

# Military Expenditure and External Debt in North Africa

Yassmin Eid

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By: Yassmin Eid

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Signed by the final Examining Committee:

\_\_\_\_\_ Dr. Jan Victor Dee

\_\_\_\_\_ Dr. Christian Sigouin

Approved by: \_\_\_\_\_

Dr. Christian Sigouin  
Graduate Program Director

Date: \_\_\_\_\_

\_\_\_\_\_ Dr. Pascale Sicotte, Dean  
Faculty of Arts and Science

## **ABSTRACT**

### Military Expenditure and External Debt in North Africa

Yassmin Eid

The economic impact of military expenditure on an economy's indebtedness is crucial for both developed and developing countries. According to the Stockholm International Peace Research Institute (SIPRI), world military spending accounted for 2.4% of global gross domestic product (GDP) in 2020. Total spending was 2.6% higher than in 2019 and 9.3 % higher than in 2011. Over roughly the same period, the military expenditure of North African countries have experienced a tremendous growth. It rose, on average, by 73% from 2010 to 2020 in nominal terms. This increase in military spending coincided with a rapid accumulation of North African countries external debt. The external debt of North African countries more than doubled from \$79.1 billion to \$168.2 billion between 2010 and 2019. Most of the literature on military expenditure focuses on its impact on economic growth. However, studies examining the relationship between military expenditure and external debt have been relatively rare. This paper examines the long-run effects and short-run dynamics of military expenditure on external debt in North Africa, using a panel regression for country-level observations over the period from 1995 to 2020. The paper focuses on four North African countries: Egypt, Tunisia, Algeria, and Morocco. The quantitative evidence shows that external debt is elastic with respect to military expenditure in the short-run, but not in the long run. In the short-run, a 1% increase in military expenditure leads to an increase in external debt by almost 0.35% while a 1% increases in economic growth decreases external debt by 0.6%.

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# 1 Introduction

In many countries, military expenditure is an important component of government expenditure and can affect economic performance. Military expenditure can represent a tradeoff between security and economic growth, especially in unstable regions. Several studies show that reducing military spending releases resources that can be used for other purposes, such as tackling the issues of poverty and economic security. For example, Sivard, Brauer, and Roemer (1989) explain that most countries with long periods of military rule spend a significant proportion of their income on military spending, at the expense of expenditures on education, health, housing, and other social services. Looney (1989) also believes that arms purchases reduce the resources available for importing capital goods that promote long-term sustainable prosperity. Other studies argue that military spending may increase output to the extent that it increases security, since the security of persons and property from domestic or foreign threats is important for the functioning of markets and increases the opportunities to invest and develop. Lack of security may be a major obstacle to development in many developing countries. For instance, Ram (1995) indicates that national security helps productive economic activities to be conducted without fear of foreign appropriation, and since national security is the most important argument for military expenditure, thus, military spending is expected to enhance long-run economic growth.

Over the long run, the economic growth of a country could be affected by increased military expenditure. This relationship between military spending and economic growth is controversial. On the one hand, several empirical studies show that military spending crowds out private investment, and results in a net decline in economic growth. Lim (1983) believes that higher military expenditures have "opportunity costs" such as lower domestic investment, limited human and physical capital accumulation, stagnant economic growth, and poor or inadequate basic needs fulfilment. Deger and Smith (1983) show that higher military spending is related to higher rates of inflation, civilian unemployment, and lower of economic growth. On the other hand, it has been argued that there are some beneficial



effects of military spending in the developing countries. Ball (1983) claims that military expenditure stimulates research and development programs, produces new technologies, and boosts economic growth. Moreover, military infrastructures such as roads, bridges, telecommunication networks, and mass education have certain positive externalities to society as a whole.

External debt also could have a significant impact on developing country's economic activities. Excessive external debt accumulation may result in the deterioration of trade, the overvaluation of the domestic currency, and slower economic development. Together with floating exchange rate systems and open capital accounts, increasing external debt accumulation could lead the developing countries as foreign currency borrowers to be vulnerable to external shocks, since the servicing of external debt obligations necessitates generating adequate export revenues or other types of income.

One of the important issues in both developed and developing countries is the role of military expenditure in accumulating more external debt. The literature reports two ways through which military spending can result in the rise of external debt. First, military expenditures are funded by either public debt or taxation. As a result, if domestic channels fail to provide adequate money for military spending, the alternative is foreign loans. Second, arms imports account for a significant portion of military spending that needs foreign reserves, and a country's insufficient foreign reserves may cause more accumulation of external debt.

According to *United Nations Development Programme*, the chances of dying from malnutrition and preventable disease in developing countries are 33 times higher than those of dying from a war. However, some of the world's poorest countries spend more on their military than on education and health. Adeola (1993) argues that poor countries may provide the necessary finances for increased military spending by raising domestic taxes or borrowing from foreign lenders. Borrowing has been a more attractive option for financing additional military arsenals since many developing countries lack the ability to make extra funds through taxation. Thus, increasing military spending may be related to a rise in the

prevalence of debt in these countries.

North African countries have been characterized by their large military expenditures. Although it is one of the world's most indebted regions, it has one of the world's highest rates of arms imports in the world. Between 2016 and 2020, the North African countries recorded rapid increases in their arms imports compared to the first half of the previous decade (2011-2015). According to *SIPRI databases*, Algeria and Egypt recorded increases of 64 percent and 136 percent, respectively. Egypt was one of the five largest arms importers in the world. Saudi Arabia, India, Australia and China together with Egypt received 36 percent of total arms imports in 2016–2020. Of these five countries, only Egypt was not among the top five importers during the 2011–2015 period. The arms imports of Algeria and Morocco together accounted for 70 percent of total African imports of major arms during the same period. These increases in arms imports of North African countries coincided with the rapid accumulation of the North African external debt. According to Pinto Moreira, Bertin, and Verdier-Chouchane (2020), total external debt as a percentage of GDP between 2012 and 2020 rose by 10.1 percentage points in Morocco, 42.4 percentage points in Tunisia, and 22.1 percentage points in Egypt. Estimates for 2020 indicates that external debt is quite high in Tunisia (97.2 percent of GDP) and Mauritania (62.6 percent).

In 2020, the world faced the COVID-19 pandemic. About 82 million people were recorded as having contracted Covid-19 and recorded deaths numbered approximately 1.8 million by the end of the same year. The pandemic had significant economic and political effects. Except for 20 countries, it led to reduced economic production. However, even during the pandemic, several countries signed large contracts for major arms.

