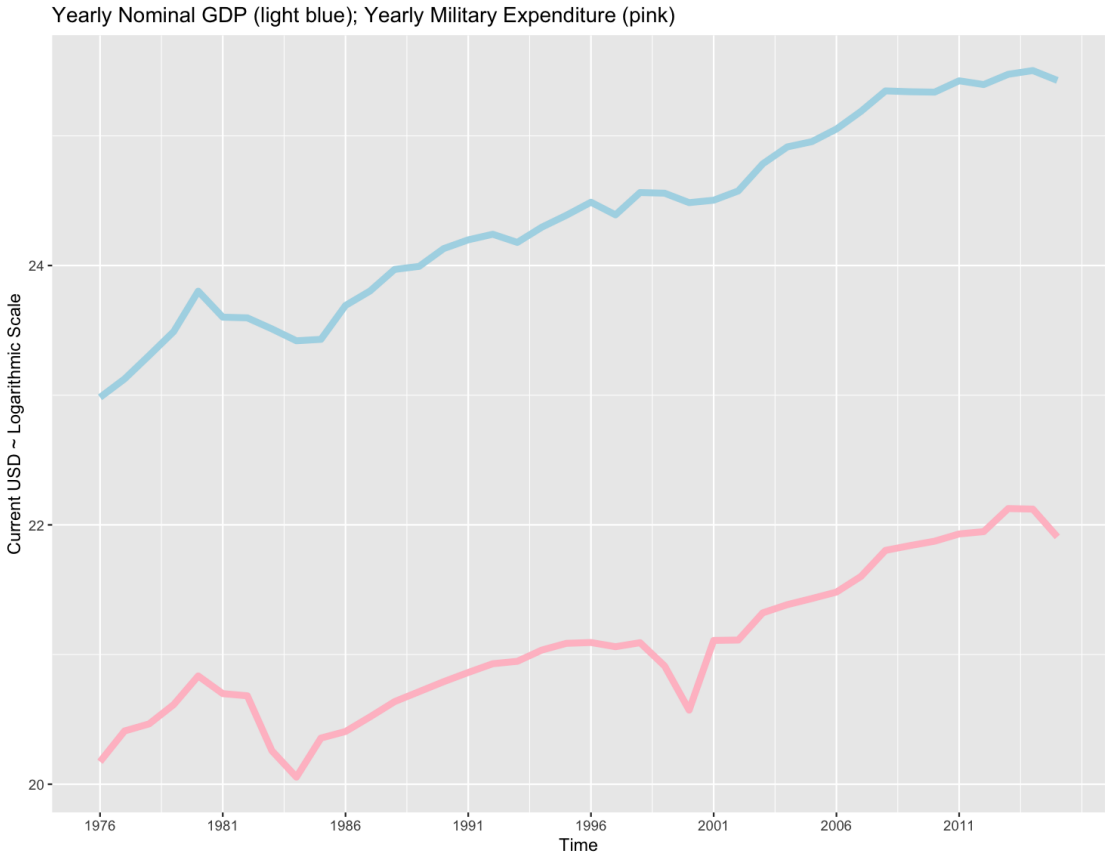

Figure 1 features line graphs of ME and GDP, represented on a logarithmic scale. These allow for a preliminary insight into how the time series data interact with one another.

Following the comprehensive analysis of Morocco's economic landscape and the implementation of the three statistical tests, we now present the results of the econometric model. The following report of the test and regression results assume a critical level of statistical significance at $\alpha = 0.05$, against which the ADF null hypothesis is being tested.

Table 2

ADF test results for stationarity of integrated logged data values, rounded to 3 decimal places

Variable	ADF Statistic	P-value
GDP_log	-4.408	0
ME_log	-5.994	0
LAG_GDP_log	-5.485	0

POP_log	-1.942	0.312
TBAL_log	-6.277	0
FDI_log	-10.231	0

Based on the results of the *Table 2* it can be concluded that all integrated variables (GDP, Military expenditure, Trade balance, Foreign direct investment) apart from 'population' are stationary at α-level of 0.05.

Table 3 indicates the test-statistic and p-values between military expenditure (ME) granger causing GDP, as well as GDP granger causing military expenditure (inverting the direction of causality).

Table 3

Granger Causality test results

	F Test-statistic	P-value
ME to GDP	0.1276	0.7231
GDP to ME	6.3425	0.0165

Based on the p-values of both tests, it is concluded that there is no significant evidence (p-values being above critical significance level) to suggest that military expenditure Granger causes GDP. However, testing for an inverted direction of causality, namely from GDP to military expenditure time series, indicates that GDP Granger causes military expenditure (p-values being below critical significance level). This means that predicting military expenditure could be done using GDP time series data but not the other way around (Granger, 1969).

Table 4 showcases the regression coefficients and standard errors in the brackets. These results provide insights into how variations in military expenditure relate to GDP growth in the context of Morocco's economy.

Table 4

Regression Analysis of the Relationship Between GDP and Military Expenditure

Model	(1)	(2)
Intercept	0.0458 [0.015]	0.030 [0.052]
ME_log	**0.294** **[0.087]**	**0.329** **[0.089]**
LAG_GDP_log		0.265 [0.145]
POP_log		-0.037 [2.861]
TBAL_log		-0.004 [0.017]
FDI_log		- 0.019 [0.012]
R-squared	0.237	0.328
Adj. R-squared	0.217	0.226
F-statistic	11.5	3.224

Upon including the control variables in the regression, the model statistics show the following evolution:

- The R-squared statistic, which accounts for proportion of the variance in the dependent variable (GDP_log) that is explained by the independent variable, amounted to 0.237 without control variables, and increased to 0.328 with the control variables.
- The adjusted R-squared statistic, which evaluates the same metric than the R-squared statistic by applying a penalty for the marginal inclusion of independent variables, amounted to 0.217 without control variables, and 0.226 with control variables.

- The F-statistic, which test for the overall significance of the model, amounted to 11.5 and dropped to 3.224 when including the control variables.

Conclusion

In conclusion, the analysis indicates that the null hypothesis has not been rejected by the Granger Causality test when performed in the direction initially outlined, namely that variations in military expenditure granger caused variations in GDP (military expenditure does not granger cause GDP). However, the Granger Causality test results indicate the existence of a statistically significant causal relationship in the other direction, i.e. from GDP to military expenditure. When taking all control variables into account, the regression model returns a coefficient of 0.329 for military expenditure. This entails that a one percent increase in military expenditure is associated with a 0.329% increase in GDP growth (ceteris paribus).

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Statement of Contributions

The whole group worked together on assignment 4A. Aya and Anje were tasked with improving the introduction and literature review based on the feedback received on previous assignments as well as finding new relevant articles to include in the study. They were also responsible for the formatting of the paper and references according to APA guidelines. Aleksandr, Elia and Peter were tasked with improving the research design based on the latest feedback received. They also adapted the code used to acquire additional information and adjusted all tables and visual representations.

The entire team contributed to proofreading the final assignment before handing it in.