Despite the large number of studies studying the relationship between military expenditure and economic growth, the impact of military expenditure on external debt has not attracted much interest among many researchers. This study therefore contributes to the existing literature by investigating the short run and the long run effect of military expenditure on external debt in North Africa for the period 1995–2020. It is one of very few studies

examining this relationship for the selected group of countries. Due to data limitations, data on GDP, external debt and military expenditure for only four North African countries, Egypt, Tunisia, Algeria and Morocco, are used. These are the four North African countries for which there are consistent data on external debt and military expenditure available over the period.

The present paper uses the model of debt and military expenditure with a real gross domestic product (GDP) introduced by Smyth and Kumar Narayan (2009). This study is the first to use a panel cointegration framework to examine the impact of military expenditure and income on external debt. Using Pedroni's (2004) test for panel cointegration, Smyth and Kumar Narayan (2009) study this relationship for a panel of six Middle Eastern countries over the period 1988 to 2002. Their results show a long-run relationship between military expenditure and external debt during this period.

The paper is organized as follows. Section 2 provides a brief overview of external debt, military expenditure and economic growth of North Africa. Section 3 reviews the literature on military expenditure and external debt. The empirical methodology for the model specifications is explained in section 4, while data on external debt, military spending, and GDP are described in section 5. Section 6 shows the results of the analysis, and the final section presents the conclusions.

## **2 Background**

North Africa has 22 percent of the African continent's area and it consists of six countries: Algeria, Egypt, Libya, Mauritania, Morocco, and Tunisia. Egypt has the region's largest population of about 102 million, and its GDP accounts for 50 percent of the region's GDP. Most of this area has been affected by political and security instabilities during the past decades. Despite considerable differences, these countries' economic systems are influenced by the same factors. Four are heavily reliant on natural resources: Algeria and Libya on oil,

Mauritania on metals and gold, and Morocco on phosphates. The economies of Tunisia and Egypt are mostly based on agriculture, petroleum exports, tourism, and worker remittances.

According to Outlook (2019)<sup>1</sup>, three factors have shaped the economy of North Africa since 2016. The first factor is the 2014–16 drop in commodity prices which resulted in a decline in natural resource based export receipts. Egypt, Mauritania, Tunisia, and Morocco have entered an International Monetary Fund (IMF) program to face this decrease, while the two major oil exporters, Algeria and Libya, have not entered any IMF arrangement and faced the drop in their export receipts by limiting the increase in their government debt-to-GDP ratios through drawing on reserves. The second factor that affected the economy of North Africa is the increase in Oil prices by 70 percent in 2016 and a further 24 percent in 2017. The improved security in Egypt and Tunisia had also its influence on the North African economy since it led to a recovery in tourism, which has been seriously affected by political and security instability. These three factors promoted the region's economic performance and caused a faster growth in North Africa during the years 2017–2018.

In 2019, North Africa was the second-best performing region in Africa with a growth rate estimated at 3.7 percent as reported by Pinto Moreira, Bertin, and Verdier-Chouchane (2020). However, economic performance varied across the region. Mauritania and Egypt were the region's most buoyant economies with 2019 growth rates of 6.7 percent and 5.6 percent respectively. Morocco's growth rate was 2.5 percent in 2019, less than the 3 percent growth rate in 2018. Growth rates in Algeria and Tunisia were 0.7 and 1.0 percent respectively. Figure 1 shows the economic growth rates in North Africa over the period 1995-2020.

However, North African countries have experienced large current account imbalances during the recent years. According to North Africa Economic Outlook 2021, North African countries have rapidly accumulated external debt since 2010. Egypt, Morocco, and Tunisia have become more reliant on sovereign Eurobond markets for external financing requirements. Other countries in the region have depended on domestic debt such as Algeria and

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1. 2019 African Economic Outlook

Libya, or official development assistance such as Mauritania. Except for Libya, in 2016, the regional average current account deficit was 8.9 percent of GDP, and decreased to 6.3 percent in 2018. Oil price fluctuations have had a significant impact on Algeria's and Libya's current account deficits, which are the region's oil producers. The 2015–2016 current account deficit was about 16.4 percent of GDP in Algeria, while in Libya, it reached a peak of 52 percent of GDP during the period from 2014 to 2016. They faced these deficits by drawing on their foreign assets without accumulating more external debts.

With the increase in oil prices and oil production, Algeria's and Libya's current account returned to surplus in 2017–2018. Due to current account deficits between 2014 and 2017, Egypt and Tunisia accumulated more external debt rapidly. Egypt's external debt experienced rising from 14.5 percent to 35.8 percent of GDP between 2015 and 2018, and Tunisia's from 62.7 percent to 82.6 percent. Morocco faced moderate and steady current account deficits in the range of 3.6–3.8 percent of GDP during this period, as well as moderate rises in external debt. Bank (2018) states that countries in the Middle East and North Africa region recorded the fastest accumulation in external debt stock in 2018, on average 6 percent, propelled by Egypt, which posted a 17 percent increase. North African countries experienced large current account deficits in 2019, averaging 4.4 percent of GDP. Figure 2 illustrates the North African external debt as a percentage of GDP for the period 1995-2020.

In 2020, the world faced the COVID-19 pandemic. Prior to the spread of the pandemic, North African economic growth was predicted to be 4.4 percent and 4.5 percent in 2020 and 2021, respectively as reported by Pinto Moreira, Bertin, and Verdier-Chouchane (2020). As of May 2020, North Africa had the highest number of COVID-19 confirmed cases among all African regions according to World Health Organization (WHO) statistics. During the pandemic, countries had to make critical decisions on the prioritization of different types of spending, such as economic stimulus packages, healthcare expenditure and military procurement. Furthermore, most countries have used their military assets to support their responses to the pandemic.

However, global military expenditure in 2021 experienced an unexpected increase, according to SIPRI, as it surpassed the two trillion US dollar mark for the first time, reaching \$2113 billion. This was 0.7 percent higher than in 2020 and 12 percent higher than in 2012. African countries allocated an average of 6.1 percent of their total budgets to their militaries in 2021, which is 0.3 percentage points lower than in 2020. The military spending in Africa in 2021 was \$39.7 billion, which accounted for 1.9 percent of the global total. Latest statistics published by *SIPRI databases* show that North African military spending in 2021 totalled \$19.6 billion, 1.7 percent lower than in 2020, but 29 percent higher than in 2012.

Besides the COVID-19 pandemic crises, the African economies experienced two other shocks in 2020: a reduction in oil prices, and a sharp drop in tourism. According to Amano and Van Norden (1998), oil price volatility has a significant impact on economic activity, and the effects differ for crude oil exporting and importing countries. When the international oil price rises, exporting countries benefit, but importers suffer.

Over the decade 2012–21, North African military expenditure followed three main patterns. It first increased continuously between 2012 and 2014, followed by four years of decline until 2018, and then three consecutive years of growth until 2021, to give an overall rise of 2.5 percent. As a result of long-standing tensions between the two largest spenders in North Africa, which are Algeria and Morocco, and the civil war in Libya, the military spending of the North African countries in 2019 was 4.6 percent higher than in 2018, and 67 percent higher than in 2010. It was about \$23.5 billion, which represent 57 percent of the total for Africa. This increase in military spending is more pronounced in Algeria. The military expenditure of Algeria in 2021 was the largest in North Africa. It was about \$9.1 billion which accounted for 44 percent of the regional total. Figure 3 shows military spending in North Africa as a percentage of GDP for years 1995-2020, while figure 4 compares spending of government on education as a percentage of GDP, health expenditure to GDP, and military expenditure to GDP in North Africa for the year 2008.

### 3 Literature Review

Empirical research on the military expenditure - external debt nexus produced conflicting results, which can be due to variations in data sets or time periods, variable selection, econometric methods used. Some studies show the existence of a long-run relationship between military spending and external debt. They suggest that the military expenditure of a country is seen as a significant contributor to its stock of external debt in many analyses. For instance, Brzoska (1983) concluded that military spending is a key variable in explaining the increase of foreign debt in a number of developing economies, implying that this rise has resulted in lower economic development.

Using both cross-sectional and panel models, Adeola (1993) investigates the effect of military expenditure as a percentage of Gross National Product, arms imports, the level of army sophistication, and military participation ratio, on domestic and external debts in the less developed countries. The author found that arms imports and large armed forces population have exacerbated the less developed countries external debt and can worsen a country's debt service problems over time. Dunne, Perlo-Freeman, and Soydan (2004) show that military burden does indeed have a positive effect on the share of external debt in GDP using panel data of 11 small industrialising economies. They provided estimates for fixed effects and random effects models and then moved on to consider dynamic models. Azam and Feng (2017) also presented both random effects and fixed effects models to study the impact of military spending on external debt, using a sample of ten Asian countries over the years from 1990 to 2011. They found that military spending has a positive effect on external debt, whereas foreign exchange reserves and economic growth have a negative effect on external debt.

Paul Dunne a, Perlo-Freeman, and Soydan (2004) suggest that military spending, as a budget item, needs funds. If an increase in military spending cannot be funded by taxation, it produces a deficit that can be covered by four methods: Printing money, using foreign exchange reserves, foreign borrowing, or borrowing domestically. However, each of these

ways has significant limitations and is connected with a specific macroeconomic imbalance. For example, printing money may cause inflation, while using foreign reserves may lead to an exchange rate crises. Moreover, foreign borrowing may result in an external debt crisis. High public sector deficits relative to GDP may thus require foreign borrowing and external debt accumulation when the ability to pay deficits domestically is limited.

For the purpose of explaining the role of military spending and arms imports in the Greek debt crisis which started in 2009, Nikolaidou (2016) uses a model estimated by the ARDL approach to cointegration, in order to study the impact of military expenditure on the evolution of Greek debt from 1970 to 2011. The author concluded that military spending and arms imports had an increasing effect on Greek public debt in the short run, while investment helped in the reduction of debt in both the short and long run. Ahmed (2012) introduces three advanced panel techniques of fully modified OLS (FMOLS), Dynamic OLS (DOLS) and dynamic fixed effect (DFE) to study the relationship between military expenditure, external debts and economic performance in the economies of sub-Saharan Africa. Using a sample of 25 sub-Saharan African countries from 1988–2007, the author observe that military expenditure has a positive and significant impact on external debt in African countries.

In order to examine the defence-debt nexus in rich economies, Alexander (2013) uses the Arellano–Bond dynamic panel model to the data available from members of the Organization for Economic Co-operation and Development, and North Atlantic Treaty Organization over the periods 1988–2009 and 1999–2009. According to his findings of this study, the defence burden is a statistically significant and economically important determinant of public debt. Dudzevičiūtė, Česnuiytė, and Prakapienė (2021) have applied descriptive statistics and methods of multivariate statistics such as Spearman’s correlation, the ANOVA test, and Life tables in order to investigate the relationship between defence expenditure and government debt in small European Union countries that are members of NATO, such as Luxembourg, Lithuania, Latvia, Estonia, Drenmark, Slovakia, and Slovenia. Their results show that the share of defence expenditure in GDP correlates statistically significantly and



negatively with government gross debt.

On the contrary, Feridun et al. (2005) shows that military burden had no impact on the evolution of debt in Argentina. His study has applied Granger-causality testing procedure on yearly data between 1971 and 2002 in order to examine the influence of military spending on Argentina's foreign debt during the 2001 Argentina Financial Crisis. Paul Dunne a, Perlo-Freeman, and Soydan (2004) also finds no evidence that military burden had any impact on the evolution of debt in Argentina and Brazill, but there is some evidence that it tended to raise debt in Chile during the debt crisis that struck South American countries in the 1980s, and caused severe recession and long-term economic consequences. His analysis examines the relationship between military expenditure, arms imports, and debt in Argentina, Brazil, and Chile during the crisis. Although Chile was the least impacted of the three countries by acute financial crises caused by debt issues, it had greater amounts of debt. This implies that military burden may be essential in determining a country's debt, but it is only significant when it is not swamped by other macroeconomic and international factors.

Smyth and Kumar Narayan (2009) support the view that military expenditure has a long run effect on external debt. Using panel data of six Middle Eastern countries, Oman, Syria, Yemen, Bahrain, Iran, and Jordan, over the period 1988 to 2002, they show that external debt is elastic with respect to military spending in the long run but inelastic with respect to military spending in the short run. For the panel of six Middle Eastern countries, a 1 percent increase in military spending results in a rise in external debt of 0.2 percent in the short run, and between 1.1 and 1.6 percent in the long run. Similar results are presented by Zaman et al. (2012) in their analysis of the long-run effects and the short-run dynamics of the rise in the levels of economic activity and real military spending on the real external debt in Pakistan over the period 1980-2008. The study is carried out using a Johansen multivariate cointegration framework and the evidence shows that there is an insignificant effect of external debt on military expenditure in the short-run, but it is more elastic in the long run.

Following the framework of Smyth and Kumar Narayan (2009), the present paper examines the short run and the long run effects of military expenditure on external debt in North Africa over the period 1995 to 2020. Due to data limitation, we use data for only four North African countries which are Egypt, Tunisia, Algeria and Morocco. The study is mainly based on Pedroni (2004) cointegration analysis and the Autoregressive Distributed Lag (ARDL) model.

## 4 Methodology

To study the short run and the long run effects of military expenditure on external debt in North Africa, we augment the bivariate model of external debt and military expenditure with GDP growth variable following most of the previous studies on this subject. This method focuses on the interrelationship between military expenditure and external debt, and includes an additional independent variable namely real GDP. To examine the impact of military expenditure on the external debt, it is assumed that the following long-run relationship holds:

$$\ln(ED_{it}) = \beta_{0i} + \beta_{1i} \ln(ME_{it}) + \beta_{2i} \ln(Y_{it}) + e_{it} \quad (1)$$

in which  $ED_{it}$  is real external debt in country  $i$  at time  $t$ ,  $ME_{it}$  is the real military expenditure and  $Y_{it}$  is the real GDP.

This equation is estimated for North Africa using annual data of four North African countries which are Egypt, Tunisia, Algeria and Morocco using for the period 1995 to 2020. The paper mix both cross sectional and time series data for depicting the military expenditure - external debt nexus. Panel data is used to avoid shortcomings which result from using cross sectional data or time series such as spurious correlation resulting from non-stationarity, and unreliable results if the data is on a short time span. Following the framework of Smyth and Kumar Narayan (2009), the Panel unit root tests and panel cointegration analysis are

applied for the purpose of better utilising the data and to avoid the problem of spurious regression.

The panel unit root and panel cointegration framework includes three steps. First, we perform the panel unit root tests proposed by Breitung (2001) and Im, Pesaran, and Shin (2003). A panel unit root means that the mean, variance, and covariance are not constant for the panel series as defined by Smyth and Kumar Narayan (2009). In Breitung (2001) test, we examine the existence of a unit root in the level and the first difference of each variable, through keeping  $\phi$  identical across cross-sectional units, but allowing the lag order for the first difference terms to vary across cross-sectional units. The panel unit root test is:

$$\Delta y_{it} = \kappa_i + \phi y_{it-1} + \varpi_i t + \sum_{j=1}^k d_{ij} \Delta y_{it-j} + \epsilon_{it} \quad (2)$$

where  $\Delta$  is the first difference operator,  $y_{it}$  is each of the variables and the subscript  $i = 1, 2, \dots, N$  is an index of cross-sectional units ( $N=4$  in the present case). The lagged dependent variable is included to allow for serial correlation. Akaike's lag selection criterion is used to obtain the optimal lag length.

To test if there is a unit root, the null and the alternate hypotheses are:

$$H_0 : \phi = 0$$

$$H_1 : \phi < 0$$

Under the null hypothesis, the variables are non-stationary, while the rejection of the panel unit root hypothesis is an evidence that a statistically significant proportion of the units are stationary.

In Im, Pesaran, and Shin (2003) test, the average of the individual ADF t-statistics for each country in the sample is calculated, then the following standardized t-bar statistic is

estimated:

$$t\text{-bar} = \sqrt{N}(t_{\alpha i} - k_t)/\sqrt{v_t} \quad (3)$$

where  $N$  is the size of the panel,  $t_{\alpha i}$  is the average of the individual ADF t-statistics for each country,  $k_t$  is the mean of each  $t_{\alpha i}$ , and  $v_t$  is the variance.

Second, if the variables are stationary in levels, we use the Simple Ordinary Least Square (OLS) estimator to examine the long-run relationship between external debt and military expenditure. However, if each of the variables contains a panel unit root but stationary in first difference, we test whether the variables are cointegrated. If they are cointegrated, a linear combination of the non-stationary variables will be stationary. According to Smyth and Kumar Narayan (2009), panel cointegration means that the residuals from a panel long-run model are stationary in that the mean, variance, and covariance are constant for the panel residual series. The panel cointegration approach is used to examine if there is a long-run relationship between military expenditure and external debt since it allows us to differentiate between the short-run and long-run effects of military spending on external debt. We follow the framework of Smyth and Kumar Narayan (2009) by using Pedroni (2004) cointegration method.

Finally, if there is panel cointegration which implies the long-run relationship among the variables or if some variables are stationary in level, the long run and short run coefficients of real military expenditure and real GDP on real external debt are estimated using both panel FMOLS, and DOLS. If there is no cointegration among the variables, the short-run dynamics are investigated using the Autoregressive Distributed Lag (ARDL) model. The ARDL approach has several advantages. First, the ARDL model is able to investigate the presence of both short-run and long-run relationships between the variables. Second, it uses a sufficient number of lags which causes process generation in a general to a specific modelling framework. The ARDL approach also provides robust results with a small sample size. The

equation of an ARDL model can be formulated as:

$$\begin{aligned} \Delta \ln(ED_{it}) = & \alpha_{0i} + \sum_{j=1}^p \alpha_{1,ij} \Delta \ln(ED_{i,t-j}) + \sum_{j=0}^{q1} \alpha_{2,ij} \Delta \ln(ME_{i,t-j}) + \sum_{j=0}^{q2} \alpha_{3,ij} \Delta \ln(Y_{i,t-j}) \\ & + \alpha_{4i} \ln(ED_{i,t-1}) + \alpha_{5i} \ln(ME_{i,t-1}) + \alpha_{6i} \ln(Y_{i,t-1}) + \xi_{it} \end{aligned} \quad (4)$$

where  $\Delta$  denotes the difference operator.  $\alpha_{0i}$  represents the fixed effects.  $\alpha_{1,ij}$ ,  $\alpha_{2,ij}$ , and  $\alpha_{3,ij}$  are the short-run coefficients, while  $\alpha_{4i}$ ,  $\alpha_{5i}$ , and  $\alpha_{6i}$  are the long-run coefficients.  $\xi_{it}$  is the error term. The parameter  $p$  represents the lags of the dependent variable and  $q$  represents the lags of the independent variables. The lengths of optimal lags  $p$  and  $q$  are determined through the Akaike's lag selection criterion.

In case of no panel cointegration, the short-run coefficients are estimated using the following error correction model (ECM):

$$\begin{aligned} \Delta \ln(ED_{it}) = & \alpha_{0i} + \sum_{j=1}^p \alpha_{1,ij} \Delta \ln(ED_{i,t-j}) + \sum_{j=0}^{q1} \alpha_{2,ij} \Delta \ln(ME_{i,t-j}) + \sum_{j=0}^{q2} \alpha_{3,ij} \Delta \ln(Y_{i,t-j}) \\ & + \theta_i ECT_{i,t-1} + \xi_{it} \end{aligned} \quad (5)$$

where

$$ECT_{i,t-1} = \ln(ED_{i,t-1}) - \gamma_{0i} - \gamma_{1i} \ln(ME_{i,t-1}) - \gamma_{2i} \ln(Y_{i,t-1})$$

The coefficient of the error correction term ( $\theta_i$ ) measures the speed of adjustment that is made towards long-run equilibrium in case of the existence of a long-run relationship between the variables. A statistically significant and negative  $\theta_i$  indicates that any long-run disequilibrium among dependent variables and a number of independent variables will converge back to the long-term equilibrium association. Therefore, in case if there is no long-run relationship between the variables,  $\theta_i$  will be insignificant.

## 5 Data

According to Looney (1989), the determinants of external debt are GNP, merchandise imports, merchandise exports, international reserve holdings and three types of governmental expenditures (military, health and education). In this study, real military expenditure and real GDP were selected as determinants of external debt. The paper uses data on North African countries for the period 1995-2020. Due to data limitation issue, we have used data for only four North African countries which are Egypt, Tunisia, Algeria and Morocco. All data are in current U.S million dollars. All of the dependent and explanatory variables were adjusted by consumer price index (CPI), whereby the year 2010 was treated as the base year (2010 = 100). Moreover, all data are transformed into logarithmic form in order to reduce the problem of heteroscedasticity and make econometric testing procedures valid. Table 1 describes the variables used in the analysis.

Data on GDP, external debt and consumer price index were obtained from *DataBank*.<sup>2</sup> Real GDP is used as a proxy for a country's capacity to engage in international borrowing. Total external debt is debt owed to nonresidents repayable in currency, goods, or services. It is the sum of public, publicly guaranteed, and private nonguaranteed long-term debt, use of IMF credit, and short-term debt. Short-term debt includes all debt having an original maturity of one year or less and interest in arrears on long-term debt.

Data on military expenditure was derived from *SIPRI databases*.<sup>3</sup> Military expenditures data from SIPRI are derived from the NATO definition, which includes all current and capital expenditures on the armed forces, including peacekeeping forces; defense ministries and other government agencies engaged in defense projects; paramilitary forces, if these are judged to be trained and equipped for military operations; and military space activities. Such expenditures include military and civil personnel, including retirement pensions of military personnel and social services for personnel; operation and maintenance; procurement; mili-

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2. World Bank

3. Stockholm International Peace Research Institute

tary research and development; and military aid (in the military expenditures of the donor country). Excluded are civil defense and current expenditures for previous military activities, such as for veterans' benefits, demobilization, conversion, and destruction of weapons. The institute's estimates of military expenditures are based on official sources and are sometimes adjusted if official data are considered to be incomplete.

## 6 Empirical Results

This section of the study presents empirical findings on the extent to which the military expenditures of the North African countries have contributed to the accumulation of their external debt from 1995 to 2020. When non-stationary data and residuals are used to estimate an OLS regression, the regression is spurious. Therefore, the first step of the analysis was testing the stationarity of all variables. For this purpose, we used Breitung (2001) and Im, Pesaran, and Shin (2003) unit root tests. The lag length was selected based on the Akaike info criterion (AIC). Table 2 and Table 3 summarize the findings of the tests. We found that while we are unable to reject the unit root null hypothesis for each of the variables in level at 5% level of significance, we reject the unit root null hypothesis at the conventional levels of significance for all the variables when we conduct the test on the first difference of the variables. From these findings, we conclude that real external debt, real military expenditure and real GDP for North Africa are integrated of order one.

Since the variables contain a panel unit root in level but are stationary in first difference, the existence of a long-run relationship between the variables was investigated using Pedroni's panel cointegration test. We estimated three models: one without time trend but with intercept, one with time trend and intercept, and one without time trend or intercept. Results of the panel cointegration test are presented in Table 4. As observed from the tables, for all these three cases we fail to reject the null hypothesis of no cointegration between the variables since the majority of the associated probability values are higher than 5%. These

high p-values indicate that there is no long-run relationship between military expenditure and external debt in North African countries.

Since the variables are not stationary in level and not cointegrated, the Autoregressive Distributed Lag (ARDL) model was used to investigate the short-run dynamics. The optimal lag length is 2 lags. It was selected based on Akaike info criterion. The results in Table 5 indicate the short-run impact and the long-run adjustment effect of real military expenditure and real GDP on real external debt in North Africa. In the short-run, if there is a 1% increase in real military expenditure, the North African real external debt increases by almost 0.35% in the next period. This simply reflects that large military expenditure can result in large real external debt in the short-run. The estimates also show that a 1% increase in real GDP reduces real external debt by 0.6% in the next period, indicating that income has an impact on external debt of North Africa in the short-run. While in the long-run, the adjustment parameter for the error correction term ( $\theta_i$ ) and the long-run coefficients of real military expenditure and real GDP are insignificant, implying that there is no long-run convergence in line with the cointegration test results.

## 7 Conclusion

The impact of military expenditure on external debt is a controversial issue. A number of studies showed that an increase in military expenditure results in an increase in external debt. Other studies found no evidence for any relationship between them. This paper uses the panel regression model to examine the influence of military spending on external debt in North Africa by applying panel unit root and panel cointegration framework and estimating an Autoregressive Distributed Lag (ARDL) model. Annual data on GDP, external debt and military expenditure for Egypt, Tunisia, Algeria, and Morocco over the period 1995-2020 are used.

Although several academic works demonstrate that military expenditure can affect ex-



ternal debt in developing countries, this analysis did not find any evidence to support the link between military expenditure and external debt in North Africa for this period. This conclusions conflict could be a result of the difference between levels of liquidity and maturity of the studied countries. Our main finding is that external debt, military expenditure, and GDP are not cointegrated, which implies that military expenditure has no statistically significant effect on external debt in the long-run. In the short-run it was found that economic growth and military expenditures have a statistically significant negative and positive effect on external debt. We found that in the short-run, a 1% increase in military expenditure increases external debt by 0.35%, while a rise in economic growth by 1% decreases external debt by 0.6%.

Similar findings were found in several previous studies. For instance, Sezgin (2004) found that the long-run coefficient of the relationship between defence expenditure and external debt is insignificant when arms imports and equipment spending are excluded from the analysis, but significant and negative when they are included. However, external debt was found to be positively related to arm imports in the short run. Sezgin followed an approach similar to that in Looney (1989) to study the impact of Turkey's defence expenditure on its external debt over the period 1979–2000.

Looney (1989) used a factor analysis of a large group of variables showing government debt, export and import patterns, and capital flows to examine the relationship between external debt and military expenditure for 61 Less Developed Countries. He classified the countries into two groups based on their relative foreign exchange positions, resource-constrained countries and resource-unconstrained countries. Looney found that military spending has different impacts on a country's external debt. He concluded that a large portion of the external public debt accumulated by 1982 in resource-constrained countries was the result of increased arms imports and military expenditure in the 1970s and early 1980s, but for resource-unconstrained countries, a negative relationship between military spending and external debt was found. However, the total sample of Looney's study showed insignificant

results for military expenditure–external debt relationship which implies that the impacts are country specific, and single country analysis might provide further evidence.

In this analysis, Egypt and Algeria which are classified as resource-unconstrained countries in Looney (1989) study are used. The other two countries used in our study, Tunisia and Morocco, are classified as resource-constrained countries in Looney’s analysis. The countries that have either more domestic resources or greater access to foreign assets will be able to support a higher level of military expenditure according to Looney (1989), while the countries with weak foreign exchange positions will not have as high a level of military expenditure and will face serious problems in servicing their external liabilities.

One important limitation on our finding is that data for only four North African countries over 25 years are used in the analysis, which resulted in a small panel ( $T=25$ ,  $N=4$ ). This is because of data limitations on military expenditure for the other North African countries. As a result, only two explanatory variables can be accommodated by this small panel without a substantial loss in power.

Our conclusion opens a new avenue for future researchers to examine the single country link between military expenditure and external debt in North Africa, and to investigate this relationship in other regions of the world including more potential determinants of external debt within a panel cointegration framework subject to an increase in data availability, or using different sample periods and methodologies.

## 8 Appendix

Table 1: Descriptive Statistics

Country	Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Number of observations
Egypt	ln ED	20.0016	19.9584	20.6351	19.4986	0.32686	26
	ln ME	17.4469	17.6303	17.9342	16.2836	0.51228	
	ln Y	21.2887	21.3736	21.5851	20.6662	0.25795	
Morocco	ln ED	19.5131	19.4961	20.1909	19.0181	0.33329	26
	ln ME	17.0321	17.1354	17.5811	16.1448	0.35366	
	ln Y	20.4389	20.5986	20.7995	19.9565	0.31640	
Algeria	ln ED	18.5752	18.0862	20.2713	17.3242	1.05405	26
	ln ME	17.6368	17.7264	18.2753	16.9753	0.47212	
	ln Y	20.8508	20.8909	21.3722	20.3564	0.34847	
Tunisia	ln ED	19.1626	19.2320	19.3510	18.8490	0.15893	26
	ln ME	15.5828	15.5667	15.8800	15.3080	0.16082	
	ln Y	19.6796	19.6580	19.9905	19.3515	0.19436	
All	ln ED	19.3131	19.3880	20.6351	17.3242	0.77563	104
	ln ME	16.9247	17.1639	18.2753	15.3080	0.89932	
	ln Y	20.5645	20.6656	21.5851	19.3515	0.65863	

*Note:* Data on GDP and external debt of the North African countries are derived from the World Bank for the period 1995-2020. Military expenditures are derived from SIPRI. Nominal GDP, external debt and military expenditure are adjusted using GDP deflator to get the real values. Real GDP, real external debt and real military expenditure are in billions of 2010 U.S. dollars.

Table 2: Breitung (2000) Unit Root Test

Variable	Level		First Difference	
	Test Statistic	Probability	Test Statistic	Probability
$\ln ED$	2.658	0.996	-2.189***	0.014
$\ln ME$	-0.40	0.345	-3.006***	0.001
$\ln Y$	2.646	0.996	-3.581***	0.000

*Note:* The null hypothesis is that the series is non-stationary, or contains a unit root. The lag length is selected based on Akaike info criterion. \*\*\*significant at 1% level.

Table 3: Im, Pesaran & Shin (2003) Unit Root Test

Individual Intercept				
Variable	Level		First Difference	
	Test Statistic	Probability	Test Statistic	Probability
$\ln ED$	1.240	0.892	-3.178***	0.000
$\ln ME$	2.119	0.983	-6.807***	0.000
$\ln Y$	0.0154	0.506	-4.042***	0.000
Individual Intercept and Trend				
Variable	Level		First Difference	
	Test Statistic	Probability	Test Statistic	Probability
$\ln ED$	2.279	0.989	-2.418***	0.008
$\ln ME$	-1.871	0.307	-6.156***	0.000
$\ln Y$	2.813	0.998	-3.352***	0.000

*Note:* The null hypothesis is that the series is non-stationary, or contains a unit root. The lag length is selected based on Akaike info criterion. \*\*\*significant at 1% level.

Table 4: Pedroni Panel Cointegration Test

Test	Statistic	Probability
Intercept		
Panel v-Statistic	-0.092	0.537
Panel rho-Statistic	0.575	0.717
Panel PP-Statistic	0.474	0.682
Panel ADF-Statistic	-0.459	0.323
Group rho-Statistic	1.685	0.954
Group PP-Statistic	1.533	0.937
Group ADF-Statistic	-1.126	0.130
Intercept and Trend		
Panel v-Statistic	0.348	0.364
Panel rho-Statistic	1.156	0.876
Panel PP-Statistic	0.018	0.507
Panel ADF-Statistic	-2.345**	0.010
Group rho-Statistic	1.313	0.905
Group PP-Statistic	0.247	0.598
Group ADF-Statistic	-2.242**	0.012
No Intercept or Trend		
Panel v-Statistic	-1.084	0.861
Panel rho-Statistic	0.446	0.672
Panel PP-Statistic	0.099	0.539
Panel ADF-Statistic	0.155	0.562
Group rho-Statistic	1.418	0.922
Group PP-Statistic	0.853	0.803
Group ADF-Statistic	-0.639	0.261

*Note:* The null hypothesis is that there is no cointegration between the variables. The lag length is selected based on Akaike info criterion with a maximum lag of 5.

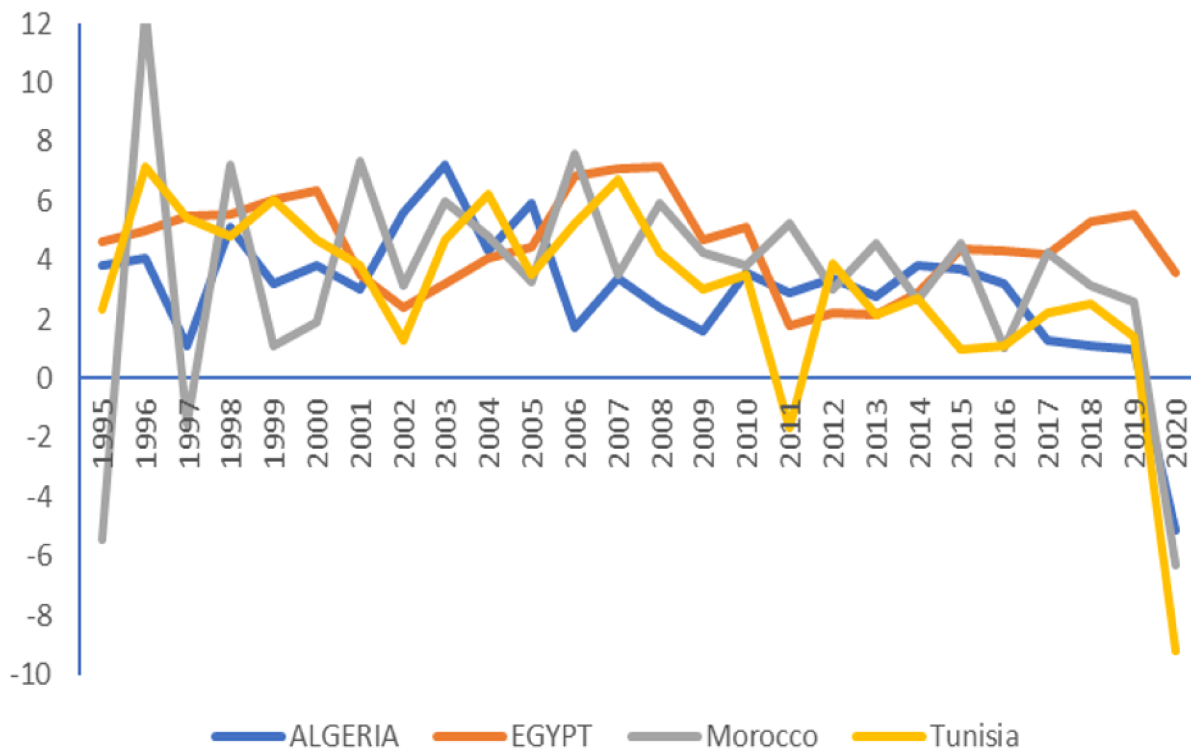
\*\* significant at the 5% level.

Table 5: Results of the Autoregressive Distributed Lag (ARDL) model

Variable	Coefficient	Standard Error	Test Statistic	Probability
Long-Run Estimation				
$\ln(ME_{i,t-1})$	-1.526	1.560	-0.978	0.332
$\ln(Y_{i,t-1})$	3.946	2.237	1.764	0.082
Short-Run Estimation				
Constant	-1.630	0.907	-1.797	0.077
$\Delta \ln(ME_{it})$	0.061	0.166	0.368	0.714
$\Delta \ln(ME_{i,t-1})$	0.352***	0.114	3.087	0.002
$\Delta \ln(ME_{i,t-2})$	0.025	0.203	0.121	0.904
$\Delta \ln(Y_{it})$	-0.027	0.287	-0.095	0.924
$\Delta \ln(Y_{i,t-1})$	-0.598***	0.156	-3.830	0.000
$\Delta \ln(Y_{i,t-2})$	-0.432***	0.094	-4.584	0.000
$ECT_{i,t-1}$	-0.045	0.026	-1.712	0.091

*Note:* Dependent variable is  $\Delta \ln(ED_{it})$ . The lag length is selected based on Akaike info criterion. \*\*\* significant at the 1% level. The first panel shows long-run effects. The second panel reports both short-run effects and the speed of adjustment ( $ECT_{i,t-1}$ ). The lag structure is ARDL (1, 3, 3).

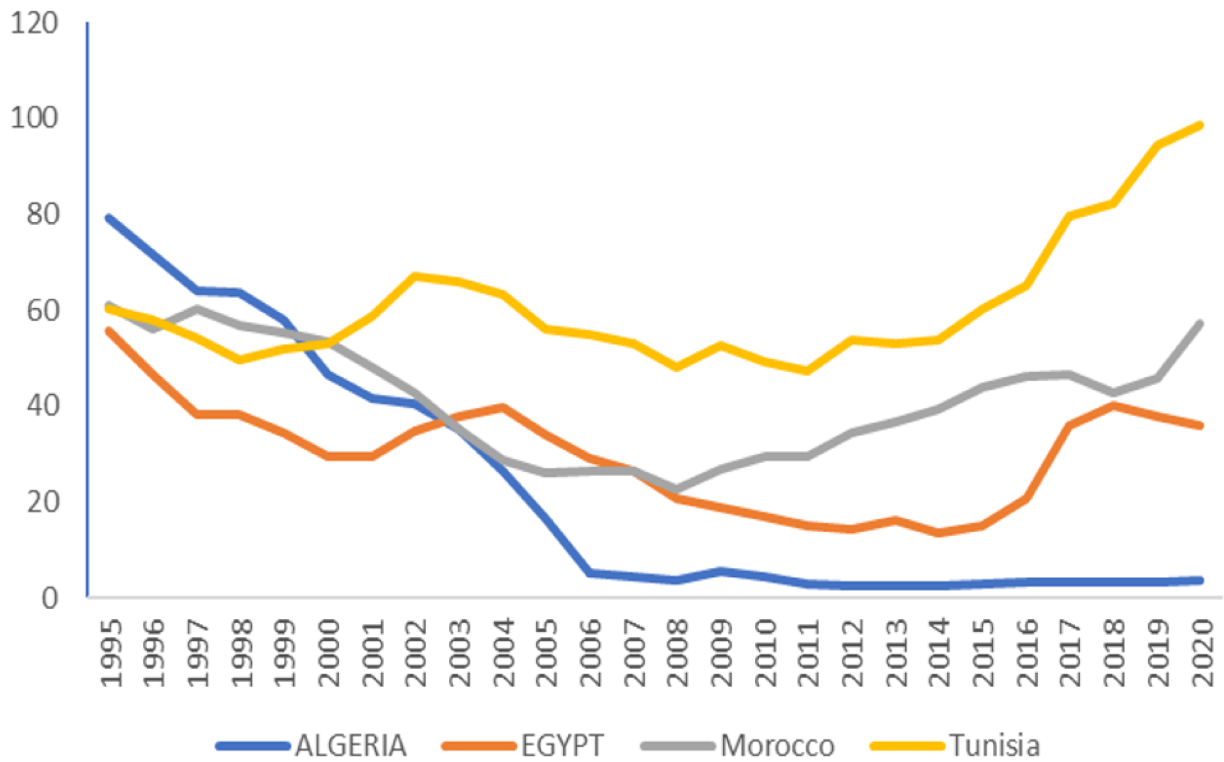
Figure 1: Economic Growth in North Africa, 1995-2020



*Note:* Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2015 prices, expressed in U.S. dollars. Data source: The World Bank.

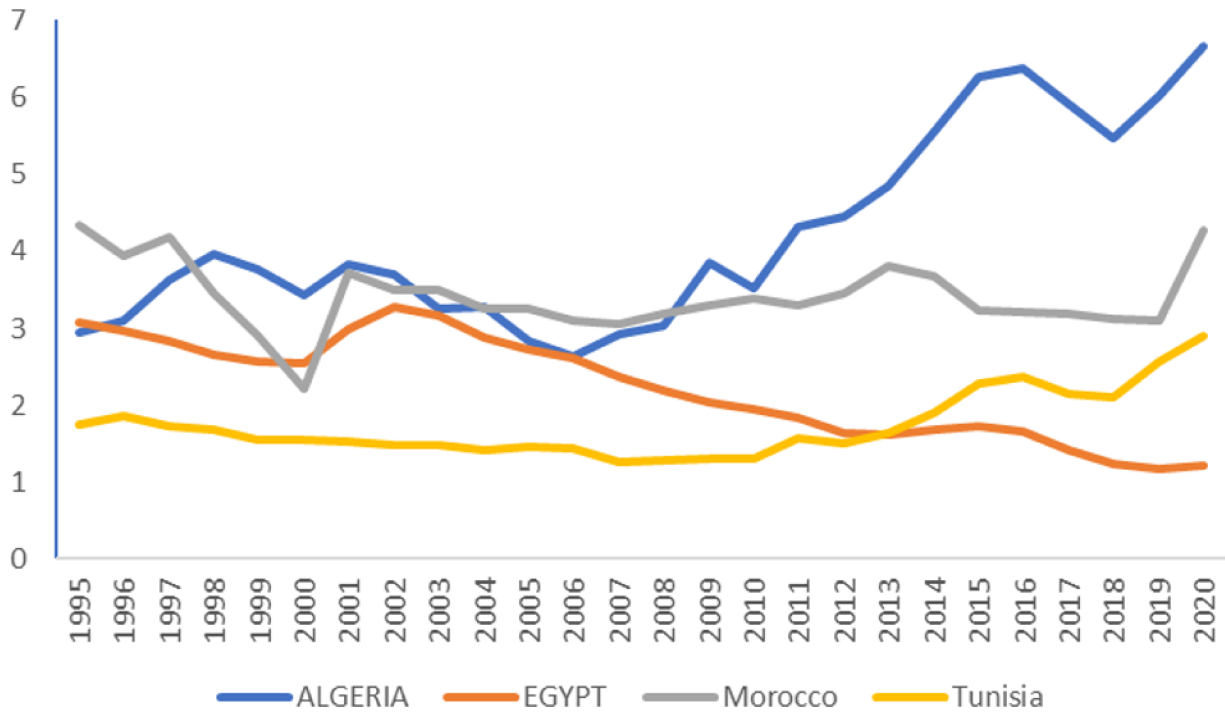


Figure 2: External Debt as % of GDP, 1995-2020



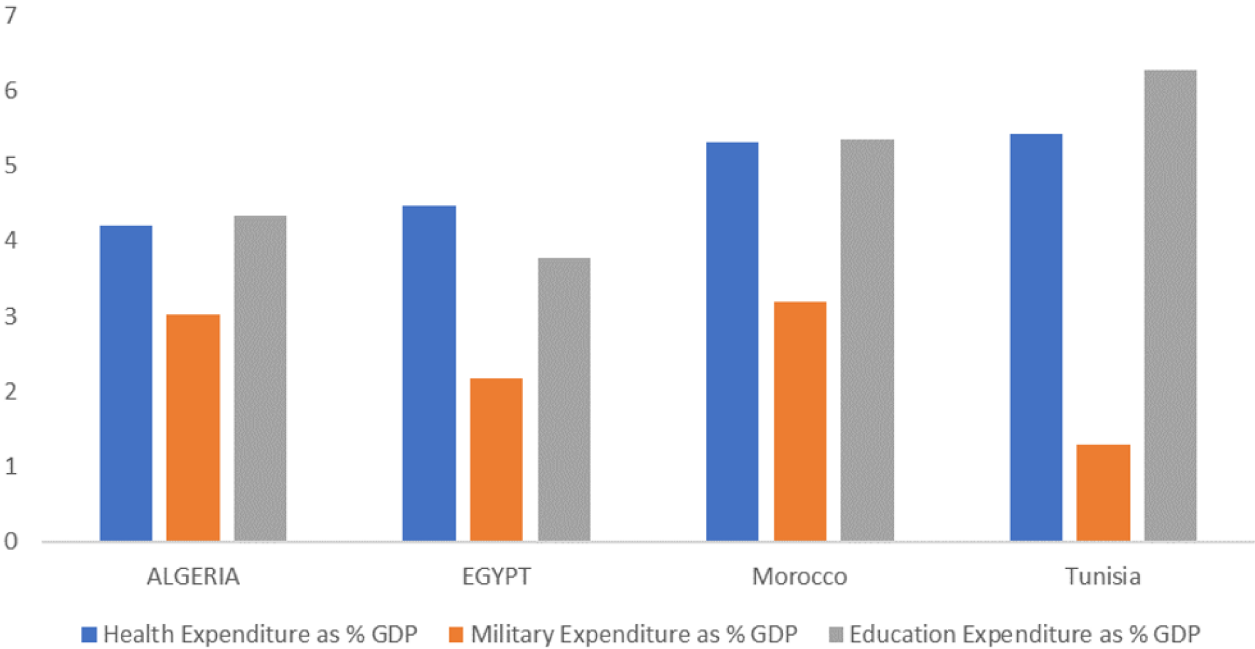
*Note:* Total external debt stocks to GDP. Total external debt is debt owed to nonresidents repayable in currency, goods, or services. Total external debt is the sum of public, publicly guaranteed, and private nonguaranteed long-term debt, use of IMF credit, and short-term debt. Short-term debt includes all debt having an original maturity of one year or less and interest in arrears on long-term debt. Data source: The World Bank.

Figure 3: Military Expenditure as % of GDP, 1995-2020



Note: Military Expenditure to GDP in North Africa for 1995-2020. Data source: Stockholm International Peace Research Institute (SIPRI).

Figure 4: Education Expenditure, Health Expenditure, and Military Expenditure as % of GDP in North Africa, 2008



*Note:* Education Expenditure to GDP, Health Expenditure to GDP, and Military Expenditure to GDP in North Africa for year 2008. Data source: The World Bank and Stockholm International Peace Research Institute (SIPRI).

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